functional requirements. It has proved to be faster and less expensive than classic software engineering practices.[2]

Computer-Aided Software Engineering

Even though the structured programming and analysis techniques of the 1970s brought more discipline to the process of developing large and complex software applications, they required tedious attention to detail and lots of paperwork. Computer-aided software engineering (CASE) appeared in the 1980s with the attempt to automate structured techniques and reduce this tediousness and, more importantly, to reduce maintenance costs.

Definition

As a development approach, CASE is the use of software tools to help quickly design, develop, deploy, and maintain software. Typically, these tools include data modeling, object modeling (using UML), code generation, and configuration management for revision and maintenance. As a development platform, CASE can be any automated tool that assists in the creation, maintenance, or management of software systems. In general, Carma McClure[3] suggests that a CASE environment includes:

- An information repository
- Front-end tools for planning through design
- Back-end tools for generating code
- A development workstation

Often not included, but implied and necessary, are a software development methodology and a project management methodology.

An information repository. A repository forms the heart of a CASE system and is its most important element, says McClure. It stores and organizes all the information needed to create, modify, and develop a software system. This information includes, for example, data structures, processing logic, business rules, source code, and project management data. Ideally, this information repository should also link to the active data dictionary used during execution so that changes in one are reflected in the other.

Front-end tools. These tools are used in the phases leading up to coding. One of the key requirements for these tools is good graphics for drawing diagrams of program structures, data entities and their relationships to each other, data flows, screen layouts, and so on. Rather than store pictorial representations, front-end tools generally store the meaning of items depicted in the diagrams. This type of storage allows a change made in one diagram to be reflected automatically in related diagrams. Another important aspect of front-end design tools is automatic design analysis for checking the consistency and completeness of a design, often in accordance with a specific design technique.

Back-end tools. These tools generally mean code generators for automatically generating source code. A few CASE tools use a 4GL. Successful front-end CASE tools provide interfaces to not just one, but several, code generators.

Development workstation. The final component of a CASE system is a development workstation, and the more powerful the better, to handle all the graphical manipulations needed in CASE-developed systems.

Timeboxing

One of the most intriguing approaches to system development in the 1980s was the "timebox," a technique that uses CASE to guarantee delivery of a system within 120 days or fewer. Today, IS departments that aim for speed turn to a development technique known as rapid application development (RAD). The following case illustrates the use of timeboxing and RAD.

CASE EXAMPLE

DUPONT CABLE MANAGEMENT SERVICES

www.dupont.com

DuPont Cable Management Services was formed to manage the telephone and data wiring in DuPont's office buildings in Wilmington, Delaware. AT&T had owned and managed the wiring for DuPont's voice networks, but then responsibility passed to DuPont's corporate telecommunications group. At DuPont's Wilmington headquarters campus, cabling is complex and wiring changes are continual. The average telephone is moved one and a half times a year. Much of the telephone moving cost is labor to find the correct cables and circuit paths.

When the cable management services group was formed, the manager realized he needed a system to maintain an inventory of every wire, telephone, modem, workstation, wiring closet connection, and other pieces of telephone equipment. Technicians could then quickly locate the appropriate equipment and make the change. Although several cable management software packages were available, none could handle the scale or workload required by DuPont. The only option was to build a custom system.

The system had to be flexible, because the company's telecommunications facilities would need to handle new kinds of equipment for data and video. Furthermore, because cable management services were not unique to DuPont, the manager believed he could sell cable management services to other large companies. Therefore, the system needed to be tailorable. So that he did not have to hire programmers, the manager decided to use DuPont Information Engineering Associates (IEA), another DuPont business service unit, to build the system.

DuPont Information Engineering Associates (IEA)

IEA believed it could significantly speed up development by combining a code generator with software prototyping and project management. The resulting methodology was called rapid iterative production prototyping, or RIPP.

Using RIPP, a development project could take as few as 120 days to complete; it had four phases.

- ***Phase 1: Go-Ahead.*** Day 1 is the go-ahead day. IEA accepts a

(*Case Continued*)

project, and the customer agrees to participate heavily in development.

- ***Phase 2: System Definition.*** Days 2 through 30 are spent defining the components of the system and its acceptance criteria. At the end of this phase, IEA presents the customer with a system definition and a fixed price for creating the application.
- ***Phase 3: The Timebox.*** The following 90 days are the "timebox," during which the IEA–customer team creates design specifications, prototypes the system, and then refines the prototype and its specifications. The final prototype becomes the production system.
- ***Phase 4: Installation.*** On Day 120, the system is installed. The customer has three months to verify that the system does what it is supposed to do. If it does not, IEA will refund the customer's money and remove the system.

Cable Management's Use of IEA

The cable management group contracted with IEA to develop the cable tracking system. After spending the first 30 days defining the scope of the project, IEA estimated that the system would require two timeboxes to complete, or about 210 days.

During the first timebox, IEA developed those portions that the cable management group could concisely define. During those 90 days, one cable management engineer worked full-time on the project, another worked part-time, and IEA had a project leader and two developers. The system they developed included display screens, the relational database, basic system processes, and reports.

At the end of the 90 days, IEA delivered a basic functional system, which DuPont began using. The second timebox added features uncovered during this use. Both parties agreed that this phase was ambiguous, which might affect the 90-day limitation. So they extended the project to 110 days. By that time, the development team had entered DuPont's complete wiring inventory, enhanced the basic system, and delivered a production version.

In all, the system took about nine months to develop. The department manager realized that was fast, but he did not realize how fast until he talked to other telecommunications executives who told him their firms had spent between two and three years developing cable management systems.

The cable management group was pleased with its system. It was initially used only to manage voice wiring, but has since been extended to handle data communications wiring. ■

Object-Oriented Development

Just as 4GLs were a revolutionary change in the 1970s, object-oriented (OO) development was a revolutionary change in the 1980s. In fact, companies had a choice. They could choose the evolutionary approach of CASE or the revolutionary approach of OO development. OO development caught on in the early 1980s because of the PC and only became more popular in the 1990s; the graphical user interfaces were developed using objects. Developers just needed to point and click at generic items—menus, dialog boxes, radio buttons, and other graphical components—and then rearrange them to create a screen. This form of programming has come to be known as visual programming.

By the end of the 1980s, OO development was beginning to be noticed in IS departments for business applications. That trickle became a tidal wave when client-server systems appeared in the early 1990s, as developers attempted to simplify these extremely complex systems by reusing objects. In the early 1990s, OO system analysis and design techniques began to appear that could be used in conjunction with OO languages such as C++ and Smalltalk.

OO development is not so much a coding technique as a code-packaging technique, notes Brad Cox,[4] an OO development pioneer. An object contains some private data (that other objects cannot manipulate) and a small set of operations (called methods) that can perform work on those data. When an object receives a request in the form of a message, it chooses the operation that will fulfill that request, it executes the operation on the data supplied by the message, and then it returns the results to the requester.

Combining data and procedures in an object, which is called encapsulation, is the foundation of OO development. It restricts the effects of changes by placing a wall of code around each piece of data. Data are accessed through messages that only specify what should be done. The object specifies how its operations are performed. Thus, a change in one part of a system need not affect the other parts. As you might expect, even though OO development promised significant benefits, it does have costs, especially at the outset. OO projects have gotten stuck in the mire of defining and redefining objects. Once defined, objects can be reused, another of OO's attractions. There are many other aspects of OO development, but this very brief description of objects suffices here. As will be seen later in the chapter, OO is a significant foundation for today's development efforts.

Client-Server Computing

As discussed in Chapter 3, client-server systems generated a lot of excitement in the early 1990s because they promised far more flexibility than mainframe-based systems. The desktop and laptop client machines could handle graphics, animation, and video, whereas the servers could handle production updating. It was a clever way to meld the pizzazz of the PC world with the necessary back-end production strengths of the mainframe world, even though mainframes were not always in the picture. The following is a typical example of the allure of client-server systems and how one company—MGM—developed its first client-server system.[5]

CASE EXAMPLE

MGM

www.mgm.com

Metro-Goldwyn-Mayer (MGM), the movie studio in Hollywood, has an extremely valuable asset: its library of TV shows and movies. The studio's first client-server application was built at the urging of end users to leverage this asset. The

(*Case Continued*)

vice president of IS knew that the only way to meet the users' expectations for a multimedia, laptop-based system with a graphical interface was to employ client-server technology.

Previously, more than 26 disparate systems on PCs, mini-computers, and the corporate mainframe were used to maintain the rights to show MGM's films. As a result, it was not possible to get a consolidated, worldwide view of which films were being leased. The client-server system—the largest IS project in Hollywood at the time—collected and consolidated all data on the film library so that MGM would know what films it has the rights to license and to whom.

Client-server technology was chosen because it could empower MGM's 20 worldwide film-rights salespeople. They could visit the head of a cable TV network anywhere in the world with an SQL database on their laptop and built-in CD-ROM capabilities to play 20- to 30-second clips of their films. They could browse the laptop's inventory database to verify availability of films and then print the licensing deal memo on the spot. Details of the deal could then be transmitted to headquarters when convenient. Only a client-server system would provide this flexibility.

The System's Three-Level Architecture

The system's architecture had three layers. At the core was an AS/400, which acted as the central processor for the database that contains descriptions of 1,700 TV shows and movies, an index, the availability of movies in different regions, license time periods, status of bills, and so forth. MGM deliberately chose a tried-and-tested rights licensing software package to manage the database because it provided the needed processing; however, it did not support graphical interfaces, laptops, or decision support. Therefore, MGM surrounded the package with the mosttested technology possible for the client-server components. In fact, wherever possible, MGM minimized technical risk by using proven products.

The second layer was an HP9000 server, which contained data and processing, but no presentation software. The Unix front end was built using PowerBuilder. In one hour with PowerBuilder, developers could do 8 to 10 hours of COBOL-equivalent work.

The third layer was the client machines, either desktop or laptop. They contained local processing, local databases, and presentation software. The laptops also had a database for the salespeople. They could upload and download information from their laptops via dial-up lines.

The premier skill required in this environment was systems integration. The developers needed both hardware and software expertise for Unix and NT, PowerBuilder, and SQL Windows.

The Development Environment

Even though partnering was always possible in the mainframe era, it was mandatory with client-server computing. With tools like PowerBuilder and a development life cycle that relied on prototyping, developers had to constantly interact with users. They could not seclude themselves for months. Moreover, client-server teams had no boss. The users and developers were equal; neither told the other what to do.

(*Case Continued*)

The role of IS at MGM changed from system development and delivery to one of cooperating and partnering. This change required a huge cultural shift in the roles and attitudes of the IS staff. Developers who formerly buried themselves in code had to conduct meetings and work side-by-side with users. In short, they had to learn people (interpersonal) skills and the business. Interestingly, the CIO felt that women had an edge because, generally speaking, they had better interpersonal skills.

With client-server systems, the hardware was cheaper than with mainframe systems, development was faster, and software support was cheaper—all by orders of magnitude. Operating costs were more expensive than MGM expected because version control of client-server software and service and systems management were more costly. ■

These technologies—structured development, 4GLs, prototyping, CASE, OO development, and client-server systems—have all proven to be foundations of today's system development environment. We now turn to that environment, beginning first by discussing the main method of building systems: system integration.

SYSTEM INTEGRATION

Integration is by far the biggest software problem CIOs face. With the increased need for supporting inter-organizational supply chains, the level of complexity becomes exponential. That is why offerings that integrate systems generate so much interest. The increasing complexity of IT, with systems from various eras and technologies that must coexist and even work together, makes the integration challenge even more difficult to solve. That is why large, integrated enterprise-wide systems have been adopted: to replace the myriad "silo" systems with one interconnected one.

CIOs have long strived to integrate the information systems in their organizations so that they work together. However, integration is complex and expensive, and it can cause systems to crash. But competitive pressures have raised the importance of integrating business processes and, thus, the underlying information systems. The trend away from in-house software development toward the use of off-the-shelf software has furthered the need for integration. Online business requires integrating systems across organizations. Technology vendors have responded with a number of products to facilitate the integration of systems.

Three main approaches to integration are:

- DBMS
- ERP systems
- Middleware

The DBMS approach takes a data-oriented view to integration. As discussed in Chapter 7, DBMS allow applications to share data stored in a single or distributed database. The applications can come from a number of sources, but they employ a common DBMS. This approach is particularly appropriate when business applications tend to use the same set of data, even if these data are physically stored at different locations. This is true for most management information systems dealing with bookkeeping, production, procurement, inventory, cash management, and the like.

The ERP approach, discussed in Chapter 7 and in the next section, takes an application view of integration. All applications come from a single computing platform and are specifically designed to communicate with each other. The ERP approach provides a more flexible approach to integrating application systems. Systems in ERP tend to serve more diverse applications, yet, ensuring a seamless integration of data and algorithms whenever the users need to.

The middleware approach takes a third-party approach; applications communicate with each other through third-party translation software.

Each of the three approaches has advantages and disadvantages, depending on the conditions in the enterprise. Typically, organizations use a combination of the three. Indeed, a quick look at vendor strategies reveals a mixture of the approaches. Oracle, firmly in the DBMS market, has moved toward offering enterprise applications. SAP, a major ERP vendor and long a competitor of Oracle, has modified its products to use standard DBMS, including that of Oracle. The three approaches are not mutually exclusive.

ERP Systems

An ERP system aims to integrate corporate systems by providing a single set of applications from a single software vendor operating with a full interoperable database. The goal is to provide the means to integrate business departments and functions across an organization or multiple organizations. ERP vendors offer a complete set of business applications, including order processing, HR management, manufacturing, finance and accounting, and CRM at additional costs. By automating many of the tasks involved in business processes and standardizing the processes themselves, the ERP system can provide substantial payback to a company if the system is installed properly, despite a high starting cost.

The history of ERP contains both successes and failures, though the failures have been especially notable. Scott Buckhout and his colleagues[6] reported on a study of ERP implementations in companies with more than $500 million in revenues. The average cost overrun was 179 percent, and the average schedule overrun was 230 percent. Despite these overruns, the desired functionally was 59 percent below expectations, on average. Only 10 percent of the implementation projects actually finished on time and within budget; another 35 percent of the projects were canceled. Even IT companies have had problems. Dell canceled its ERP project after two years and expenditures of more than $200 million.

Some of the failures can be attributed to factors common to other IS projects, such as the system's large size and complexity. However, ERP systems differ in a significant way from other systems, which is not always recognized. Because they are designed to integrate and streamline numerous business functions, they have significant implications for the way the firm is organized and operates. Many failures result from too much attention being given to the technical aspects of the system and too little attention being given to its organizational impacts.

An ERP system contains a model of the business that reflects assumptions about the way the business operates. The vendor makes these assumptions and designs the system to reflect the vendor's understanding of business processes in general. As a result, the business model embedded in the ERP system may be different from the way the business actually operates. Even though the ERP system can be customized to some degree, configuring the system entails compromises. The company must balance the way it wants to operate with the way the system wants the company to operate.

To realize the benefits of ERP—integrated systems and integrated business processes—a company must therefore change its organizational structure and culture. From his extensive studies of ERP, Thomas Davenport[7] stresses that companies that have derived the greatest benefits have viewed ERP (he prefers the term "enterprise system, ES") primarily in strategic and organizational terms, not in technical terms; they "stressed the enterprise not the system." The managers have asked: "How might an ES strengthen our competitive advantages? How might it erode them? What will be the system's effect on our organization and culture? Do we need to extend the system across all our functions, or should we implement only certain modules? What other alternatives, if any, for information management might suit us better than an ES?"

As an example of a successful implementation of ERP, consider Colgate-Palmolive.

CASE EXAMPLE

COLGATE-PALMOLIVE

www.colgate.com

Colgate-Palmolive Company is a 190-year-old consumer products leader. In the mid-1990s, it faced a competitive crisis. Sales of personal care products dropped 12 percent and operating profits dropped 26 percent in North America. Colgate-Palmolive had a decentralized structure, with national or regional control in more than 200 countries. This structure produced independent operations that were expensive to coordinate, slow to respond to market changes, and constrained company growth. Management needed to develop new products, reduce product delivery cycles, and reduce the cost of operations.

Management's vision was to abandon the decentralized structure and become a truly global company with an integrated business environment and standardized business processes. Their first step toward this vision was to integrate their supply chain in 80 countries and distribution to 200 countries. The goal was to reduce the annual cost of the supply chain by $150 million and to standardize business processes. A key element to achieving this integration was a global ERP system.

(*Case Continued*)

After setting up a prototype environment in the United States, Colgate was convinced that the SAP R/3 modules for sales and distribution, materials management, finance, and HR would provide the functionality and flexibility it needed worldwide. Management also decided on Oracle's relational DBMS and a Sun hardware platform running the Solaris operating system. The current network has 270 servers, 11 terabytes of data storage, and can support 3,000 concurrent users accessing the network from PCs around the world. The global ERP implementation took five years and cost $430 million.

The company quickly met its goals, realizing savings of $50 million the first year and $100 million the second. These savings were invested into creating and marketing new products, including the successful Target toothpaste, which allowed Colgate to regain the number-one market position for toothpaste in the United States that it had lost 34 years earlier. The company also reduced the product delivery cycle by more than 60 percent. Integration allowed regional cooperation on purchasing, resulting in larger contracts with fewer suppliers, which saved $150 million the first two years.

Colgate also accrued substantial savings in IT operations. The old, highly complex, decentralized IT infrastructure, which had many data centers and local applications, was streamlined. Data centers around the world were consolidated from 75 to 2. The complexity of the global data networks was also simplified. SAP's R/3 provides a standard for applications, although the core support for the applications remains with each division.

The success of Colgate's ERP project stems from senior management convincing all employees that the company faced a crisis that only a dramatic change in strategy and organization could solve. The need for global restructuring of strategies and operations drove the need for a global, integrated IT infrastructure. The initial focus on the supply chain led to immediate positive results, validating management's strategy and providing support for the organizational changes. Colgate was also under pressure to integrate its operations from its larger customers, who had already begun to integrate their own operations. The ERP project was actually part of a larger project to rethink and realign Colgate's business strategies, structures, processes, and systems. ■

Middleware

Most organizations have a wide range of applications, new and old, from a variety of vendors, running on numerous platforms that use or require different data formats and message protocols. Replacing or rewriting these applications is not feasible due to cost or lack of time. One option is to employ a class of development products known as middleware. As its name implies, middleware is a wide spectrum of software that works between and connects applications, allowing them to share data. Without middleware, applications would have to be modified to communicate with each other, usually by adding code to each application, perhaps causing unintended negative effects. Middleware acts as a translator between the applications so that they do not need to be changed.

As Woolfe[5] points out, middleware simplifies development by acting as the glue that binds the components, allowing them to work together. A plethora of middleware is available. Some are for communicating among applications; others are for managing transactions across platforms; and still others provide general services, such as security, synchronization, or software distribution.

One type of middleware that has gained popularity is Enterprise Application Integration (EAI) products. EAI tools typically use a message broker to transfer data between applications. They allow users to define business processes and make data integration subject to rules that govern those processes. As an example, a rule might state that data moves automatically from the purchasing application to the accounts receivable application only after the appropriate person has signed off on the purchase. Companies acquire a central module plus the interfaces needed to connect the applications. To handle unique integration needs, EAI vendors provide custom programming to modify the EAI modules to fit the company's requirements.

Another emerging trend in middleware is to link large and distributed mainframe systems with mobile devices in real time. Examples of such architecture includes mobile payments involving more than one bank, and a large chain of retail stores using RFIDs to locate items in store shelves. Middleware provides fast, scalable, and even disposable solutions. However, it calls for careful planning, costing, and performance monitoring. An uncontrolled proliferation of middleware could lead to unexpected expenses and slower overall system performance. Another potential area of concern is the unpredictable single point of failure. In a complex network of middleware, a faulty middleware can bring that entire system to a halt.

INTER-ORGANIZATIONAL SYSTEM DEVELOPMENT

As noted in Chapter 1, one of the main business trends is the appearance of business ecosystems; that is, groupings of businesses that work closely together. This trend is obviously affecting the kinds of systems being built and how they are built. Systems that integrate supply chains, supply-chain management (SCM) systems, are now a major trend, as supply chains compete against one another on their ability to reduce costs and time across their entire chains. Needless to say, development of these inter-organizational systems, which cross organizational lines, requires teams from the different organizations to work together.

Another type of inter-organizational system is a platform, which provides the infrastructure for the operation of a business ecosystem, a region, or an industry. In fact, platform development is a major trend in an increasing number of industries. One example, albeit an old one, is American Airlines' development of its SABRE computer reservation system. Originally, American developed SABRE for its own use. But the system was so leading edge, and so expensive to build, that other airlines paid American to use it. SABRE became a platform for the airline industry. Today, the video game industry has intense competition among platform developers Sony (PlayStation 2), Nintendo (GameCube), and Microsoft (Xbox). Following are two examples of platform developments. The first one, yet to become a platform, is in the following two Case Examples; they point out the types of coordination needed to develop an inter-organizational system for a business ecosystem.

CASE EXAMPLE

HOW SHOULD EXXONMOBIL LEVERAGE ITS IT ASSETS?

www.exxonmobil.com

In 1996, Mobil Corporation created Mobil Speedpass, a system that uses a 1.5-inch-long wand that motorists can attach to their key chain and wave at an electronic reader on a Mobil gas pump to pay for gas. Mobil's goal was to speed motorists in and out of its stations. It calculated that Speedpass would save motorists one-half minute off of a 3.5-minute transaction, states Hammonds.[8]

The device caught on. Mobil, now part of $230-billion ExxonMobil, has 5 million Speedpass holders. Furthermore, these customers buy more Mobil gas than non-Speedpass customers, they visit Mobil stations one more time per month, and they spend 2 to 3 percent more money at the stations that have paid $15,000 for the Speedpass scanner, notes Hammonds.

Speedpass is free to motorists. It uses radio frequency identification (RFID) technology from Texas Instruments to store the driver's credit card information and transmit it to the scanner. It is easy to use. No keyboard, no swiping.

ExxonMobil's Dilemma

The RFID technology is easy to replicate, so other gas station chains are testing competitive systems. Mobil has been in this situation before. In the early 1990s, the company invested early in pay-at-the-pump technology so that motorists could just swipe their credit card to buy gas. But competitors quickly caught up, and Mobil's first-mover advantage disappeared.

From that experience, Mobil learned it could lose its competitive advantage by keeping its technology proprietary. So with Speedpass, management is taking the opposite approach. Mobil now sees the value of Speedpass as being its relationship with its 5 million users—not the Speedpass technology.

How should Mobil leverage this customer relationship? To start, it has changed the name from Mobil Speedpass to simply Speedpass to eliminate the exclusivity aspect. It also has teamed up with McDonald's restaurants in Chicago to test the use of Speedpass to pay for food.

(*Case Continued*)

Mobil also plans to create similar deals with a U.S. drugstore chain, a supermarket chain, and other chains, notes Hammond.

The goal is to create a network effect: The more motorists sign up for Speedpass, the more attractive it becomes for retailers. The more retailers Mobil signs up, the more consumers will be attracted to Speedpass. It forms a vicious circle; see Figure 9-3. ■

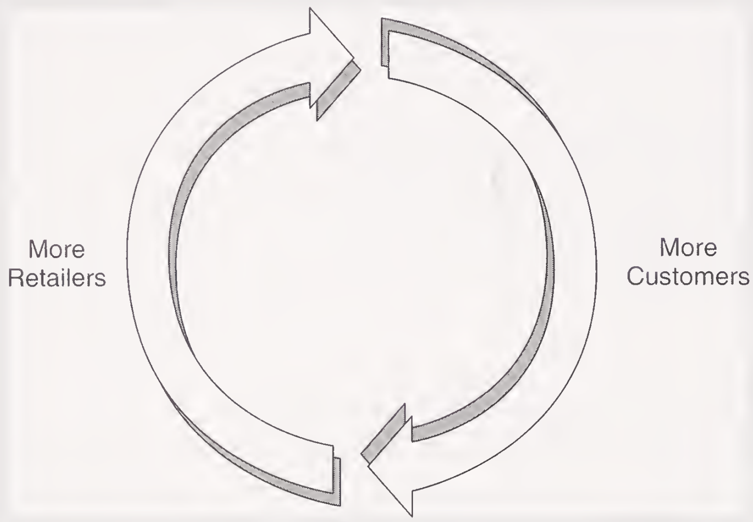


FIGURE 9-3 Speedpass's Potential Virtuous Circle

CASE EXAMPLE

HONG KONG EXCHANGES AND CLEARING

www.hkex.com.hk

Hong Kong Exchanges and Clearing (HKEx) is Asia's second-largest, and the world's ninth-largest, stock market. Due to the globalization of stock markets, stock exchanges now compete against one another for investors. And investors have become very demanding. They want more features from exchanges; more flexibility in how they trade securities; and faster, cheaper, and more cross-border trading. Furthermore, there has been much talk about exchanges forming global alliances.

Aiming for an Inter-organizational System, AMS/3

To put itself in a stronger competitive position, HKEx decided to embed its business processes in an open-trading

(*Case Continued*)

architecture, notes David Lo, vice president of trading and participant services at HKEx, and his coauthors,[9] so that it can extend its market reach beyond Hong Kong, handle greater trading volumes, and more easily interconnect with business partners' systems. This architecture underlies HKEx's third-generation automatic order matching and execution system, called AMS/3, which is the system that handles securities trading at HKEx.

The first-generation system, a closed system, allowed brokers to enter orders, but only from special terminals on HKEx's trading floor. The second-generation system allowed orders from dedicated terminals in brokers' offices. However, it still did not connect to external networks or to the computer systems of HKEx's 500 brokerage-house members.

In planning for AMS/3, HKEx wanted to improve the efficiency of the exchange, open up the system to individual investors, and lay the foundation to eventually automate the entire trading process so that it could offer "straight-through processing." In short, HKEx's goal is integrated end-to-end computerized trading processes from investors through brokers to markets.

AMS/3 permits brokers to enter orders as they have in the past, using dedicated terminals on and off HKEx's trading floor. Or they can use a new option: accessing AMS/3's trading host through an "open gateway." Thus, data can flow back and forth between a broker's back-office system and AMS/3, which gives those back-office systems the data to perform, say, market analyses not feasible before.

Furthermore, individual investors can make online inquiries or order requests using their mobile phone or the Internet once their broker has registered them with HKEx. Of course, each transaction is safeguarded with an authentication check.

Due to the flexibility of AMS/3, HKEx can now offer members and individual investors customized services, such as bundled products or distinctive trading processes. It has also made the market more transparent by providing more timely information to members and investors. It also gives trading service partners, such as software developers and mobile phone operators, a new market for their services.

Building AMS/3

The project was daunting, involving both internal and external people—40 staff from different departments, 150 consultants, and 500 brokerage firms. The project had five development teams, for the network, the host and open gateway systems, the multiworkstation system (for brokerages wanting to use HKEx's system instead of their own back-office system), the order routing system (for access via the Internet or mobile phones), and user-acceptance testing.

PCCW (formerly Cable & Wireless HKT) built the trading network, the order routing system, and the multiworkstation system. Compaq supplied the host and the open gateway systems. Accenture, the large consulting firm, designed the architecture, managed user-acceptance testing, coordinated the 500 critical project activities, managed the interdependencies among the numerous project segments, and oversaw the work of the contractors through a project management office of 10 people.

Each week the project management office reported to the project steering

(*Case Continued*)

group, which included senior HKEx executives from the various business and IT areas.

Another group, the trading and settlement committee, had members from brokerage firms and other organizations involved in HKEx's market, such as accountants, solicitors, Hong Kong's Monetary Authority (which manages Hong Kong's fiscal policy), the Securities and Futures Commission (which regulates the brokerage industry), and the Financial Services Bureau (which regulates Hong Kong banking). This committee reviewed development of the system, offered opinions on the planned trading mechanisms, and made sure their firms (and the market) were on schedule to be ready to use the new system when it was launched.

Throughout the two-year development, HKEx maintained a dialog with all interested parties to be sure they accepted the plans, contributed ideas to improve them, put the appropriate regulations in place, and got their own systems and processes ready to use AMS/3. Furthermore, they held open forums and used the media to educate investors about their coming new trading options.

Testing the System

To guard against system failure, HKEx conducted three levels of system testing. The first was single-component testing, where each component was tested on its own until it reached the needed performance level. Then came partial integration tests between components to catch as many interconnection problems as possible. Third was integration testing, which tested end-to-end processes. Overall, testing was 40 percent of the project. One thousand errors were found, mainly during integration testing, because vendors had made different assumptions during development.

Some of the major system specifications were that AMS/3 be able to process 200 orders per second (higher than American and European exchanges), process 150 orders per second on an individual stock (a "hot stock"), handle off-hour orders transmitted all at once from 1,000 systems, accommodate new computers easily, and have a "flood control" mechanism so that no hot-stock activity can destabilize the system. AMS/3 has achieved all these requirements, and HKEx has recovery procedures for all the system-failure scenarios that people could dream up.

About 100 brokerage firms have built their own systems to interface with the open gateway. These could inadvertently interrupt AMS/3's processing and disrupt the market, so HKEx opened up an AMS/3 testing environment every Saturday for six months for the brokers to perform end-to-end testing. Some 35 brokers at a time had 5 consecutive weeks to perform their tests. In addition, HKEx inspected brokers' offices, and only allowed those that passed the tests to move into production mode, either when AMS/3 went live or at successive rollout times. Finally, HKEx also held marketwide network tests to test the system fully loaded.

Rolling out AMS/3

Once acceptance testing was complete, HKEx and its many partners followed a detailed, nine-month-long, three-layer migration plan, state Lo et al. Each change was high risk, so to mitigate the possibility

INTERNET-BASED SYSTEMS

HKEx's system is actually a good introduction to Internet-based systems. AMS/3 is not Internet based, but it allows Internet access for online trading as well as other actions. The Internet has opened up the options HKEx can offer. Internet users have become so sophisticated that Internet-based systems must now be scalable, reliable, and integrated both internally and externally with the systems of customers and business partners. In developing such systems, companies have learned they must negotiate programming language differences. For example, a system may have to port old COBOL applications to Java; reconcile interface discrepancies; and interface with back-end legacy applications, often without documentation or past experience with those systems.

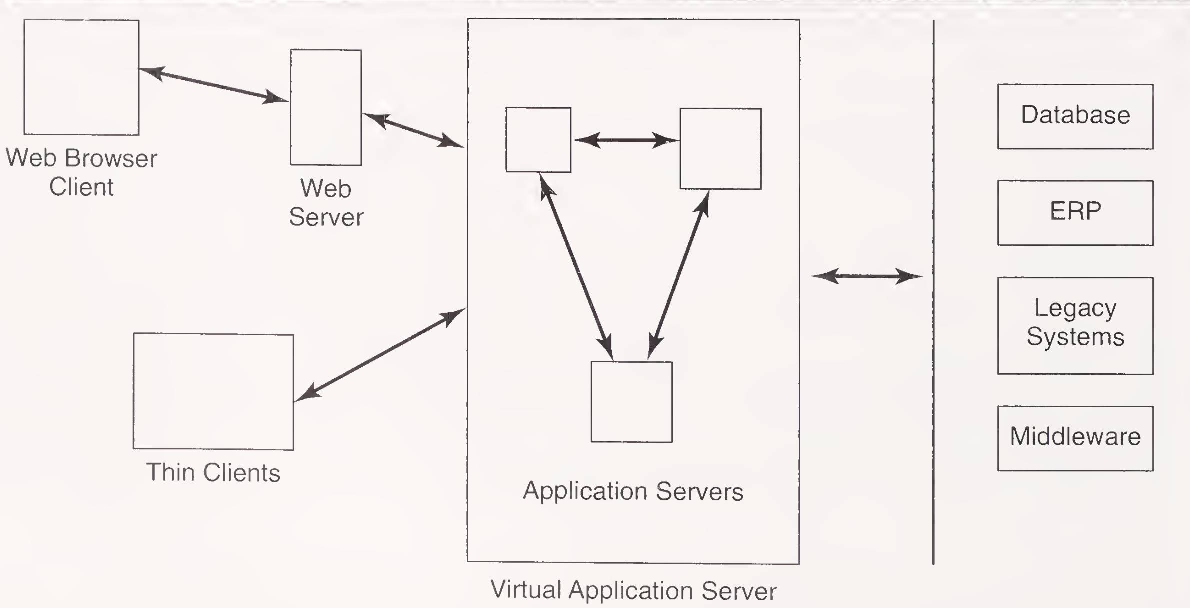
Internet-based systems are where the system development action is occurring. This section discusses three aspects of Internet-based systems: a framework, a language, and an environment. We examine these aspects for the following reasons:

- Application servers because they appear to provide the preferred framework for developing Internet-based systems
- Java because customers are demanding open systems; they do not want to be tied to a single vendor's proprietary technology. Java is a fairly open language that has evolved from client-side programming to being a server-side application development standard.
- Web Services because they are touted as the development environment of the future

Application Servers

Originally conceived as a piece of middleware to link a Web server to applications on other company systems, the application server has grown into a framework for developing Internet-based applications. Figure 9-4 illustrates the basic application server architecture. A set of application servers is connected to create a single virtual application server. This virtual server takes requests from clients and Web servers (on the left), runs the necessary business logic, and provides connectivity to the entire range of back-end systems (on the right).

FIGURE 9-4 An Application Server Architecture



In addition to providing middleware and integration functions, application servers have become application development platforms, with a wide range of development and automatic code generation tools. They can provide common functions, such as security and database connectivity, notes Radding,[10] they can store business logic components (forming the building blocks for applications), and they provide development capabilities inherited from CASE [now called integrated development environments (IDEs)]. In short, they aim to increase programmer productivity by automating and managing many of the technical tasks in developing and running Internet-based applications. They also provide scalability. As demands on applications grow, a company can increase the power of its virtual application server by either installing more servers or replacing smaller servers with larger ones. The application server also provides automatic load balancing among the multiple servers.

Java

If companies are to develop Internet-based systems quickly, as the e-business environment demands, they need component-based development tools. In addition, to develop portable and scalable systems, companies need to employ an open-system architecture. For both component-based tools and open systems, industry standards are necessary. Currently, some of the most widely used standards for Internet-based systems development have evolved from Java.

Java was originally developed to provide applets that run on Web clients. However, it quickly evolved into a full programming language with the goal of providing platform independence; that is, Java applications could run on any system through a Java virtual machine. This promised application portability was dubbed "write-once, run-anywhere." That promise has not been met, though. Java performed poorly relative to other languages, such as C++. Therefore, companies have not converted their client applications to Java. However, Java has evolved into a standard platform for developing server-side applications.

The two major components in the Java server-side platform are Enterprise JavaBeans (EJBs) and the Java 2 Enterprise Edition (J2EE) software specification. EJBs emerged on the developer scene in 1998 when Sun Microsystems unveiled a specification for creating server-based applications using software components. EJBs are preconfigured pieces of code that IS staff no longer have to build from scratch. They can be as simple as an order entry form or as complicated as a virtual shopping cart that even protects shopper privacy. Use of EJBs can greatly enhance programmer productivity. Microsoft competes with its own version of components called COM (Component Object Model) components. (Note the term "object." OO programming has become increasingly important in system development.)

J2EE defines a standard for developing Internet-based enterprise applications. It simplifies enterprise application development by basing it on a collection of standard server-side application programming interfaces (APIs), providing a set of services to modular components, and handling many of the core functions for the applications. Components include an API for database access, security modules that protect data in the Internet environment, and modules supporting interactions with existing enterprise applications. J2EE also supports XML.

Together, J2EE and EJBs provide an alternative to building online business systems from scratch or buying packaged online business systems because of their multivendor platform capability and pre-built, reusable components.

Web Services

As inter-organizational computing has become more and more diverse and pervasive, the need for supporting cost-effective and just-in-time interoperability on the World Wide Web has led to the idea of making Internet-based software components available to their users. Known as Web Services, these software programs have emerged in the IT ecosystem in an overhyped and somewhat chaotic way. Web Services mean different things to different people. Back in 1998 and 1999, business executives were fired up with the transformational potential of business-to-business interactions, but the technology was not ready and the notion of Web Services proved too inefficient to be commercially viable at that time. Several years after the disappointing first wave of hype, business integration technology is finally maturing in the form of Web Services. In an attempt to provide an industry-wide consensus to the concept of Web Services, the W3C Web Services Architecture Group managed to agree on the following working definition of a Web Service: "A Web service is a software system designed to support interoperable machine-to-machine interaction over a network. It has an interface described in a machine-processable format (specifically WSDL3)."

To interact with other systems on the Internet, software applications could call Internet-based software components—called Web Services—to perform just-in-time specific tasks. To ensure interoperability, Web Services use SOAP4, a protocol for exchanging XML-based messages, typically conveyed using HTTP with an XML5 serialization in conjunction with other Web-related standards." In a service-oriented environment, Web Services providers use UDDI6 as a mechanism to publish service listings and discover each other and define how the services or software applications interact over the Internet. A UDDI business registration consists of three components:

- White Pages—address, contact, and known identifiers;
- Yellow Pages—industrial categorizations based on standard taxonomies; and
- Green Pages—technical information about services exposed by the business (Curbera et al. 2002).

The service provider (or supplier) publishes a Web Service by creating it on an appropriate platform and generating a WSDL document that describes it. The provider then sends service details to the service broker for storage in a repository. The service requester (or client) registers with the broker, searches and finds the appropriate Web Service in the broker's repository, retrieving the WSDL descriptor. It then negotiates with the provider to bind to the provider's Web Service. We argue that the current features of Universal Discovery Description & Integration (UDDI) function currently provided by the WD (www.uddi.org) as a "metaservice" for locating Web Services by enabling robust queries against rich metadata is a rather limited one and additional functions are required to allow market transactions to occur.

In sum, Web Services have the potential to be the next stage of evolution for e-business—the ability of deploying systems from a service perspective, dynamically discovered and orchestrated, using messaging on the network. The fundamental roles in Web Services are service providers, service requesters, and service brokers. These roles have operations: publish, find, and bind. Operation intermediation occurs through environmental prerequisites, and it introduces aspects such as security, workflow, transactions, billing, quality-of-service, and service level agreements. The mechanism of service description language is key to fundamental operations in Web Services. Technically, a complete description of a Web Service appears in two separate documents: a Network-Accessible

Service Specification Language (NASSL) document and a Well-Defined Service (WDS) document. According to IBM Services Architecture Team (www.us.ibm.com), Web Services architecture provides four major benefits:

- Promoting interoperability by minimizing the requirements for shared understanding
- Enabling just-in-time integration
- Reducing complexity by encapsulation
- Enabling interoperability of legacy applications

John Hagel III and John Seely Brown[11] point out that this is what Citibank has done. In the late 1990s when online exchanges were popping up like weeds, Citibank noticed that although the purchasing process was handled electronically, the actual exchange of money was generally handled manually or through special banking networks. Citibank had expertise in electronic payments, so it created a payment processing Web Service called CitiConnect.

When a company plans to purchase, say, office supplies through an online exchange, the company can utilize CitiConnect by first registering with CitiConnect the bank accounts to withdraw funds from as well as the purchasing employees and their spending limits. When a purchase is made, the buyer clicks on the CitiConnect icon on the screen. That click automatically assembles an XML-wrapped message that contains the buyer's ID, the amount of the purchase, the supplier's ID, the withdrawal bank account number, the deposit bank account number, and the timing of the payment. Using predefined rules, that message is then routed to the appropriate settlement network to perform that financial transaction.

The benefits of this Web Service are substantial, note Hagel and Brown. Settlement times are 20 to 40 percent shorter, and settlement costs are half or less. In addition, Citibank has extended its brand into a new market, and the exchanges have happier customers.

This arrangement also illustrates the second way to build a Web Service: use one someone else has already exposed. Commerce One drew on Citibank's Web Service, allowing Commerce One to focus on the other aspects of its business. Hagel and Brown believe companies will couple their own Web Services with those of others to create complex, yet flexible, best-in-class systems. To illustrate the basics of building a Web Service, consider the following simplified example, followed by a case about Bekins.

CASE EXAMPLE

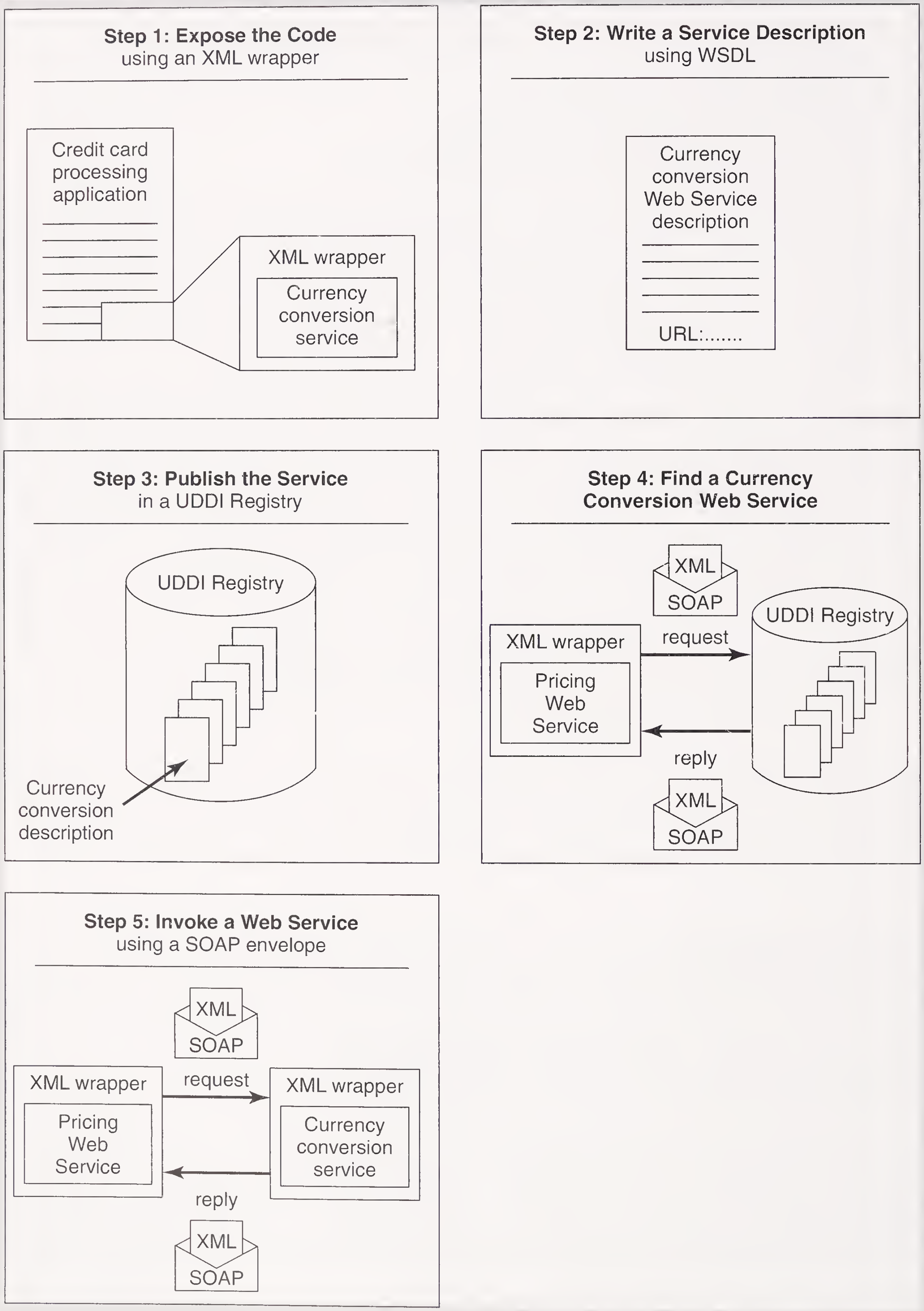
BUILDING A WEB SERVICE

A graphical example of building a Web Service from an existing in-house application is shown in Figure 9-5. Following is a much simplified description of that process.

Step 1: Expose the Code. A currency conversion Web service is created by exposing the currency conversion code of a credit card processor by encapsulating it in an XML wrapper.

(*Case Continued*)

FIGURE 9-5 Building a Web Service



(*Case Continued*)

Step 2: Write a Service Description. A description of the currency conversion service is written using WSDL (Web Services Definition Language). Housed in an XML document, this description describes the service, how to make a request to it, the data it needs to perform its work, the results it will deliver, and perhaps the cost to use it.

Step 3: Publish the Service. The currency conversion service is then published by registering it in a UDDI (Universal Discovery, Description, and Integration) registry. Publishing means that its service description, along with its URL (its address), is housed in the registry for others to find. The registry is essentially a Web services Yellow Pages.

Step 4: Find a Currency Conversion Web Service. The currency conversion service can now be found by, say, a pricing Web service. The pricing Web Service sends a request in the form of an XML document in a SOAP (Simple Object Access Protocol) envelope to one or more registries. This special envelope is also based on XML. This particular request of the UDDI registry asks for a listing of currency conversion Web Services. The reply is sent in an XML document in a SOAP envelope back to the requestor.

Step 5: Invoke a Web Service. The pricing service can now bind to and invoke the selected currency conversion service by sending it an XML message in a SOAP envelope asking it to, say, convert US $1,250.25 into Australian dollars. The currency conversion service performs the task and returns the answer in an XML document in a SOAP envelope and quite likely invokes a payment Web Service to be paid for performing that conversion service. ■

CASE EXAMPLE

BEKINS HOMEDIRECTUSA

www.bekins.com

Bekins, the moving company, is using Web Services in its HomeDirectUSA business unit, which specializes in the home delivery of household appliances; large-screen televisions; and other large, expensive furniture. Bekins uses some 1,000 independent moving agents across the United States to move furniture when Bekins' own fleet cannot.[12]

Formerly, Bekins faxed or phoned these agents to arrange deliveries, but the process was slow and not equitable to all the agents. To automate the process, Bekins used Web Services technology to create an online brokering system called Tonnage Broadcast Exchange (TBE). When Bekins receives an order to deliver, say, a refrigerator, that its centrally managed fleet cannot

(*Case Continued*)

handle, it uses TBE to "tender" that job to its agents (and perhaps other shippers). All agents are sent the tender at the same time based on pre-established criteria; so the system is fair. Once an agent accepts a job, it becomes unavailable to the others. The results have been lower tendering costs, faster customer service, and better utilization of agents' trucks. Furthermore, because the system is so efficient, Bekins can offer lower-margin jobs to the agents, increasing its shipping volume and revenues.

Bekins' E-Commerce Platform

In 1990, Bekins made two key IT decisions about how it would develop future systems. One, it chose Java, rather than Microsoft's. NET, as its e-commerce platform. Two, it chose IBM's WebSphere to develop and deploy future applications. TBE uses two systems that initiated Bekins' new e-commerce environment. The first system was the Shipment Tracking System, which lets Bekins' customers (such as manufacturers and retailers) and consumers track shipments via the Web. Retailers like this system because its accuracy lets them bill their customers for home delivery faster. The second Java-based system was the Customer Order Management and Inventory System, which lets customers and shipping agents enter shipping orders via the Web. This system improved order accuracy up to 40 percent and allows customers to see the inventory Bekins is holding.

The TBE system, which is also based on the Java platform and built using WebSphere, advances Bekins' e-commerce platform by adding Web Services technologies. These technologies allow Bekins to link an agent's transportation management system into TBE almost instantly once the agent has readied its system to exchange messages using the Web Services standards: XML, SOAP, WSDL, and UDDI.

TBE runs on Bekins' mainframe. Each business partner has a client-side Java application running on one of its servers. When an agent wants to accept a tender from Bekins, its client-side application accesses the private TBE UDDI registry to find out how to communicate with the SOAP servlets. The SOAP servlet transmits the acceptance message to Bekins, where an XML parser translates it. A Java interface then passes it to Bekins' customer order management system, where it is booked as an order in the DB2 database.

Building TBE

The TBE development team consisted of an XML expert, two Java developers (one senior and one junior), an architect who knew IBM's WebSphere and DB2 database, and two COBOL programmers. They developed TBE in just five months' time, partly due to their experience and partly due to WebSphere, which provided the framework and sample code they built upon.

The team followed a formal development methodology with the developers focusing on creating TBE's components and the architect helping put the pieces together. The project was divided into five phases:

1. Code the core of TBE in Java (to be hosted on a Bekins' mainframe)
2. Convert the Java objects to Web Services
3. Deploy the Web Services

(*Case Continued*)

4. Code the client side of TBE (to be run on each agent's server)
5. Test the integration of the various parts of TBE

Building TBE required commitments from several moving partners because it was to be an inter-organizational system. Three partners were readying their companies to use Web Services technologies internally to integrate their own systems. Another seven acted as beta test sites for TBE using actual data. The tests gave Bekins confidence that TBE met its partners' requirements. TBE went live with 10 percent of the agents. Agents have been coming online since. Agents not ready to participate in TBE using Web Services technologies can access the system through a Web portal. Involving its partners in the development proved important, but equally important was their comfort with the new Web Services environment.

Real-time Information about Delivery Status

In 2005, Bekins decided to provide their customers with real-time information about delivery status using a system called STARS. About 600 Bekins agents are now equipped with handheld devices using the STARS application to track the location, status, project arrival time, and eventual customer receipt of every piece of furniture or goods they are delivering. Bekins agents have their Intermec handheld connected to the central DB2 databases from IBM. Using handheld sets from a different vendor, Bekins had to find a solution to link them to the mainframe. The company used a third-party company to create JDBC (Java Database Connectivity) middleware. The use of the JDBC driver from a third-party company helped save development staff and time. ■

Preparing for On-the-Fly Web Services Development

Although Web Services can help enterprises develop systems faster, the technology might have other ramifications as well—ramifications that CIOs would do well to prepare for, before they actually happen. One possibility is end-user development of Web Services, believes Jonathan Sapir, of InfoPower, a company that offers an SOA-based development platform.[13] He believes that companies are experiencing a crisis in software development because their IS organizations cannot keep up with users' requests for changes to applications. Due to the increasingly volatile business environment, systems need almost continual enhancement. When they do not get it, they do not change as fast as the business environment.

This "crisis" situation has occurred before. When corporate databases first appeared, only programmers had the tools and know-how to generate reports from them. But those reports did not solve individuals' needs. When report writers and query languages appeared, end users eagerly learned them to query the databases on their own, reducing the time needed to answer their questions. Likewise, programmers wrote large financial programs to manage corporate finances, but those programs did not meet the needs of individual accountants. Thus, when spreadsheets arrived in the 1970s, accountants (and others) eagerly used them to write personal applications. In fact, the spreadsheet was the "killer app" that drove the initial growth of the PC industry.

Today, Web Services and service-oriented architectures have set the stage for yet another round of even-more-powerful, on-the-fly end-user development, believes Sapir. The need is here; so is the IT savvy. Many people have been using computers for at least 20 years—some, for their whole life. They play games, manage their finances, buy stock, and perform other online tasks that are a form of programming. They would develop their own personal programs if they had the tools. End-user tools based on Web Services and SOA are coming, and they will again let users write personal applications. The difference this time is that these applications will use Web Services standards, so they will be packaged as services that others can find, use, and even build upon.

Sapir foresees people computerizing their part of the business on their own with these user-friendly tools, thereby shifting computerization from top-down to bottom-up. To do so, though, people will need to view business needs as a series of small events that are handled throughout the day as they occur, rather than consolidated and addressed after-the-fact in one large development effort by the IS organization.

This bottom-up shift has come before, as noted, with mini-computers, then PCs, as well as with spreadsheets and fourth-generation languages. Each time, most IS organizations were caught unprepared. They had not laid down an infrastructure, provided tools or training, nor established principles for end-user development using the new technologies. Companies ended up with "personal silos of data and apps" that were difficult to share and were not maintained nor backed up. IS departments had to catch up to bring order to the chaos. It behooves CIOs to respond to users' current requests for changes to applications by piloting a company-wide Web Services platform and tools that users can use to get ahead of the curve.

Most importantly, IS management needs to implement a management system to manage the eventual intertwining of Web Services—before it happens. Without a Web Services management system, it is going to be awfully difficult to know which applications depend on which Web Services. Corporate executives will not want their major business processes to be based on applications that are not well managed. This management aspect of Web Services is a looming issue CIOs need to address, believes Sapir, before users take development into their own hands, as they have done so eagerly in the past.

The future of Web Services is yet to define. Web Services are more than just new technologies. They open up new and creative ways of doing business. Bui, Gachet, and Sebastian,[14] for example, have provided a framework to facilitate the market transactions of Web Services. Their concept is to have a broker service that goes beyond the posting service currently offered by UDDI. Web Services can indeed be used to support a complete spectrum of typical processes found in negotiation and bargaining. Under a well-defined and structured environment—such as e-procurement of any goods and services—electronic markets can be facilitated with supporting Web Services that serve as intermediaries or value-added service providers to buyers and suppliers of goods and services. As a market broker, these Web Services would help (a) discover the supply/demand of Web Services in e-marketplaces; (b) find the most appropriate available service for a specific request; (c) facilitate that services be modified if needed to satisfy user's needs; (d) arbitrate the pricing mechanism with the recourse to bargaining whenever necessary; and (e) generate a contract. Very likely, Web Services will further support the global aspect of business computing systems.

CONCLUSION

The traditional approach to system development from the 1960s evolved to give the process more discipline, control, and efficiency. It was valuable in moving programming and system analysis from pure free-form "art" to a better defined "craft." Problems remained, though, with long development times, little user involvement, and lack of flexibility in the resulting systems. The tools and methods of the 1970s and 1980s—4GLs, software prototyping, CASE, and OO development—permitted more rapid development and even experimental development; some were seen as revolutionary techniques to conventional developers.

The 1990s brought the need for integrated enterprise systems and Internet-based systems. Both required more flexibility and speedier development with a significant amount of integration, both internal and external to the company. With the integration efforts, companies realized the importance of focusing less on technical issues and more on the impacts of IT on business strategy, organization, and people. Widely reported failures of large ERP projects reinforced this need to concentrate on the business.

Most recently, the IT industry has responded with new tools and approaches. Application servers support integration across a wide range of new and legacy systems, Java supports Internet-based application development, and Web Services promise to make the Internet the heart of systems building. We have indeed entered a new era of application development where the focus is on the Internet, inter-organizational development, and ecosystem applications.

QUESTIONS AND EXERCISES

Review Questions

1. What are the goals of the traditional system development life cycle approach?
2. Refer to the list of features and functions of 4GLs in Figure 9-2. Briefly explain each.
3. What are the main characteristics of the prototyping approach?
4. Define the components of a computer-aided software engineering system.
5. What is unique about DuPont Cable Management Service's use of CASE?
6. What are the basic characteristics of an ERP system?
7. Why have so many ERP implementation projects failed?
8. Describe Colgate-Palmolive's approach to implementing their ERP.
9. What is a platform inter-organizational system? Give a few examples.
10. In a nutshell, what does HKEx's AMS/3 system do?
11. Describe HKEx's testing procedure for AMS/3.
12. What is Java and why is it important?
13. What are five steps in building a Web Service?
14. What does Jonathan Sapir foresee with regard to Web Services?

Discussion Questions

1. IS organizations will no longer need to develop a proprietary infrastructure; they can just rely on the Internet. Therefore, they will again focus mainly on developing applications. Discuss.
2. The field is moving too fast for companies to keep developers abreast of the state-of-the-art. To keep up, they should outsource application development to the experts, providers who specialize in development. Discuss.
3. How do you think ExxonMobil can leverage Speedpass?

Exercises

1. Find a description of an Internet-based application. What features does it have? What approach did the company choose to develop the application?
2. Visit a company in your community with an IS department with at least five professionals. Prepare a short case description to summarize the company's current approach to developing systems. Does it have one standard approach or a combination of several? Is it developing Web Services? If so, describe one or two. Is it participating in inter-organizational system development? If so, describe the development.
3. Visit the Web sites of three vendors of Web Services tools. What are they selling? Relay some client successes to the class.
4. Prepare two scenarios of what ExxonMobil could do with Speedpass. What are the crucial differences in assumptions between the two?
5. Given that ExxonMobil has a head start, what actions should management take to make Speedpass an ecosystem platform?

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CHAPTER

10

MANAGEMENT ISSUES IN SYSTEM DEVELOPMENT

INTRODUCTION

Infrastructure Management

Customer Relationship

Product Innovation

PROJECT MANAGEMENT

What Is Project Management?

The Job of a Project Manager

Case Example: A Day in the Life of an IT Project Manager

Change Management

Case Example: The BOC Group

Change Management Process for IT Systems

Risk Management

Case Example: Dow Corning

Tips for Good IT Project Management

MODERNIZING LEGACY SYSTEMS

To Replace or Not to Replace?

Options for Improving a Legacy System

Case Example: Verizon Directories

Case Example: Amazon.com

Case Example: Toyota Motor Sales

Case Example: Wachovia

MEASURING SYSTEMS BENEFITS

Distinguish Between the Different Roles of Systems

Measure What Is Important to Management

Assess Investments Across Organizational Levels

Case Example: A Trucking Company

Do Investors Value IT Investments?

CONCLUSION

QUESTIONS AND EXERCISES

REFERENCES

INTRODUCTION

Chapter 9 dealt with developing systems. This chapter looks at the issues surrounding system development. The context for this discussion is set by the ideas of John Hagel III and Marc Singer while they were at McKinsey & Company.[1] They see companies as being in three businesses:

1. Infrastructure management
2. Customer relationship
3. Product innovation

Traditionally, companies have bundled the three, which leads to compromises because the three have conflicting agendas. The Internet allows companies to unbundle them, say the authors, by specializing in one business and optimizing it.

IS departments can be viewed as being in the same three businesses. Operations are infrastructure management. The help desk is the customer relationship business. System development is product innovation. The three need to be managed differently.

Infrastructure Management

The goal of infrastructure management is to reduce costs. Providing necessary infrastructure, such as hospitals, roads, wireless networks, and such, involves high fixed costs, so the goal is to build scale. High barriers to entry also mean that only the few largest players will dominate, which explains the huge battle now ensuing among telecommunications companies, handset makers, and others to become wireless service providers. Management focuses on efficiency and standards, which is just what we have been seeing in network and computer operations. Companies outsource their network management and data centers to large ESPs such as IBM, CSC, and EDS to lower costs through cost sharing for both labor and infrastructure.

Customer Relationship

The goal of the customer relationship business is service. Here the goal is scope, by having lots of custom offerings to increase the company's "wallet share" of each customer. In this business, the customer is king, and developing relationships with customers requires large investments. Hagel and Singer see only a few large players dominating. In the IT arena, PC support and help desks are often outsourced to specialists, especially in Europe, where multilingual support is needed. Outsourcing offshore is also increasing dramatically in the customer service arena.

Product Innovation

The goal of product innovation is speed, because it provides nimbleness. Low barriers to entry mean many small players. The key to success is talent. In IT, developers are king, so software companies give them the coolest tools, allow them to work day or night, permit their pets at work, always have a stash of free Jolt Cola on hand, and so on. Software companies are always on the lookout for talent, and they reward stars generously, which is one reason IS departments can have a hard time attracting the talent they need.

One of the most sought-after skills in system development today is project management. This chapter begins with a discussion of project management and then moves on to discussions of how to improve legacy systems and how to measure the benefits of systems.

PROJECT MANAGEMENT

Today, much organizational work is performed via projects. In IS as well as other functions, being able to manage a project to completion, and deliver the expected outcome within the allotted time and budget, has become an increasingly valuable skill. This section explores six aspects of project management:

1. What is project management?
2. The job of a project manager
3. A day in the life of an IT project manager
4. Change management (an area IS teams have not always handled well)
5. Risk management (another area IS teams have not always handled well)
6. Some tips for good IT project management

What Is Project Management?

Project management is simply the management of a project, notes Michael Matthew of Matthew & Matthew consulting firm in Sydney, Australia.[2] This definition may sound simple and self-evident, but that does not make it easy. Many people get confused or concerned about IT project management because it involves the "T" word: technology. In reality, IT project management is not much different from other forms of project management, such as those used to construct an office building or a bridge.

A project is a collection of related tasks and activities undertaken to achieve a specific goal. Thus, all projects (IT or otherwise) should:

- Have a clearly stated goal
- Be finite, that is, have a clearly defined beginning and end

It has been said that IT project management is 10 percent technical and 90 percent common sense, or good business practice. Indeed, many of the best IT managers do not have a background in IT at all, but they possess the important skills of communication, organization, and motivation. Perhaps the most difficult component of IT project management is keeping in mind, and under control, all the interdependencies of the numerous tasks being undertaken.

"A project is a temporary endeavor undertaken to achieve a particular aim and to which project management can be applied, regardless of the project's size, budget, or timeline," states the Project Management Institute (PMI).[3] Project management is "the application of knowledge, skills, tools, and techniques to project activities to meet project requirements," states PMI's 2000 edition of *A Guide to the Project Management Body of Knowledge* (PMBOK, 2000 Edition).

PMI, which was founded in 1969 in Philadelphia, Pennsylvania, has established the standard for project management and is the leading association in educating project managers in all fields, including IT. It has some 125,000 members in 240 countries and over 10,000 Project Management Professionals (PMPs) who have passed its rigorous set of tests and been certified as PMPs. PMI views project management as encompassing five processes (initiating, planning, executing, controlling, and closing) and nine knowledge areas. To become a certified PMP, a person must pass tests covering all nine knowledge areas:

1. Integration, which involves ensuring that the various elements of a project are properly coordinated
2. Scope, ensuring that the project includes all the work required, and only the work required
3. Time, ensuring timely completion of the project
4. Cost, ensuring that the project is completed within the approved budget
5. Quality, ensuring that the project satisfies the needs for which it was undertaken
6. Human resources, making the most effective use of the people involved
7. Communication, ensuring timely and appropriate generation, collection, dissemination, storage, and disposition of project information
8. Risk, identifying, analyzing, and responding to project risks
9. Procurement, acquiring goods and services

To explore project management in a bit more detail, here is one view of the job of a project manager.

The Job of a Project Manager

Project management was once viewed as a specialty, with roots in construction, engineering, and IT, note Craig Anderson, a practice leader in KPMG's Queensland, Australia, office, and Michael Matthew.[4] But now, business managers need project management skills to implement change in a disciplined and successful manner. Business project management is evolving from IT project management. Both IT and business project managers are responsible for the following tasks:

- Setting up the project
- Managing the schedule
- Managing the finances
- Managing the benefits
- Managing the risks, opportunities, and issues
- Soliciting independent reviews

Setting Up the Project

Each project needs a project charter or document to serve as the one source of truth for the project and the first point of call when there are differences of opinion in the project, note Anderson and Matthew. It should spell out the following:

- ***Why.*** A brief background of the project (i.e., the result of a strategic review) and the business objectives to be achieved.
- ***What.*** A description of the nonfinancial benefits to flow from the project and a list of the key outputs to be produced.
- ***When.*** A list of the milestones and expected timing (a high-level project plan).

- ***Who.*** A definition of the project team and an analysis of the stakeholders of the project and their expectations.
- ***How.*** A definition of the work that needs to be undertaken to achieve the project, its scope, and specific exclusions. This definition also needs to address how much the project is expected to cost (a detailed financial breakdown) and expected benefit.

Risks, opportunities, prerequisites, assumptions, and the communications plan also should be included. Then this document needs to be approved.

Managing the Schedule

The schedule or project plan is the heart of a project because it communicates the activities that need to be completed to achieve the benefits, when they need to be completed, and who needs to complete them. First, develop a high-level plan of the entire project. Next, break down the business objectives into deliverables and then into the pieces of work to produce these deliverables (and the time required). Do not plan the details of the entire project at the outset because that is too difficult and the project will change. Instead, plan the details of a stage at its outset based on the work completed and the deliverables yet to be achieved.

Then baseline the schedule, affixing a starting point so that you can gauge progress. Tracking is essential for anticipating completion and taking corrective actions when issues arise. Many automated tools are available to help project managers manage the schedule.

Anderson and Matthew make four recommendations on managing the schedule:

- Focus on the date that tasks are completed rather than the percentage of the overall project that has been completed.
- Review progress at least monthly, preferably weekly or fortnightly for shorter projects.
- Focus on tasks to be completed, not those that have been finished.
- Reforecast when new evidence comes to light.

Managing the Finances

At its most basic level, the financial plan describes the project's costs, who is accountable for them, the expected financial benefits from the project, and the cash flow. These projections flow from the project plan and are determined by the resources committed to the project, when these resources are committed, and external costs, such as contractors or general expenses.

The greatest areas of contention in most projects are project costs and benefits. Whereas outsiders may focus on deliverables, insiders will focus on financials. Just as with the project plan, once authorizations have been obtained, it is a good idea to baseline the costs and track them because the approved figures are only estimates. They will change over time. As the project manager, you will need to know how much has been spent and how much money is left.

Managing the Benefits

Four benefits can emerge from IT and business projects: profitability, cost reduction, changes to working capital, or adherence to legal or regulatory reform. Benefits are much more difficult to estimate than costs. Anderson and Matthew offer four suggestions for managing benefits:

- Be realistic (most people overestimate benefits).
- Make sure the benefits are greater than the estimated costs.
- Base costs and benefits on the same assumptions.
- Forecast for various scenarios.

It also is important to forecast the timing of benefits. Discounted cash flow is one technique to compare the timing of benefits and costs. Again, a project manager should track benefits throughout the life of the project by asking, "Why are we doing this?" The answer might need to change if the business environment changes, as often happens in long-term projects.

Managing Risks, Opportunities, and Issues

Every project encounters the following:

- ***Risk.*** A potential threat or something that can go wrong that may prevent the project from achieving its business benefits
- ***Opportunity.*** A project going better than planned
- ***Issue.*** Something that threatens the success of the project

All possible risks and opportunities should be listed at the project outset and then analyzed to determine each one's likelihood and impact. Risk mitigators for high risks need to be built into the project plan. Likewise, major opportunities need to be built into the plan to maximize potential benefits. Both risks and opportunities need to be monitored.

Ongoing monitoring of risks and opportunities is one of the weakest areas of project management, note Anderson and Matthew. A good project manager continuously monitors the risks and opportunities along with the schedule, costs, and benefits. One of the most effective tools for monitoring risks and opportunities is a risk log.

Likewise, issues management is an ongoing task. Once an issue is identified by a project team member, it should follow a standard resolution process. An issue should be brought to the project manager's attention, its impact assessed, and then it should be assigned to a team member for resolution and its resolution monitored.

Soliciting Independent Reviews

Reviews help the project manager and project sponsor assess the "health" of a project. As the project progresses, team members often focus on delivering on specific objectives. They lose sight of the overall project benefits. An independent review can identify overlooked opportunities and risks. However, this review is not the same as a progress report. It should look at whether the project is still appropriate, whether its approach is the most effective, whether the deadline will be achieved, and if the costs are as expected.

To give a flavor of what project management work actually entails, here is an example of a day in the life of a project manager, excerpted from a blog on ITToolbox's Web site (www.Ittoolbox.com).[5]

CASE EXAMPLE

A DAY IN THE LIFE OF AN IT PROJECT MANAGER

www.ittoolbox.com/profiles/conelarry

Larry Cone is VP Software Development. He has managed over 100 IT projects. On January 28, 2004, Cone began a highly informative and entertaining blog about his day-to-day experiences, starting with his managing a project to implement a content management system for a medical publisher. He describes himself as a motivator, problem-solver, business process analyst, and technologist.

The blog appears on ITToolbox.com, a Web site for IT professionals that features blogs from IT professionals, providing site visitors a look at the day-to-day challenges these professionals face and how they address them. The following are brief excerpts from Cone's blog.[5]

September 18, 2007: Learning from Failure—Question Assumptions

Failure is not useful if the act of failing doesn't help us move ahead. What is most important when declaring a project a Failure is: What you do next? Upon failure, several doors open.

One door is the door of analysis—with Failure, it is natural to try and figure out what went wrong. Actions are questioned, assumptions reviewed, and goals are thrown out. It is a natural time to question our methods, and to review our assumptions.

A common source of failure is the discovery of key factors in the environment which had not been considered. This is a failure of assumptions. Often, there are unspoken assumptions that are found to be wrong.

Some common unspoken assumptions are:

- Performance won't be affected by these changes.
- The users have a stake in this project.
- Reporting won't be impacted by the data structure changes in this release.
- Our conversion processes will retain all needed data.
- The source interface system has accurate, timely data.
- The client can make needed updates to downstream systems.
- The whole business process must be addressed before any benefits can be gained.
- Senior Management supports the system.
- A comprehensive, normalized data model must be developed before we do anything.

This is far from a comprehensive list, just the first set of unaddressed issues that came to mind from projects that I've been associated with.

In most of these cases, the project went to completion, the damage was done, and the project was extended or compromised to deal with the results of these

(*Case Continued*)

unaddressed assumptions. In several cases, the project never got out of pilot.

The lesson is, better to declare a small, early failure than wait until you are too far in to adjust.

So the first door that opens is the opportunity to rethink what you are doing, specifically to question and reassess any hidden project assumptions.

The second door that opens is the opportunity to try again.

May 24, 2007: Everything You Need to Know about Software Architecture in Kindergarten

Designing and building software can be easier than you think. What makes it easy is having a set of rules any decision can be tested against so the rules may design the system for you.

The idea isn't so crazy. In 1986, Craig Reynolds simulated the behavior of a flock of birds using only three rules. What was previously thought too complex to program without great effort was suddenly not just easier for programmers to construct, but easier for nonprogrammers to understand. [...]

When all a system's code is is the result of a small set of rules, its behavior is more easily predicted and its complexity more easily comprehended. Knowing what a system does and what it will do, and knowing the rules that created it, make extending and adapting it in unanticipated ways much easier, even by new programmers.

To really pick up development momentum the staff also shares a common metaphor. Few systems are truly ex nihilo and without precedent either man-made or natural. Inspiration for working software models can come from physics, biology, dams, post offices, or dry cleaners. When everyone understands the metaphor then everyone knows how to marshal their efforts toward that goal without consulting a single oracle they would otherwise depend on.

So the first rule we learned in kindergarten: sharing. Share your rules and share your inspiration.

October 10, 2006: To the User, Definitions are Key

We are discussing some of the things that can be missed without effective prototyping and iteration.

In my friend Don's case study, there was another item missed, one more subtle, but a potential show stopper. It was: "What is a Customer?" To the back-office guys who sat in the room for several months, a customer was an aggregate of ship-to locations with the same bill-to address. The system was designed to break down and roll-up volume and margin by product by customer.

To the sales guy, the customer was the person he called on in Schenectady, or Sausalito. This customer might control multiple bill-to's, or just one ship-to. The sales guy's customer was a product of the back office operation as seen through the lens of Sales Geography, that arbitrary and ever-changing map that the sales force management group draws. Clearly, the customer in the system had to be aligned with the sales guy's customer in order to give the sales suy actionable information.

The lesson here is that the definitions of core components of your system are very important, and that even subtle differences between your systems definitions and another systems definitions can cause confusion to the point of unusability.

(*Case Continued*)

A user usually won't make a leap of faith—this is someone's job, after all, and faith doesn't figure into it. A user won't use a system that doesn't make sense, and one way to not make sense is to change the core definitions.

The result? After a few minor tune-ups, the system was a big success. Due to the system's ability to communicate information about both volume and margin, the sales force became aligned with the goals of the group (more profit, not more volume) via access to margin information from the newly improved transaction system. Promotional costs, basically money handed out by the sales force to make deals, dropped dramatically. Overall profit margin increased dramatically, and volume increased, too.

The icing on the cake for me is the story Don related about witnessing one sales guy showing another sales guy from a different division how the new system helped him make more in commissions. When you can get one user training another, you know that you got most of the system right.

Without an iteration or pilot phase that included real users with production data, this system which had so much right, and delivered such significant benefits, might have failed right out of the box.

September 5, 2006: Don't Do the Wrong System

In starting a new project, I try to identify the main risk,and structure the project accordingly. Most of the time though, it is the same risk.

I do a wide range of projects in a wide range of industries, and I often participate in a project that is something new for the organization. If it is an incremental project on an existing system, they usually don't need me. So I'm often doing a project in a new functional area, or applying a new technology (mobile, data mart, etc.) to an existing functional area. And these are usually operational systems, rather than administrative systems, in that someone is trying to improve a business process through automation.

In these types of projects, the primary risk is always the same—the risk of doing the wrong system.

By the wrong system I mean successfully implementing the wrong feature set. By wrong feature set I mean missing that subset of all possible functions and features which are the minimum necessary for an operationally viable system.

Simply put, the primary project risk is that the feature set you deliver doesn't match or support enough of the business function to be viable.

Does this sound unlikely to you? Are you confident in your ability to understand a business function and implement a feature set to support it? So am I, but when I look at the projects that I've been involved with, the record tells a different story.

My guestimate is that approximately half of the hundred-plus implementation projects that I've been involved with were ultimately not operationally viable. There were a wide range of reasons—sometimes the technology just wasn't appropriate or ready. But often, the feature set we identified and implemented didn't support enough of the business process.

Sometimes the needed scope was way beyond the available time or budget. But often it was possible. In short, we implemented the wrong system. ■

Change Management

IS staff members are often so enthralled with the technical aspects of a new system that they presume a technically elegant system is a successful system. However, many technically sound systems have turned into implementation failures because the people side of the system was not handled correctly. IT is all about managing change. New systems require changing how work is done. Focusing only on the technical aspects is only half the job. The other job is change management.

Change management is the process of assisting people to make major changes in their working environment. In this case, the change is caused by the introduction of a new computer system. Management of change has not always been handled methodically, so choosing a change management methodology and using it is a step toward successfully introducing new computer systems.

Change disrupts people's frame of reference if it presents a future where past experiences do not hold true, says ODR, a change management firm in Atlanta, Georgia.[6] People resist change, especially technological change, when they view it as a crisis. They cope by trying to maintain control. In the case of an impending new computer system that they do not understand fully or are not prepared to handle, they may react in several ways. They may deny the change; they may distort information they hear about it; or they may try to convince themselves, and others, that the new system really will not change the status quo. These reactions are forms of resistance.

ODR offers a methodology to help companies manage technological change. They use specific terms from the field of organizational development to describe the types of people involved in a change project.

- The sponsor is the person or group that legitimizes the change. In most cases, this group must contain someone in top management who is highly respected by the business unit because change must be driven from the business unit.
- The change agent is the person or group who causes the change to happen. Change agents are often the IS staff. They can introduce the change but they cannot enforce its use.
- The target is the person or group who is being expected to change and at whom the change is aimed.

Using surveys completed by a project's sponsors, change agents, and targets, ODR aims to:

- Describe the scope of the change
- Assess the sponsors' commitment to the project
- Assess the change agents' skills
- Evaluate the support or resistance of the targets

The goal of these initial evaluations is to determine whether the change can be made successfully with the current scope, sponsors, change agents, and targets. By evaluating each area, the change agents can determine (1) whether the scope of the project is doable or whether the organization is trying to change too much at one time, (2) whether the sponsors are committed enough to push the change through or whether they are sitting back expecting the organization to change on its own, (3) whether the change agents have the skills to implement the change or whether they are not adept at rallying support, and (4) which groups are receptive to the change and which are resistant. Once these assessments have been made, ODR assists IS project teams to understand the risks their project faces and what they can do to mitigate those risks.

As an example of an organization that used this approach and successfully implemented nine change management projects, consider BOC Group, as described by Neil Farmer.[7]

CASE EXAMPLE

THE BOC GROUP

www.boc.com

The BOC Group is an industrial gas manufacturer with global headquarters in Windlesham, England, and U.S. headquarters in Murray Hill, New Jersey. The company operates in 60 countries and sells industrial gases such as oxygen for steel making, carbon dioxide for food freezing, and so on.

The industry is mature and highly competitive, so companies compete on price and service. To improve the company's competitive position, management committed $35 million to reengineer BOC's core processes. In all, nine reengineering projects were initiated. All succeeded over a 30-month time frame—a significant achievement.

The company established nine full-time teams, each to improve a selected process. Following completion, all team members were guaranteed a return to their former (or equivalent) job. Each team was co-led by a business and information management (IM) process leader because IT was a major component of most of the projects. Each team also sat together in a bullpen setting.

For the first six months, each team studied its chosen business process. The research was not parceled out among team members; every team member studied everything. Thus, IM team members were like all the other members. They studied the existing processes and then had a say in how implementation should be handled, they supplied input into the training plan, and they helped devise the customer communication plan. They were often significant influencers because the other team members respected their opinions and their technical knowledge.

Garnering True Executive Sponsorship

Although the president was the executive sponsor for all the teams, he was not intimately involved in each project. Thus, the real executive sponsors were vice presidents and directors. Although they understood the need for the changes and were committed to the concepts behind them, day-to-day operational pressures put a strain on true sponsorship. To address this problem, BOC called on ODR to teach sponsorship to the nine sponsors in a two-day event.

The sponsors were reticent to go off-site for two days to talk about managing change. They believed employees did

(*Case Continued*)

what they were asked to do. The sponsors did not understand the full impact of the changes on employees nor how employees would be assimilating the changes. They also did not realize their sponsorship job included building sponsorship down through company levels.

During events, the ODR facilitator described the sponsorship job in basic here's-what-is-needed terms, and he challenged the nine sponsors to ask the important questions, such as: "What in our culture might make our project not work? What has failed in the past at BOC? Are we asking too much? Is this realistic?" The facilitator pressed the sponsors to question the company's capacity to assimilate change. He got them to be honest and identify obstacles. They were, indeed, challenged. Up to that point, they had not addressed these questions.

The workshop did the job. It opened their eyes to their sponsorship role, which turned out to be crucial to the success of all the projects. They had underestimated the involvement required from the total organization. They had been sitting back expecting their teams to make change happen. But the teams could only put the tools in place; the organization had to make change happen. The workshop taught the sponsors the difference. They left understanding how they needed to drive change through the organization. The facilitator led them into planning their own strategies and examining possible consequences.

One Change Project

One of the reengineering projects changed the way BOC processed the paperwork for delivering gas products and invoicing customers. Previously, drivers received a batch of shipping tickets each morning from a clerk. These tickets described their route for the day. When they dropped off a cylinder of gas or picked up an empty one, they marked it on a full-size sheet of paper and handed it to the customer. They also returned hand-written notes to the clerk for entry into the system.

The solution was to replace the paper with a point-of-delivery handheld device (PODD). Schedules would be made at night and downloaded electronically to the PODDs. Loaders would use this information to load the trucks during the night. In the morning, the drivers would pick up their PODD, which contained their route for the day. When they delivered a cylinder, the PODD would accept the customer's signature and then print out a delivery document the size of a grocery store receipt. At the end of the day, the driver hung the PODD back on the rack and the billing data were automatically transmitted to headquarters.

To arrive at this solution, the team, as a whole, studied the process from order to delivery to billing. In working as a unified team, the IM folks began to act as business folks, and vice versa. At the end, the two were indistinguishable because they had absorbed each other's knowledge.

This interaction was a much-appreciated by-product of the process. Once the entire team devised the solution, the IM staff built the technical infrastructure.

Involving Middle Management. To engage middle managers in the nine reengineering projects, BOC established an advisory council for each one. Each advisory council's job was twofold, upward and downward. The upward job was to give feedback on recommended changes, pointing

(*Case Continued*)

out implementation issues. The downward job was to describe the recommendations to employees and get their buy-in.

The PODD advisory council had 11 members, which included drivers, logistics, IM, field people, and managers. They met several times, and they had more influence than they realized. Their upward feedback significantly affected the PODD team's decisions and their downward communication gave the field people a way to be heard. Through all the advisory councils, BOC created a cascade of influencers, which was a key contributor to their success.

Training the Drivers. The PODD team developed a handheld device that was so logical and intuitive that little training was needed. However, to make the drivers comfortable and ensure success of the project, the team created a six-hour training program.

The training theme was "A day in a driver's life," and the purpose was to show the truck drivers how to use the PODD to do their job. The lead trainer (a former truck driver) first led the drivers through "A perfect day" scenario where nothing went wrong. With PODD in hand, each driver followed the lead trainer in going through an entire day's use of the PODD, from loading cylinders into the truck to dropping off the PODD at night. This rapid scenario gave them the overall feel of its use. The drivers made mistakes, but as they corrected their own mistakes, they became more and more comfortable with the PODD.

The drivers then worked at their own pace through three successively harder scenarios following a laminated sheet of instructions that included cylinder bar codes and other pertinent information. The drivers who got through all three had no problem with the PODD. Those who got through two might need a little support. Those who struggled would need a trainer to ride with them for a day or two.

To ensure that the drivers were fully comfortable with the PODD, the PODD team offered to ride with any driver for a day. Many accepted, not just to build their confidence, but because they enjoyed the company of another person. Whenever the driver raised a question during that day, the team member usually responded, "What do you think you should do?" Generally the driver's answer was right, which built self-confidence.

Due to all the training, the PODD team encountered little resistance from the drivers. In fact, the drivers were so pleased the company was investing in them that they proudly showed their PODD to their customers; they were the only drivers in the industry to have them.

The project was successful because the PODD team had assessed its people aspects at the outset and mitigated the identified risks by holding the sponsorship event, involving middle management via the advisory council, and thoroughly training the truck drivers. ■

Change Management Process for IT Systems

We discuss here the process that is required to change or modify an existing IS. Change management here refers to the use of methods and procedures, typically standardized, to handle change request in a responsive and least intrusive manner to the organization's daily operations. Change management affects hardware, software, data, and procedures. Often, changes are initiated by incidents reported by users—use problems, needs for new system functionalities, etc. The IT staff is in charge of raise and document change requests, assessing the impacts, cost, benefits, and risks of proposed changes. In many IT departments, there is a responsible staff—the change manager—whose function is to coordinate change implementation. The change manager provides justification to get change approval from management, and monitors and reports the status of the change process. A task that requires close attention is to set up test environments to make sure that all is working as expected before the new version is released for production. In large organizations, a Change Advisory Board (CAB) is formed to oversee the change management process.

Risk Management

Not all IT-based projects succeed. In fact, many fail—especially the really large projects, such as those implementing ERP or CRM systems. Thirty to 70 percent of IT projects fail. Why do IT projects fail? Because they do not overcome their risks, either technical or business ones, notes Chuck Gibson.[8]

Technical risks might be a vendor package not scaling up as expected or the project's scope creeping so much that the project becomes too complex to implement. Although technical risks cannot always be anticipated, they can be contained with the right technical corrections. Business risk, on the other hand, is the risk that the business does not change properly to use the new system. Business change is necessary to achieve business results from IT. Lack of business change can come from the appropriate new work environment not being put in place or people's skills and attitudes not being updated to take advantage of the new environment.

Business risks are not as easily righted as technical risks, notes Gibson. Instilling the right business changes requires using the project management approach that reduces the main risks. When the risks change, the project management approach probably needs to change to keep the project on track. Gibson proposes eight project management approaches, from the Big Bang approach (which is appropriate when all the main business risks are low) to the Mitigate or Kill the Project approach (which is appropriate when all the main risks are high).

To ascertain which project management approach is most likely to yield the needed business changes, Gibson proposes using a three-step process whenever the main risks in a project change: assess the risks, mitigate the risks, and adjust the project management approach.

Step 1: Assess the Risks

The business case for an IT project should include the business risks. Based on his experience and research, Gibson believes the three predominant risk factors are leadership of the business change, employees' perspective on the change, and the scope and urgency of the change.

To visually see a project's overall risk from these three factors, a decision tree can be created. It shows the eight possible combinations of the three factors (Figure 10-1). A plus sign (+) on a factor means "positive support for the business change"; it increases the likelihood of success by reducing the risk. A minus sign (2) on a factor means "negative support for the business change"; it decreases the likelihood of success by increasing

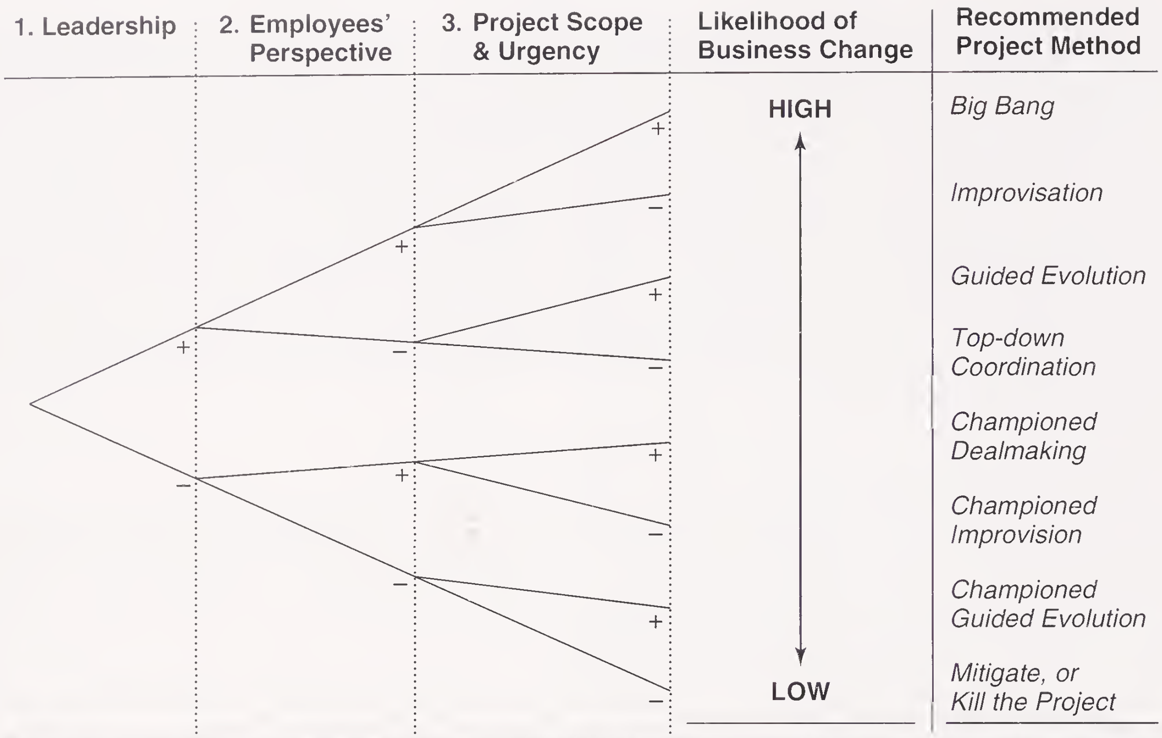

FIGURE 10-1 Risk Management Decision Tree

Source: C. Gibson, "IT-Enabled Business Change: An Approach to Understanding and Managing Risk," *MIS Quarterly Executive*, Vol. 2, No. 2, September 2003, pp. 104–115. Used with permission.

the risk. The factor that is the greatest contributor to project success or failure should be placed on the left. In this example, it is leadership, which is often, but not always, the case. On the far right are the eight project management approaches, one for each path through the decision tree.

A project leader is the executive (or executives) responsible for the change. The project leaders should be business executives, not IT executives, notes Gibson, because the business (not IS) is being required to change. To assess whether a project's leadership contributes to success or failure (whether it is a plus or a minus on the decision tree), Gibson recommends asking six questions:

1. Are they committed to the business case?
2. Do they understand the extent of change in work behavior required for the project to succeed?
3. Are they formally motivated to pull off the change, such as building it into their performance goals?
4. Are they at the appropriate organizational level and do they have the formal power to influence the needed changes in work behavior?
5. Do they have experience with a project of similar scope, urgency, and people impact?
6. Do they have informal power, such as respect and credibility?

The answers are likely to be mixed, notes Gibson, so give each a weight to ascertain whether the leadership factor should be a plus or minus on the decision tree.

To assess employees' perspectives, he recommends asking two questions. One, "How will the affected people react?" Will they embrace the change, follow orders, follow others, wait and see, resist, or sabotage the change? Two, "Why are they likely to react this way?" This assessment should also yield a single plus or minus on the decision tree.

To assess the project's scope and urgency, Gibson suggests asking three questions: "Is the scope wide?" (A wide scope is a minus.) "Is the change scope deep and severe?" (A major change in processes is a minus.) "Is there urgency?" (Urgency is a minus because it increases risk.) Overall, the scope and urgency factor on the decision tree gets a plus or a minus. The result of these three analyses yields a path through the decision tree that indicates both the project's level of risk and the appropriate project management approach.

Step 2: Mitigate the Risks

Mitigation involves identifying, evaluating, prioritizing, and implementing countermeasures to reduce risks. The decision-making process should reflect the attitude of the organization toward risks. Some organizations use the least-cost approach to identify the most cost effective and acceptable controls. Some others give more importance to minimizing adverse impact on the organization's resources and mission.

Risk mitigation includes the following options:

- Risk avoidance by eliminating the source of the risk (for example, sacrifice certain functions of the computer systems to avoid hacking)
- Risk limitation by implementing controls that keep the risk to an acceptable level (for example, implement some monitoring to prevent a major disaster)
- Risk transfer by letting others assume the risk (for example, outsource a vulnerable system), or by buying insurance to recover possible loss

Step 3: Adjust the Project Management Approach

Gibson divides project management styles into whether they are authoritative or participative and whether the project's budget and time frame are rigid or adjustable; see Figure 10-2. The resulting four project management approaches are appropriate for the least risky projects, he believes, which are the four top paths in the decision tree.

The Big Bang approach is authoritative and has a fixed budget and deadline. This approach is only appropriate when all three factors are positive. Improvisation is participative and has an adjustable budget and deadline. This is the approach to use when leadership and employee perceptions are positive, but scope or urgency place the project at risk, because the committed workforce can adapt to difficult tasks. The Guided

	Management Style	
Project Budget and Deadlines	**Authoritative**	**Participative**
Fixed	Big Bang	Guided Evolution
Adjustable	Top-down Coordination	Improvisation

FIGURE 10-2 Four Approaches to Project Management

Source: C. Gibson, "IT-Enabled Business Change: An Approach to Understanding and Managing Risk," *MIS Quarterly Executive*, Vol. 2, No. 2, September 2003, pp. 104–115. Used with permission.

Evolution approach is participative, but it has a fixed budget and deadline. This is the project management approach to use when only the employee-perception factor is negative, because that negativity can be overcome by involving the employees through strong leadership, motivating them to accept the change. Top-down Coordination is an authoritative approach with an adjustable budget and deadline. This method only works when the leadership factor supports the business change and when the leadership is respected, full-time, and highly experienced in leading business change.

The projects on the bottom half of the decision tree, where the leadership factor is negative, are the riskiest. The only project management approaches that will lead to the success of such projects are those that have a champion in the user organization. These champions generally have to be willing to bet their job on the project's success. In actuality, these four options "are not in the realm of responsible senior management," notes Gibson, but they do happen. And champions can pull them off, generally by gaining adherents through informal channels—except when all three factors are negative. That's when Mitigate, or Kill the Project is the only option.

To illustrate effective choices in project management, Gibson presents the successful implementation of ERP at Dow Corning from 1995 to 1999. Each project phase had different business risks. Realizing this, the project executive took a different project management approach in each phase. The project management terms used in the case are Gibson's.

CASE EXAMPLE

DOW CORNING

www.dowcorning.com

In 1995, Dow Corning gained a new CEO, Dick Hazelton, who led his operating committee through a strategic review to decide the company's strategy for the next 10 years.[8] They decided to leave the business strategy intact, but use IT to foster business process change.

Phase 0: Get Ready

The operating committee viewed business process change as highly risky, for the following reasons (to use Gibson's framework):

- Leadership of business change: High risk, because the IT organization had recently failed to implement a global order-entry system.
- Employee perception of business change: High risk, because the company had never experienced a major change and its culture was long employee tenure and adherence to existing practices.
- Scope and urgency of business change: High risk, because the scope was wide (company-wide); it was deep and severe (new processes, new jobs); and it was urgent (which actually was the only positive factor because it got people's attention).

(*Case Continued*)

According to Gibson's decision tree, this was the riskiest type of project: Mitigate, or Kill the Project.

To change the leadership from negative to positive, Hazelton appointed a 30-year Dow Corning veteran, Charlie Lacefield, to be in charge of both IT and the business change. Lacefield would report directly to Hazelton. To mitigate the other two risks, the operating committee followed Lacefield's recommendation of using a package, SAP's R3 ERP suite, and minimizing changes so that the company could focus on the business changes, not the technology changes.

Phase 1: Understand the New System

Use the Improvisation approach of participative management and flexible deadlines. In the first phase, Lacefield was most concerned about employee reticence in the later phases, so he focused this phase on building commitment to the SAP ERP system by getting 40 of the most respected managers in Dow Corning on his implementation team full-time and having them work closely with his IT staff. They used the traditional Dow Corning approach of consensus and flexible milestones to understand the SAP ERP system and to redesign work processes to match it.

Phase 2: Redesign the Work Processes

Use the Guided Evolution approach of participative management with fixed deadlines. Although the Improvisation approach worked in phase 1 to get the 40 managers deeply committed, it did little to get the work processes redesigned. As a result, Dow Corning employees were seeing little progress (but hearing that big changes were coming), so their perception turned negative. In response, Lacefield changed his project management approach. He appointed a new project manager, a man who was comfortable with IT and had a highly respected track record in manufacturing at the company. Lacefield also set firm deadlines so that employees would see progress. This Guided Evolution approach continued through the pilot—a cutover to the SAP ERP at a newly acquired European business.

Phase 3: Implement the ERP Worldwide

Use Top-down Coordination with its authoritative management style and flexible timelines. The pilot's success demonstrated management's determination and shifted employee perception to positive. But the scope of the rollout in this third phase shifted to negative, because it was company-wide. Lacefield thus changed his project management approach in response, to authoritative, but permitted flexibility in deadlines because the three risk factors at Dow Corning sites varied widely. During this phase, Lacefield traveled extensively for a year, negotiating and cajoling executives at the company sites to stick to their commitment to change to the new ERP-based work processes. He even made project success one of his performance goals for the year.

Phase 4: Complete Implementation

Use the Big Bang approach of authoritative management and firm deadlines. By the end of 1998, most of the company sites had implemented the SAP ERP system, so all the risk factors had turned positive. So Lacefield opted to

(Case Continued)

implement the system in the few remaining pockets of resistance by setting firm deadlines. Initially, site conversion took 18 months. In these remaining sites, though, Lacefield required that it take only four months.

In 1999, Dow Corning became the largest successful single-database implementation of SAP's ERP. Gibson attributes the success, in part, to the adroit use of four project management approaches, each fitting the circumstances at hand. ■

Tips for Good IT Project Management

Most people would agree that a successful project has the following characteristics, notes Michael Matthew:[2]

- It is delivered on time.
- It comes in on or under budget.
- It meets the original objectives.

However, some people do not realize that success also means that the project meets users' and the organization's needs, which may have changed since the original objectives were stated. Projects that do not give users what they want cannot be deemed a success. Following are some tips from Matthew on how to better assure IT project success.

Establish the Ground Rules

Define the technical and architectural specifications for the systems following four guidelines:

- Adhere to industry standards.
- Use an open architecture.
- Web-enable the system.
- Power with subsystems.

These principles should help ensure no nasty surprises along the way, as well as provide the ready ability to update/switchover systems in the future. The basic tenet is that the systems should be as simple as possible while fulfilling all of the (reasonable) user requirements.

Foster Discipline, Planning, Documentation, and Management

In many respects, these elements are what project management is really all about. It does not matter how well the requirements have been specified or whether the "perfect" solution has been selected; if the process is not controlled properly, anything can happen or, more realistically, potentially nothing will happen.

A firm timeline for system rollout needs to be formally established and signed off. Once this task has been done, the project team needs to work backward from the critical dates and map out the timing for the intermediate steps and include any interdependencies. Teams should take the critical date and subtract some time to factor in unforeseen contingencies. The project must progress with the target critical date in mind, which requires strong discipline.

The project also needs to follow a sound methodology and have key points planned and documented (and reported on) using a product such as Microsoft Project. All members of the team need to be aware of their responsibilities and timelines. Nothing should be left assumed. In addition, regular meetings and updates of the project plan are needed, along with proper documentation of the system development effort. Senior management needs to be able to see this documentation whenever they want. Management, key users, and even vendor personnel should be included on project steering groups, which should meet regularly to make sure the project continues on track. Such meetings also provide a venue for airing problems and raising issues that might affect others.

In addition, it is desirable to have an overall IT project steering committee. Regular project manager meetings from the various projects are key to keeping each other informed of their progress and for raising issues that might affect other projects.

Obtain and Document the "Final" User Requirements

Documenting user requirements is critical because it is the only way the team can evaluate the project outcome. Scope creep (users asking for more and more functions) causes many system failures. Documenting requirements helps lock in the scope of the work and reduce the possibility of costing problems and time overruns due to additional requests. Documenting user requirements can be done via a variety of methods, including facilitation sessions and one-on-one interviews.

A common mistake is writing user specs in technical jargon, notes Matthew.[8] Some IT consultants make this mistake to "maintain the IT mystique." However, this approach can do harm. Similarly, IT project teams should not accept overly technical sign-off requests from software houses. These developers need to prove they can fulfill the users' requirements.

Obtain Tenders from All Appropriate Potential Vendors

Today, much software is bought rather than built in-house. This option needs to be considered when beginning a project, notes Matthew. In fact, companies that do not have expertise in the area under consideration might want to call in consultants to make a recommendation. Their extensive contacts in the IT community can significantly improve selection of the package or packages. Or consultants may simply help the IT project team create the selection criteria for evaluating bids and selecting a winner.

Include Suppliers in Decision Making

If development is to be handled by an outside firm, then create a joint project team. The supplier, or suppliers, will undoubtedly appoint their own project managers for their respective assignments. They need to be part of the governing team.

Convert Existing Data

Data conversion needs to be properly planned to make sure that the output data are complete and accurate. Although this task might appear quite simple, it is often the area that creates the biggest headaches. Here, perhaps, the oldest maxim in the IT industry applies: garbage in, garbage out.

Follow Through After Implementation

After successfully implementing the systems, project managers need to cross their t's and dot their i's in terms of documentation, future maintenance processes, and so on.

The bottom line is that IT project management is no different from any other form of project management. Success requires good planning, along with good communication, and ensuring active participation of all appropriate parties. These elements, along with some hard work, will better ensure a successful system.

Thus far, this chapter has dealt with managing system development projects. We now shift to an issue that repeatedly comes around: how to improve legacy systems.

MODERNIZING LEGACY SYSTEMS

Legacy systems are business applications that were developed in the past to help support the critical mission of the organization. For example, airline reservation programs represent the mission-critical legacy system of the airline industry. Most IS executives feel trapped by the past. They have thousands of legacy programs and data files they want to replace. CIOs may not have the resources to replace all the remaining legacy systems. Replacement is not the only option, though. In many cases, it may not even be the wisest option. Legacy systems embed significant business knowledge that the organization has accumulated throughout its development and maintenance. In the process of improving legacy systems, it is important not to lose this corporate asset. The challenge of modernizing legacy systems is to systematically migrate old systems to newer ones in the least disruptive way possible. Large organizations should have well-laid-out migration strategies.

To Replace or Not to Replace?

To replace or not to replace? That is the question studied by the Boston Consulting Group (BCG)[9] in 18 manufacturing companies, service firms, and government organizations in North America, Europe, and Japan that had either just replaced or upgraded legacy systems or were in the process of replacing or upgrading. Of the 21 projects compared, 12 were successful in that they worked and had a bottom-line impact. However, the other nine were either unsuccessful or did not deliver the anticipated results.

From these findings, BCG concluded that upgrading (rather than replacing) made more sense in most cases, even if it was difficult and not seen as being as exciting as a totally new system. They noted that people get seduced by a new technology and want to rush out and replace old systems with it. However, most of the replacement projects that failed could have been upgrade projects. In fact, in some cases, the company reverted to upgrading the old system anyway.

When a system's technology is so obsolete that it does not exist in many places, then replacement is probably the only choice. Otherwise, BCG recommends that companies perform three analyses:

- Rigorously analyze the costs and benefits of the new system. Most companies underestimate the cost of replacing a system and overestimate the achievable business value, even on the successful projects. Furthermore, they do not factor in the risk of failure.

- Determine how specialized the new system really is. Sometimes companies think they need a made-to-order system when a purchased solution would do just fine. Their requirements are not as unique as they think.
- Assess the IS staff's capabilities honestly.

Several companies in the study failed to develop replacement systems because management had overrated the staff's skills. It is important to know that the IT staff is able to decipher the legacy system, and fully understand the desirable features of the target system. In conclusion, BCG recommends that the burden of proof lies with those who advocate replacement of a legacy system rather than with those who advocate an upgrade, especially for mission-critical systems.

Options for Improving a Legacy System

With this insightful study as a backdrop, here are seven choices for creatively dealing with legacy systems from least to most amounts of change (Figure 10-3).

Enterprises use a variety of approaches in these options. In moving to a totally new platform, such as ERP, for example, companies have taken one of two strategies in using outsourcing firms. The first has been to keep the legacy maintenance work in-house, hiring the third party to implement the new system and then phasing out the legacy maintenance work. Others have opted for the opposite. They have outsourced maintenance of the legacy systems so that the in-house staff could focus on developing the ERP system. As the new system has come online, the outsourcer has turned off the legacy systems. Companies take this transitional outsourcing approach when they feel they have (or can get) the in-house expertise required by the new platform. As BCG found in its survey, in-house skill levels can be the main determinant in deciding whether this second approach is even feasible.

Here, then, is the spectrum of options for improving legacy systems. As shown in the figure, it may be useful to compare these seven options to fixing up a house.

Restructure the System

In fixing up a house, restructuring is akin to updating the look of a room or the house, perhaps by repainting or getting rid of clutter so that it "feels" better to live in. In IT, if an application program is basically doing its job but it runs inefficiently or is "fragile" or unmaintainable, then it may simply need to be restructured.

Computer applications that were developed in the 1970s and 1980s are typically hardware dependent (for example, the software is built for a particular computer monitor or printer). Also, the data and the business algorithms are tied together in the same set of codes, making any modification difficult. For years, vendors have offered software products to help separate data from codes, and business algorithms from hardware.

A noted area of improvement is the improvement of the code itself. Old programs were written in second-generation programming language (such as COBOL) that had little structure with thousands of illegible lines of nested code. The most popular ones use automated restructuring engines to turn this "spaghetti code" into more structured code. The process involves the following seven steps.

1. Evaluate the amount of structure in the current system, including the number of layers of nesting, degree of complexity, and so forth. Use the tools to present a trace of the program's control logic. Subjectively evaluate the code to determine

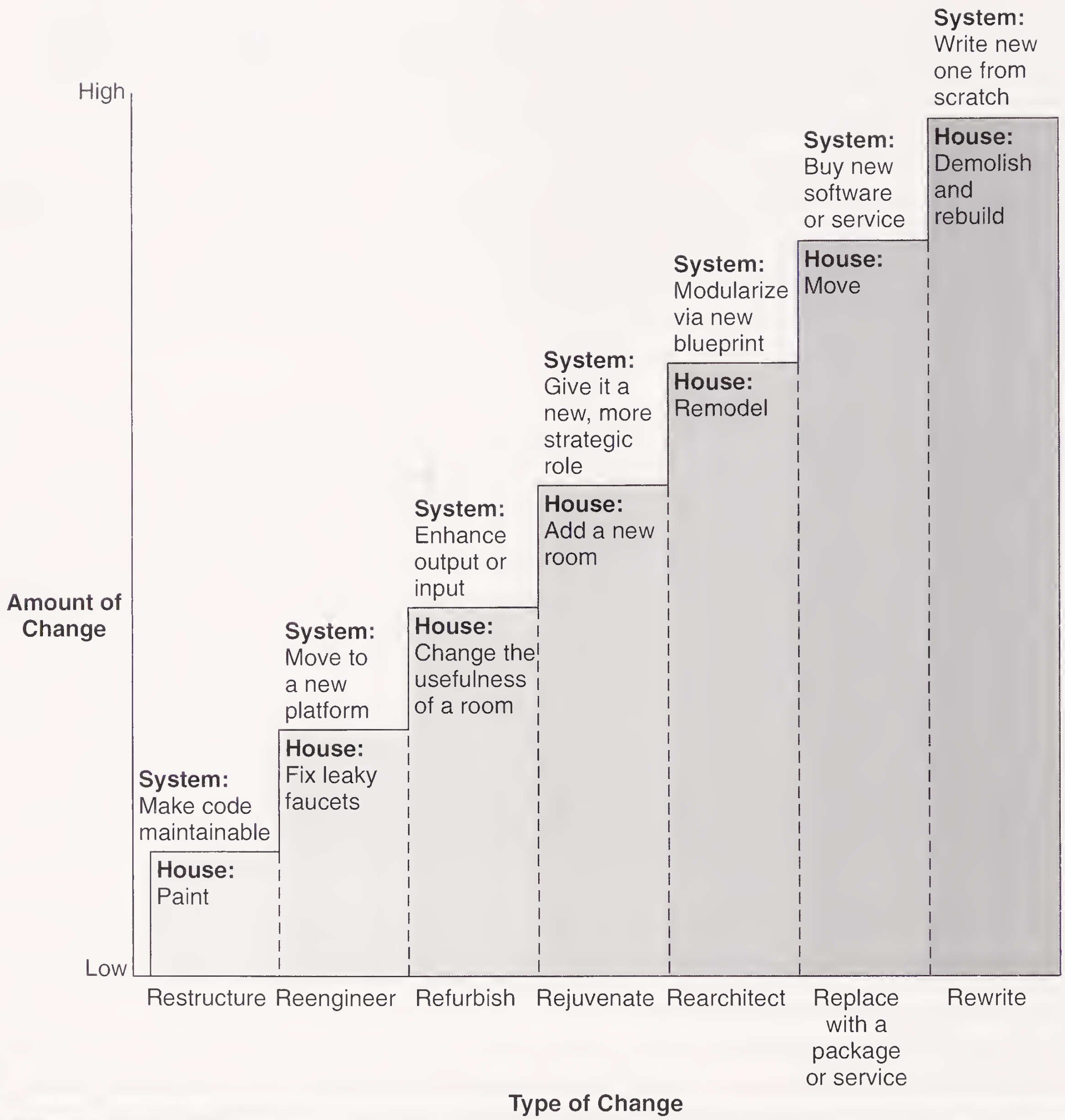

FIGURE 10-3 Options for Improving a Legacy System with Home-Improvement Analogy

whether restructuring is warranted at all or if more extensive change is required; this task can only be performed by people.

2. Compile the program to be sure it is in working order. A code restructuring tool will not make a nonoperative program run.
3. Clean up and restructure the code by running the program through a structuring engine. This automated process does not change the logic of the program; it simply replaces poor coding conventions with structured coding conventions, such as reducing the number of GOTOs, removing dead code and altering statements, highlighting looping conditions, and grouping and standardizing input-output statements. It uncovers the structure hidden inside the convoluted code.
4. Reformat the listing, making it easier to understand, by using a formatting package.

5. Ensure that the old and new versions produce the same output by using a file-to-file comparator.
6. Minimize overhead introduced by restructuring by using an optimizer package. After optimization, restructured programs generally require between 5 percent less and 10 percent more run time than the unstructured versions.
7. "Rationalize" the data by giving all uses of the same data one data name. This step is optional.

These seven steps can be used to restructure a functional system or to get it in shape to be reengineered.

Another quick fix is to add a new, more user-friendly interface to the legacy system. One popular technique is called black-box optimization. The old computer program is seen as a black box with undecipherable source code and is "wrapped" by a layer of new code to allow it to interface with other applications, such as new report generators, or new screen generators.

Reengineer the System

In fixing up a house, reengineering is akin to fixing what isn't working, such as replacing broken door handles, repairing leaky bathroom fixtures, adding more insulation in the attic, and even feng-shui-ing the house to put furniture in more harmonious locations. In IT, a step beyond restructuring is reengineering, which means extracting the data elements from an existing file and the business logic from an existing program and moving them to new hardware platforms. This use of the term "reengineering" should not be confused with the term "business process reengineering." The term "system" or "application" reengineering is much narrower and refers only to software. The other term refers to redesigning business processes. Like code restructuring, reengineering requires automated tools because the process is too complex to be cost-justifiably done manually. Database reengineering tools began appearing on the market in the late 1980s.

According to Charles Bachman, a pioneer in the database field, the major problem in the computer field is that people consider existing systems as liabilities that must be maintained, taking resources away from developing new and exciting applications. Instead, management needs to see existing systems as assets from which to move forward.

If developers can reverse engineer a system, that is, extract the underlying business logic, they can forward engineer that business logic to a new system platform. With this approach, existing systems become assets. Developers can extract the intelligence in them rather than start over from scratch.

Bachman believes a new system development life cycle can use automated products to help perform the reverse engineering. It encompasses all four basic development activities: maintenance, enhancement, new development, and migration. This life cycle is circular rather than linear, as shown in Figure 10-4.

- Reverse engineering—where existing programs, along with their file and database descriptions, are converted from their implementation level descriptions that include records, databases, code, and so on, into their equivalent design-level components of entities, attributes, processes, messages, and so on.
- Forward engineering—which goes the opposite direction, moves from requirements-level components to operational systems. Design items created by reverse engineering are used to create new applications via forward engineering.

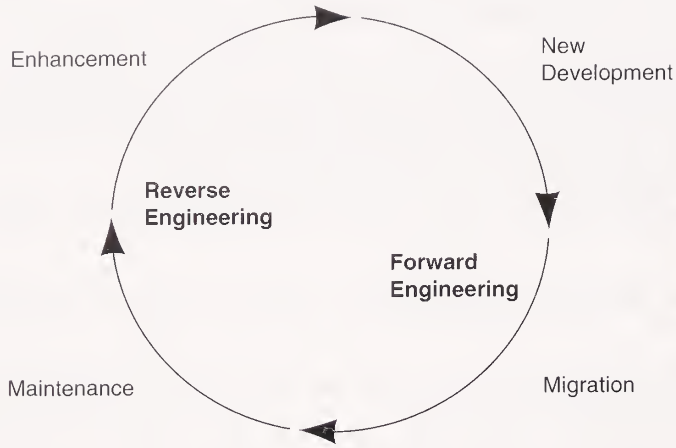

FIGURE 10-4 The Reengineering System Development Life Cycle

Source: Courtesy of Charles Bachman, founder of Bachman Information Systems, Cambridge, MA.

The cycle continues because as new applications go into operation; they become candidates for reverse engineering whenever they need to be changed. Neither people nor automated tools can use this new life cycle by themselves, notes Bachman, but together, it becomes feasible. Verizon Directories is an example of a company that used such reengineering tools.

CASE EXAMPLE

VERIZON DIRECTORIES

www.verizon.com

Verizon Directories produced, marketed, and distributed more than 1,500 different telephone directories in some 14 countries. To accelerate their response to changing markets, Verizon Directories began automating its telephone directory publishing business.

The directory publishing system had four main databases. The largest supported all of the administrative functions for creating and selling Yellow Pages advertising, from sales to photo composition. The second was used by representatives to sell Yellow Pages advertising for non–Verizon Directories. The third database handled billing. The fourth database provided order entry for independent telephone companies for whom Verizon produced telephone books.

The databases were originally designed application-by-application. The result was records that contained data elements with no business relationship to each other, making them difficult to reuse, enhance, and change. The data administration group acquired reverse engineering tools to help them improve these databases.

To reverse engineer the database, a designer used a design administrator to display the existing database definitions graphically. The designer made changes by manipulating the graphical icons. The

(*Case Continued*)

tool helped draw complete and consistent relationship diagrams because it had the intelligence to identify inconsistencies and incomplete structures.

Once the new database design had been created, the designer forward engineered the database design and ran the physical implementation design rules. When the design was satisfactory, the new database statements were automatically generated.

Such database reengineering was used on two projects.

The Blueprint Project

The largest database had not been properly designed, so the data administration group used the toolset to create a blueprint of what the database should look like. They reverse engineered the existing database from its physical to its data model from which they created a new, properly designed data model using entity-relationship modeling techniques. By experimenting with this model, they created a design that was more adaptable to change. It became their blueprint for the future and was used to guide maintenance work. As the database administrators maintained the database, they made changes to align it more closely with this blueprint. Without the reengineering tools, they would not have even attempted this project because they could not have done the "what if" modeling necessary to create the blueprint.

A Reuse Project

The database administrators reused some of the data elements in the largest database for a new production scheduling system. The company had scheduled production of their 1,500 directories among their three printing plants using a 15-year-old system. Some scheduling data were in the system; some were in the new administrative system.

The company created a new scheduling system, drawing some scheduling-related data from the administrative database. Again, they used reengineering tools to create the design models for the new scheduling databases. From these models, they used a tool to generate the necessary database statements. With the new system, salespeople no longer had to interrogate both the 15-year-old publishing system and the administrative system—which had different sets of data—to see directory publishing schedules.

Because maintenance was the bulk of the work of the database administration group, the tools became invaluable in helping them redesign old databases, design new databases using portions of existing ones, and create their blueprint for the future. ■

Refurbish the System

In fixing up a house, refurbishing is akin to enhancing the usefulness of the house, perhaps by replacing old furniture in a room, relandscaping the yard to improve its curb appeal, or turning a college graduate's bedroom into an office. In IT, if an old system is maintainable and is causing no major problems, it may be worthwhile to add some extensions. Potential extensions would supply input in a new manner, make new uses of the output, or allow the programs to deal more comprehensively with data.

Refurbishment is actually occurring quite a bit these days because of the Web. Companies are leaving existing systems in place but adding a Web front end, along with accompanying query translation software, so that the system can be accessed directly by employees, suppliers, or even customers. Witness FedEx's Web site, which allows customers to directly access the company's tracking database. In such cases, companies generally follow a "surround" strategy, where they treat the old system as an untouchable black box and surround it with new facilities. This approach has been a popular way to upgrade legacy systems, even before the Web's appearance.

Rejuvenate the System

In fixing up a house, rejuvenating means adding new functions, such as adding a room, a porch, or a swimming pool. In IT, rejuvenating an old system is a step beyond refurbishing the system because it adds enough new functions to a system to make it more valuable to the firm. The first step is to recognize a system's potential. The second is to clean up the system, perhaps using restructuring tools. The third step is to make the system more efficient, perhaps using the reengineering approach mentioned earlier, then port the system to a new operating environment and database structure. The fourth step is to give the system a more strategic role, such as allowing it to feed a data warehouse so that people in field offices can access data far more quickly. Another possibility is to give it a role in a company's e-commerce strategy by using it as a back-end system accessible via the Web.

As an example, consider Amazon.com, the online retailer, which is using Web Services technology to give third-party developers access to its data and content to use in their software, hardware, or services. Amazon's goal is to use its information to increase the company's market share.

CASE EXAMPLE

AMAZON.COM

www.amazon.com

In 2002, Amazon.com initiated its Web Services program where anyone can receive a license to access Amazon's data and content via XML feeds—for free. The licensees must agree, though, to not use any of the logos on Amazon.com's site or use any of the restricted or copyrighted material on the site (such as copyrighted reviews).[10]

Over 27,000 people have obtained licenses, some for their personal use, some to offer free software to Amazon.com users, others to build hardware for use with Amazon.com's site, and still others to sell software or services related to the site. Examples of these third-party offerings include:

- Software for people to download their Amazon.com wish list onto their cell phone to use when shopping in stores
- Software to help merchants offer their products on Amazon.com, with the merchant paying a

(*Case Continued*)

percentage of each sale to the software developer
- A small bar code reader for scanning UPC codes of inventory to be sold via Amazon.com
- Software to add a "real-time scrolling ticker tape" of Amazon.com-based data to a Web site
- Software that links Amazon.com's music offerings to radio play lists so that listeners can buy a song when they hear it

Amazon.com takes the risk of not controlling how others use its information, but in return, others are creating gadgets, links, services, and software that Amazon.com could not build itself, increasing the value of its site to consumers. Amazon.com is using its data to create an online ecosystem of businesses and services that rely on its marketplace and the vast amount of data it collects. In so doing, Amazon.com seeks to transform itself from a retailer into an e-commerce platform where "buy" buttons on many, many Web sites take buyers to Amazon.com. Furthermore, Amazon.com now handles content hosting and order fulfillment for many retailers, large and small. In short, it is using Web services to rejuvenate its data, giving it a strategic role via XML. ■

Rearchitect the System

In fixing up a house, rearchitecting is akin to rethinking the use of its space by perhaps gutting a major portion of a house and remodeling it by combining the kitchen, dining room, and family room into a great room. In IT, the step beyond rejuvenating a system is the newest option—rearchitecting it. This option involves having a to-be architecture for new systems, and then using that architecture to upgrade legacy systems. As noted in Chapter 5, due to the increasing complexity of enterprise systems, the advent of inter-enterprise systems, and the dependence of interlinked systems in supply chains, CTOs are devising enterprise IT architectures. In the past, IT architectures were not seen as necessary. They now are seen as mandatory because they show how systems are interconnected. Where possible, CTOs work hard to migrate their enterprise to that desired- to-be architecture, generally one system at a time. Following is the example of Toyota Motor Sales. As Roger Woolfe and Marcus Blosch[11]a of Gartner EXP point out, a main use of Toyota's IT architecture is to remediate legacy systems.

CASE EXAMPLE

TOYOTA MOTOR SALES

www.toyota.com

Toyota Motor Sales, headquartered in Torrance, California, handles U.S. sales of Toyota and Lexus vehicles for its parent, Toyota, in Japan. In 1998, Barbra Cooper

(*Case Continued*)

became CIO and found no IT architecture, no development methodology, no application integration, and no standards. Each part of the business had its own applications, information, and technical architectures. Cooper thus formed an architecture group, drawing from her applications group, headed by her most senior technology manager and reporting directly to her.

The Business Environment

One of the dilemmas Karen Nocket, chief architect, faced as head of the new group was the shrinking business cycle. In the 1970s and 1980s, Toyota's business cycle was five to seven years, thus its IT cycle time could be three years. In the 1990s, though, Toyota's business cycle time plummeted to 9 to 12 months, so IT's had to shrink likewise, to 6 to 9 months. For 2002 to 2010, Nocket sees the business cycle time shrinking to three to six months, so IT's plans must be one to three months. "How do you optimize 3-month plans into an IT plan?" she asks.

Nocket notes that competitors are addressing the shortened business cycle and other changes in the business environment by emphasizing online sales, moving to shorter delivery times, letting customers configure their own vehicles, and moving toward a "no hassle" sales experience.

Another issue facing the architecture group was IT's approach to building systems the old-fashioned way: supporting silos (sales and marketing, parts, accessories, warranty, HR, finance, and so on). Costs were higher because functions were duplicated in numerous systems rather than drawing from common systems.

Creating an Architecture

Nocket's group chose six initial projects: create a first iteration of an enterprise IT architecture, review it, then review development tools, look for infrastructure patterns, create an e-commerce architecture, and work on security.

In creating the first iteration, the architecture team quickly discovered that Toyota's most immediate need was a standard, integrated application development environment so that all systems would be developed using the same methodology. Nocket's team chose a methodology that includes tools as well as a development process. The process gives Toyota a way to move from business requirements to IT standards and strategies. This link is important because it helps business folks understand how IT supports them and why an enterprise architecture is important to them.

The architecture group then developed a global reference architecture. This architecture defines the current goal: Toyota's to-be IT architecture. It consists of enterprise services and products that support five tiers of services:

1. Presentation services: user interface, Web servers
2. Application services: logic specific to a business unit
3. Business services: reusable enterprise components
4. Integration services: access to legacy data sources; mapping to a common XML structure
5. Resource services: data resource managers, relational DBMS?

To develop this to-be architecture, Nocket used her budget to have her group

(*Case Continued*)

describe the as-is architecture of Toyota's six largest systems. From these six, the group defined Toyota's as-is enterprise architecture. From it, they defined the global to-be architecture.

Nocket and her group have also carefully defined their focus (they do not build systems), understood the true business benefits of having an architecture (discussed later), and promulgated an architecture-first approach to developing systems.

Nocket has learned that a key to success in IT architecture is having a domain architect for each domain to create the plans to migrate their domain to the to-be architecture and then see that everyone follows the plans. "Having domain architects assigns accountability to a single leader," says Nocket. However, having only technical people on the architecture staff has not fully gotten the message out, so she recently hired a project manager whose job is to foster communication among the numerous parties in a project. "He's our communication link to the world. He brings people together," she says.

Benefits of the Architecture

Through the development and use of the architecture, Nocket and her group have come to understand that the architecture can bring the following kinds of value to Toyota.

Rearchitect Legacy Systems. Both the as-is and to-be architectures have proven valuable in remediating legacy systems. Using a system's as-is architecture, Nocket's group can give business units alternatives to totally replacing a system. Her architects can show, for instance, how the user interface tier is separate from the data and application tiers. Pieces of code can be remediated, for example, by being rewritten in Java, to migrate the legacy system toward the new architecture, leaving the rest of the system as is. One business unit recently accepted this approach to upgrading a major legacy system. The architects are now detailing the as-is architecture to determine which code needs to be replaced. They will then write it to fit the new architecture.

Keep System Designs Robust. Using the new architecture-first approach to building systems, integration between the new system and other systems must be demonstrated in the design stage (rather than uncovered in the final system-integration stage). The new approach forces design breaks in the design phase, where errors can be fixed by redesign. When such errors are not caught until system integration testing, after the system has been built, the only solution is patching, which often destroys the system's original design. The architecture-first approach thus results in a much more coherent and maintainable design, and the architecture risk areas are addressed first, which is the only way to keep an architecture relevant.

Deliver Applications Faster. In understanding the patterns of applications to create the architecture, Nocket and her group are using the patterns to develop new applications much faster because they have turned silo infrastructure elements into services that can be reused. The global reference architecture thus addresses a major business pain point—applications not being delivered fast enough—thereby demonstrating the architecture group's value to both business folks and to IT project teams. To shift to a new

(*Case Continued*)

development approach, the architecture-first approach, both groups must see the value of an architecture. That value has been devilishly difficult to demonstrate in most companies.

Permit Future Flexibility. Nocket's group has successfully architected Toyota's three e-commerce Web sites—Toyota.com, Lexus.com, and Financial.com—using the "UNIX pattern" in its new architecture. Because the three sites share the same infrastructure, Toyota can easily bring the one hosted outside back in-house, if desired. Furthermore, the company will be able to more easily integrate other systems in the future; for instance, allowing vehicle owners to manage their own vehicle warranty from the Web site.

More recently, IT architects from the three Toyota regions (Europe, North America, and Asia) have worked together to develop a second iteration of the architecture as well as review, as a group, the architecture of two Japanese applications. Nocket believes that the move to standardization and architecture on a global basis, which these two recent efforts demonstrate, will give Toyota a real competitive advantage. ■

Replace with a Package or Service

In fixing up a house, replacement with a package or a service is akin to realizing that the house no longer works for you, so you move to another house. In IT, many old systems built in-house have been replaced by a package developed by a third party. In fact, this alternative has become the norm. One widely chosen use has been to replace many old and disjointed applications with one corporatewide system, such as SAP or a smaller commercial off-the-shelf (COTS) product. The other popular option is to distribute an application's workload among a host computer, some servers, and many PCs and laptops. An increasing number of commercial packages permit such three-tiered processing. These packages not only support communication among the three types of machines, but they also split the processing job and facilitate downloading and uploading of files.

Another reason to consider replacing an old system with a commercial package is that packages are becoming more versatile. Many offer selectable features that allow purchasers to tailor the package to their work style. The options can be turned on or off using control files, so no programming is necessary. Even end users can specify some of the operating instructions. Even so, replacing one or more applications with a package is not a trivial task, especially for large systems. Just ask people who have installed an ERP system.

Another option, one being touted as "the future," is to replace a system with a service delivered over the Internet. Now that software vendors have a ubiquitous delivery mechanism—the Internet—they can sell a per-seat, per-month service in place of leasing a package. Companies may reap several benefits from choosing this option. One, the software will be available quickly. Two, the cost can be expensed rather than be a capital expenditure. Three, the software is run and maintained by the vendor.

Four, it is centralized in that it is handled by the vendor, but it is distributed in that it can be accessed from anywhere. Companies are even considering creating corporate portals where commonly used software is accessed via the Web rather than housed on PCs. That software can be located anywhere. The promise of Web services fits in to this replacement option. As an example of replacing a system with a service, consider what Wachovia did.

CASE EXAMPLE

WACHOVIA

www.wachovia.com

Wachovia is a large U.S. bank with headquarters in Charlotte, North Carolina.[12] Its capital management group was growing so fast a few years ago that it outgrew Wachovia's contact management system, which had been written in-house when the sales team was one-third the size.

The system was used by the sales reps to support existing clients and identify and pursue new prospects. But the original programmers had left the bank, so the system was being maintained by consultants. The system did not work with newer bank systems, and it was so inflexible that it did not support the bank's newer sales processes. Furthermore, no one could ensure that remote entries actually updated the database, so the data were not seen as reliable. As a result, the sales force only used the system to record basic customer information once they closed a sale. They used their PDAs and other means—not the system—to keep track of prospects. Hence, the system did not give management the data needed to forecast sales or spot trends that could be useful in setting bank strategy.

Management decided to replace the contact management system with a full CRM system with a central repository of real-time data so that the sales reps could manage all their customer dealings online. Management looked at various CRM packages, but found them to be very expensive and time-consuming to implement. At the time, the national sales director happened to see an article in a business magazine about Salesforce.com, which offers a Web-based, pay-by-use CRM system. The director realized that the money he was spending on consultants to keep the old system barely alive would almost cover his use of Salesforce.com. So he opted for it. The system was installed in six weeks, which included customizing the service to Wachovia's processes and training all the employees who would use it.

Using the system, the sales reps have at least 30 more hours a month to spend on selling—time they used to spend on administrative work. The system also gives management the data it needs to identify the most valuable clients and its own highest yielding work.

The sales director uses Salesforce.com to coach his salespeople. He reviews their notes about their sales calls to see whether they are using the right approach and following up using the correct strategy. He coaches them on how to improve their

(*Case Continued*)

approach. And when potential clients have a wide geographic spread, the sales reps can now collaborate on their sales calls. Formerly, they were not able to see who was selling what to whom. Now, they can collaborate and present more valuable combined offerings to their potential clients. ■

Rewrite the System

In fixing up a house, rewriting is akin to realizing the house no longer is appropriate for the family but the location is perfect, so the house is demolished and rebuilt with a new one. In IT, in some cases, a legacy system is too far gone to rescue. If the code is convoluted and patched, if the technology is antiquated, and if the design is poor, it may be necessary to start from scratch. Today, few companies write new applications from scratch. It is just too time consuming and too expensive. Rewriting a system now means system integration; that is, finding packages that do pieces of the work and then using middleware tools to link them together.

Whether a system is new or a replacement, or anything in between, the question that is always asked is, "What is this system worth to us?" It is a question all executives need to be able to answer because investment in IT has become such a large part of corporate expenditures.

MEASURING SYSTEMS BENEFITS

Measuring the value of information systems is a continuing request. Never mind that the Internet has changed the world or that e-commerce and e-business are impossible without computers. Executives want specific links between new systems and corporate financial measures, such as increases in revenue, stockholder value, or earnings. Achieving this link is devilishly difficult because IT is only one of the factors contributing to successful use of systems.

The value of decision support systems and data warehouses, for example, is difficult to measure because they are intended to change such unmeasurable actions as improved decisions, better identification of opportunities, more thorough analysis, and enhanced communication among people. E-commerce systems, which aim to improve a firm's competitive edge or protect its market share, also elude measurement. It makes no sense to determine their return on investment (ROI) in terms of hours saved when their intent is to increase revenue or help the firm enter a new market. Finally, infrastructure investments upon which future applications will be built cannot be justified on ROI because they have none. Only the subsequent applications will show a ROI, which has caused the measurement conundrum.

In *Uncovering the Information Technology Payoffs*,[13] Walter Carlson offers the following three suggestions, as well as numerous others, on how to deal with these measurement dilemmas.

1. Distinguish between the different roles of systems.
2. Measure what is important to management.
3. Assess investments across organizational levels.

Distinguish Between the Different Roles of Systems

Paul Berger,[14] a management consultant, believes that companies can measure the value of IT investments by using many of the management measures now in place. Information systems can play three roles in a company, Berger told Carlson.

1. They can help other departments do their job better. Berger calls these "support systems." Their goal is to increase organizational efficiency.
2. IS can carry out a business strategy. Examples are CAD systems that customers and suppliers can use together to design custom products. Web-based systems and other such strategic systems need to be measured differently from support systems because they are used directly by customers, suppliers, and clients; support systems are not.
3. Systems can be sold as a product or service or as the basis for a product or service. Many Web-based information services fall into this category.

The benefits of these three kinds of systems are measured in different ways.

Measuring Organizational Performance

Organizational performance has to do with meeting deadlines and milestones, operating within budget, and doing quality work. Performance measures the efficiency of operations.

A number of years ago, Berger worked on developing a large HR system with decision support capabilities and then tracking its benefits. To measure the value of the system, the development team compared the productivity of people who used it to the productivity of people who did not. Data were collected on the cost of operating the system and the total costs of running the HR departments.

Operating costs did not rise as fast in the HR department where the system was used, the team found. By the fifth year, the using department had a cost of $103 per work unit (up from $82), whereas the nonusing department's cost was $128 per work unit (also up from $82). During those five years, the unit costs in the department using the system rose about 25 percent; the nonusing department's costs rose more than 56 percent.

Measuring Business Value

Measuring business unit performance deals with internal operational goals, whereas measuring business value deals with marketplace goals. Systems that are part of a business plan can be measured by their contribution to the success or failure of that plan. However, for systems to be measured on their business value, they must have a direct impact on the company's relationships with its customers, clients, or suppliers, says Berger.

Berger's HR system was measured on departmental performance. It could not be measured on business value because its effect on the corporate bottom line was indirect. No direct link to increased revenue could be identified. This distinction is important in measuring the value of IT investments.

In another firm, several information systems were developed to help marketing people analyze their customer base, both current and potential customers. The goal was to improve the quality of their customer base so that sales per customer would increase, while, at the same time, decreasing sales and promotion costs.

After implementing the systems, advertising and customer service costs did decrease. The company also experienced higher customer retention and lower direct sales costs compared to industry standards. By being able to equate the particular information system expenditures to marketing, they could identify a direct correlation between system costs and sales revenue. They could measure business value. The information systems affected their sales directly through the marketing decisions the system supported, thus the value of the investment could be stated in business terms.

Measuring a Product or Service

An information system can be offered as a product or service or it can contribute to a product or service intended to produce revenue. In these cases, its value is measured as is any other business venture, by its performance in the market. The measures are typical business profitability measures, such as ROI, return on assets, and return on equity.

Measure What Is Important to Management

Charles Gold,[15] an IT consultant, recommends measuring what management thinks is important. Information systems support can only be linked to corporate effectiveness by finding all the indicators management uses, besides the traditional financial ones. Relating proposed benefits to these indicators can make it easier to sell a system at both the individual and aggregate levels.

Gold suggests trying to assess benefits in terms of customer relations, employee morale, and cycle time or how long it takes to accomplish a complete assignment. Each measure goes beyond monetary terms, which few executives deny are vital to a company's success. He gave Carlson two examples.

As a measure of customer satisfaction, one power company kept a log of how many complaint letters customers sent to the Public Utilities Commission each month; this commission regulates the utility companies within its state. The power company installed a computer system for its customer service representatives, giving them online access to the information they needed to answer customers' questions. When the system was in operation, the number of complaint letters decreased; when the system was down, the number of letters increased. Thus, one aspect of the effectiveness of this system was measurable in terms of public opinion.

A second possible measure is cycle time. Faster cycle times can mean much more than saving hours. It can mean higher-quality products, beating competitors to market, winning a bid, and so on. The benefit may have nothing to do with saving money. Rather, it may focus on making money.

So, concentrating only on cost and monetary measures may be shortsighted. Other measures can be even more important to management.

Shenhar and Dvir[16] emphasize the necessity of balancing risks and benefits. They suggest that any organization should consider at least the five following metrics:

- Project efficiency: meeting time and budget targets
- Impact on the customers: meeting requirements and providing customers satisfaction, benefits, and loyalty

- Impact on the development team: job satisfaction, retention, and personal growth
- Business results: return on investment, market share, and growth
- Preparation for the future: new technologies, new markets, and new capabilities

Assess Investments Across Organizational Levels

Kathleen Curley, at Lotus Development Corporation and John Henderson, at Boston University,[17] recommend measuring IT benefits at several organizational levels. They developed the Value Assessment Framework to do just that.

The Value Assessment Framework

Potential benefits of IT investments differ at various organizational levels. Curley and Henderson believe that companies need a systematic way to separate these benefits by organizational level. They see three organizational levels, or sources of value, as benefiting from IT investments: the individual, the division, and the corporation. Furthermore, the impact focus of an IT investment extends beyond business performance measures to encompass three dimensions:

1. Economic performance payoffs (market measures of performance)
2. Organizational processes impacts (measures of process change)
3. Technology impacts (impacts on key functionality)

Combining the two views creates a 3×3 matrix that can be used to systematically assess the impact of a potential IT investment in nine areas. This framework was used by a trucking company, and its use uncovered benefits that otherwise would have gone unrealized.

CASE EXAMPLE

A TRUCKING COMPANY

A medium-size company in the refrigerated carrier business has been around since the 1920s. When the Motor Carrier Act deregulated trucking companies, competition increased. Midsize truckers like this one were hit the hardest. Even though it had been one of the top five refrigeration trucking firms, its share of shipped tons fell to less than one-half the former level because national and regional carriers took away its business. In response to the crisis, management made two decisions: First, they would manage the company by information, transforming company procedures and tracking success via a large suite of measures. Second, management would use IT to differentiate the firm from other refrigeration trucking firms, initially with a $10-million investment in a state-of-the-art satellite system and a computer in every truck cab so that drivers could be in constant voice and data communication with the company and customers.

The results were remarkable. Tons shipped increased from 300,000 tons to

(*Case Continued*)

1,100,000 tons, and the trucker became an industry leader in the innovative manipulation of information. It introduced groundbreaking information services that provided superior levels of customer service.

Their Measurement Program

On the measurement front, the company developed world-class goals for each of its three mission statement objectives:

Our mission is to exceed the expectations of our customers, earn a return on investment that is the best in the industry, and provide our employees an opportunity to attain fulfillment through participation.

Overall performance was measured in three ways:

1. Customer satisfaction—determined by "moment of truth" questionnaires filled out by customers to rate the company's service performance
2. Return on investment—measured by an operating ratio
3. Employee satisfaction—from questionnaires that captured employee sentiments and charted them on an index

The company established interim performance improvement goals for the company as a whole and for each department to be achieved by specific dates. These interim measures were to see how fast and how well it was progressing toward its world-class goals. As performance improved, the goals were raised so that performance improvement was built into its measurement system.

After studying its measurement and tracking processes, Curley said, "They have one of the most detailed sets of measures I have ever seen."

Measuring the Value of the Satellite System

Following IBM Consulting's recommendation, the trucker used the Curley and Henderson Value Management Framework to evaluate the satellite investment after-the-fact, with eye-opening results. The trucker began by identifying the specific process improvements made possible by the system, entering them into the framework along with an outcome and outcome measure for each one.

- At the individual level, the company estimated that improved communications from the truck cab would increase driver production time by one-half hour a day. The result: a savings of $59.60 a month per driver.
- At the work group level, it estimated that improved truck-to-load or vice versa matching would save 1 percent deadhead time: a $49.68 savings per month per truck.
- At the business unit level, it estimated that improved customer service would increase market share, but it could not pin down a dollar amount for this increase.

Once these figures were calculated, a manager was assigned to assess the savings targets, allowing the company to evaluate whether it was realistically estimating the investment. It intended to manage the value it was receiving from its investment, not just make the investment and hope it paid off.

The most interesting piece of the Value Management Framework analysis, Curley said, was not the identifiable cost savings, but the large, unexpected revenue benefits. Due to the analysis, management discovered that customers were willing to

(*Case Continued*)

pay a premium price for the ability to call a truck driver directly from their warehouse. Constant communication with drivers was worth a lot—much more than management thought. This discovery gave management even more confidence in their decision to bet on technology and in their ability to sell information-based services. Due to the sophisticated and ingrained measurement system, management was even able to see the effect of pricing on market share. ■

Do Investors Value IT Investments?

An even more intriguing question than how business executives value IT investments is how investors value IT investments. As reported in the recent Gartner EXP report *Getting Shareholder Credit for IT,* by Andrew Rowsell-Jones and Marcus Blosch,[11b] three researchers recently performed a study to see whether or not a company's stock market valuation correlated with the size of its computer investments and with its organizational practices. Their results show that investors do indeed value IT investments.

Erik Brynjolfsson of MIT's Sloan School of Management, Lorin Hitt of University of Pennsylvania's Wharton School, and Shinkyu Yang of New York University's Stern School[18] found that every $1 of "installed computer capital" yielded up to $17 in stock market value, and no less than $5. Whereas, $1 in property, plant, and equipment (book value) only yielded $1 in stock market value; and $1 in other assets (inventory, liquid assets, and accounts receivables) yielded only 70 cents.

The researchers reason that investors value $1 spent on "installed computer capital" more than the other investments because it leads to organizational changes that create $16 worth of "intangible assets"—know-how, skills, organizational structures, and such.

To reach these conclusions, the three researchers compared eight years' worth of stock market data for Fortune 1000 companies between 1987 and 1994 (importantly, before the dot-com bubble) with these firms' IT investments and organizational practices (from studies in 1995 and 1996). They were able to correlate all three kinds of data for 250 companies, with a total of 1,707 observations.

They found that variations between companies were more important than variations over time in the same company. Firm-specific factors accounted for most of the firms' higher market values.

Past IT investments correlated with higher current market value, but not vice versa. The reasoning is that firms continue to build up complementary intangible assets from these IT investments, say Brynjolfsson, Hitt, and Shinkyu; investors value these additional assets.

Earlier research by Brynjolfsson and Hitt showed that four organizational factors correlate to and complement IT investments: (1) use of teams and related incentives, (2) individual decision-making authority, (3) investments in skills and education, and (4) team-based initiatives. They found that firms making the highest IT investments not only invest in the information systems but also invest in making organizational changes to complement the new systems.

These investments in "organizational capital" generally lead to the adoption of decentralized work practices. The firms (1) use teams more often, (2) give employees broader decision-making authority, and (3) offer more employee training, no matter the size or industry of the firm.

In the latest study, the three researchers found that firms with these three decentralized work practices had a market value 8 percent higher than the mean. They state, "Investors appear to treat organizational capital much like more tangible types of capital by recognizing its contribution to the market value of a firm."

Furthermore, the researchers found that the companies with the highest market valuations, in fact, disproportionately higher than their Fortune 1000 peers, had both the largest IT investments and decentralized work practices. Investors drove up their stock price more than firms with smaller IT spending and centralized work practices.

They conclude that the market value of investing in IT is "substantially higher" in firms that use these decentralized practices because each dollar of IT investment is associated with more intangible assets because the IT investments complement the work practices. Centralized, low-skill firms do not reap as much increase in intangible assets from their IT investments as team-oriented, highly skilled, decentralized-responsibility firms.

Investors apparently sense that investments in training, organizational structures, and work practices create new assets. Even if intangible, these assets will contribute to higher firm performance in the future, hence higher stock prices today. Yet investors cannot see these intangible assets directly; they can only surmise them through "installed computer capital," hence the link between IT investments and stock price.

CONCLUSION

Managing projects has always been one of the most important, and toughest, jobs in the IS organization. Even with outsourcing and software packages, project management belongs in-house because responsibility for project success remains in-house. In fact, project management skills have grown more important because of the complexity of integrating systems and the need to assess who does and does not support the project, to turn nonsupporters into supporters, and to guide the organization in making the needed changes in business processes and work. As shown in this chapter, managing a project requires a plethora of skills. This is one reason CIOs are now emphasizing project management skills in their staffs.

Most software is devilishly difficult to keep up to date. As a result, at some point in time, management needs to decide what to do with aging software. Among the various options, the most common these days is to replace it with a package. One new alternative is to rearchitect the system to move the company toward a desired architecture. Another new option is to rent the software from a vendor on a per-seat, per-month basis over the Web. Some contend this option is the wave of the future.

Finally, the question continually asked about applications is, "What is it worth to us?" Because IT is not the only contributor to corporate operational improvements, a direct link can be difficult to establish. However, the process of justifying a new system can uncover what is important to management, and measuring benefits afterward can help companies spot benefits they had not originally planned. Furthermore, even though investors cannot see how well or poorly public companies invest in IT, they do more highly value companies with higher IT investments and more distributed work practices. Thus, the value-of-IT question is gradually being answered.

QUESTIONS AND EXERCISES

Review Questions

1. What three businesses is the IS department in, using Hagel and Singer's framework?
2. According to the Project Management Institute, what are the nine areas of knowledge a project manager needs to know well to successfully manage a project?
3. What are the six things a project manager needs to do, according to Anderson and Matthew?
4. When Cone is interviewing people, what three things does he keep an ear open for?
5. Describe three tools in Cone's project manager's toolbox.
6. Describe the three types of people involved in a change project, according to ODR.
7. How did the BOC Group involve middle management?
8. Describe the decision tree that Gibson uses to assess the business risk of a project.
9. Which does the Boston Consulting Group recommend, replacing or upgrading a legacy system?
10. List the seven ways to improve a legacy system.
11. How is Amazon.com promoting third-party Web Services offerings that relate to Amazon.com's Web site?
12. What four benefits does IT architecture bring to Toyota Motor Sales?
13. How does Wachovia benefit by replacing a system with a service?
14. What are the three roles of systems, according to Berger?
15. What benefits did the trucking company realize at the individual, group, and business levels?
16. What three decentralized work practices were found at companies with higher market valuation in research by Brynjolfsson, Hitt, and Yang?

Discussion Questions

1. IS staffing should become easier as more people gain experience in e-business or move from failed dot-coms. Do you agree or disagree? Discuss.
2. If companies are moving toward providing corporate portals and Web Services where software is rented from a third party over the Internet, IS departments can get out of the application development business. Do you agree or disagree? Discuss.
3. The strategy of minimum maintenance until a system must be completely redone is still best for challenging and developing the programmer/analyst staff. The few people that like nitty-gritty maintenance activities can take care of the programs that need it, while the majority of the development staff can be challenged by the creativity of new development. The seven options turn most developers into maintenance programmers. Do you agree or disagree? Discuss.
4. Management has no way to estimate the benefit of a system that is intended to generate new revenue, so it must build the system on faith, not estimates. Do you agree or disagree? Discuss.

Exercises

1. In April 2004, Cone's content management project had issued an RFP and was waiting for proposals to arrive. Please visit his blog at blogs.ittoolbox.com/pm/implementation and answer the following four questions: (1) What has happened since then on that project? (2) What problems did Cone encounter? (3) How did he solve them? (4) What did you learn from this blog?
2. Find three articles on IS departments that have established a project management office (PMO). Why did they establish a PMO? How is each staffed? What benefits did the PMO generate? What did you find most interesting about the PMOs?
3. Find a company in your community with more than 20 years' experience using computer systems. Develop a descriptive case study for that company showing how it deals with its legacy systems. Include an inventory of major systems and the company's strategies for maintenance and modernization. How does the company decide which applications to upgrade and which approaches to use? Explain how top management and line management get involved in application portfolio decisions. If they do not, why not?
4. Use the Gibson decision tree to assess the business risks of a project you are involved in or know a great deal about. Present your assessment to the class. What are the three main risk factors in the project? Describe which ones support success and which do not. Based on his decision tree, which project management approach should you use? What have you learned from this analysis?

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CHAPTER

11

MANAGING INFORMATION SECURITY

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INTRODUCTION

This chapter is dedicated to one of the biggest challenges in IT management—managing information security. We live in an unprecedented era in which organizations are dependent on Internet-based technology to accomplish their business missions. Consequently, issues related to IT security have increased significantly in complexity and the potential harm caused by malicious attacks could just bring the entire organization to a halt. Management must overcome a number of technological, business, and legal issues to effectively deal with never-ending information security threats.

The overarching goal of information security is to ensure data integrity, availability, and confidentiality. Data should be entered in the system in a secure and accurate manner, and cannot be modified without authorization. Also, they should be made available only to authorized users whenever and wherever they need it. Therefore, managing security refers to a comprehensive set of activities that develop, implement, direct, and monitor the organization's security strategy and activities.[1] The core challenge of security management is how to find the right balance between shielding the organization's main assets and processes from potential harm, and enabling them to do their jobs.

Prior to reading this chapter, we suggest that the reader review the risk management principles and techniques discussed in Chapter 10. These concepts are useful to our discussion on how today's organizations are approaching information security.

INFORMATION SECURITY

Information security used to be an arcane, technical topic, but today even CEOs are concerned about it due to the importance of IT in running their businesses. All business executives now need to understand Internet-based threats and countermeasures and continually fund security work to protect their businesses.

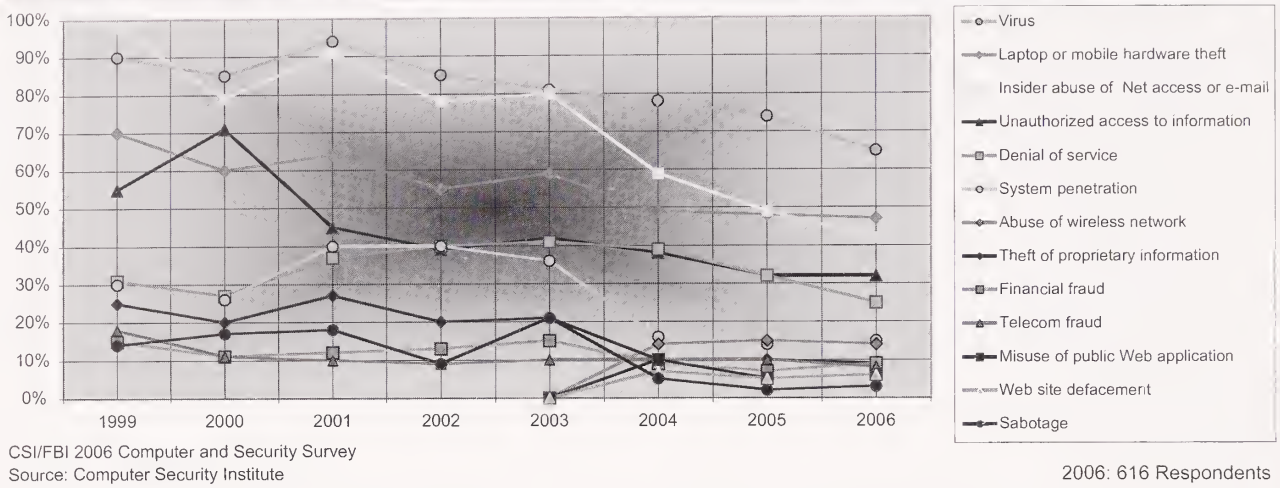
As one security officer told us:

> *If I were an e-tailer, I might not call the Internet a bad neighborhood, but I would certainly "watch my back." My equivalent brick-and-mortar store would have automatic locks on the doors, cameras watching every aisle, and only $20 in the safe, because I would never know what kinds of thieves might show up or what kinds of attacks they might launch—from anywhere in the world. Furthermore, as an e-tailer, I would need more security than a brick-and-mortar store manager because customers can get a lot closer to the guts of my business.*

The Threats

Perhaps one of the most talked about security incidents in 2007 was the Skype Trojan Horse that froze Skype's entire network of servers, depriving millions of users from temporary access to the popular VoiP provider massive electronic system. McAfee Labs reports that, as of June 2007, there were more than 217,000 types of known security threats, not to mention those that are yet to be discovered by cybercrime prevention specialists. With the convergence of computer and communication technologies, security risks grow even greater. To take advantage of the explosive demand for social computing (such as instant messaging, video sharing, etc.), mobile viruses become more prevalent. Since 1996, the Computer Security Institute and the San Francisco Federal Bureau of Investigation Computer Intrusion Squad[1] have conducted an annual survey of U.S. security managers to uncover the types of computer crimes committed, the countermeasures being taken, and other aspects of cybercrimes.

FIGURE 11-1 Types of Attacks or Misuse Detected in the Last 12 Months By Percent of Respondents



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The 2004 CSI/FBI survey report[1a] contains responses from 494 computer security practitioners from a wide range of enterprises—government and private industry and from those with fewer than 99 employees to those with over 50,000 employees. Two of the report's key findings relate to threats: the unauthorized use of computers is declining, and the most expensive cybercrime was denial of service.

This good news is unfortunately short-lived. The 2006 CSI/FBI raises a new level of alert. Figure 11-1 reports the types of attacks or misuse detected from 1999 to 2006. In addition to the already known array of perils related to e-mail attachments—such as viruses, worms, spyware, spams—, wireless and VoIP applications introduce new security threats. In 2007, Symantec (symantec.com) released its eleventh Internet Security Threat Report. It reported more than 6 million bot-infected computers worldwide during the second half of 2006, representing a 29 percent increase from the previous period. As discussed more in detail later, the article noted an increase in data breaches. Just to emphasize the severity of security threat, Symantec also observed a rise in sophisticated spam and online fraud schemes, with high levels of coordinated attacks combining spam, malicious code, and online fraud.

Data Thefts: The Biggest Worry and Insider Threats

Simply stated, a data theft occurs when information is illegally copied or taken from a business or an individual. Passwords, social security numbers, credit card and bank information, and other personal information are often reported in the local media. The Credit Card case example offers a typical situation. It also provides a few tips to deal with this type of fraud.

With the proliferation of terabytes of data, data thefts have become one of the top security concerns, across all organizations, large or small, private or public. When stolen data are used to steal people's identities, the potential harm is enormous, with major economic and legal implications. The worst thing about the data theft is that they can remain undetected.

The complexity and impacts of data thefts are such that, despite the billions of dollars spent on information security products, a survey released by *InformationWeek* (informationweek.com) and Accenture in July 2007 indicated that 89 percent of the 1,010 U.S. companies still felt vulnerable. Dealing with computer hackers is like playing cat and mouse. On the one hand, security technologies are getting better (for example, vein-viewing technology in biometrics to replace signatures, keys, and passwords). On the other hand, threats are getting more sophisticated (for example, SQL injection, botnets), while the Internet-enabled architecture and wireless applications offer more opportunities for attacks, and hackers are more creative in their malicious acts.

However, confidential corporate information is becoming a much-sought-after target for hackers, and the damage of stolen data could be far-reaching. *InformationWeek.com* (July 2007) reported the case of a former employee of Boeing who illegally downloaded 320,000 pages of sensitive business documents to his home computer. Boeing estimated that if some of these documents had gotten into the hands of its competitors, it could have cost the industrial giant $5 to $14 billion.

The issue of insider threat is quite a challenge. According to Greenemeier,[2] criminals inside the organization are not the most common security problem. However, attacks by insiders can be among the most expensive and most damaging to the organization's reputation. An estimation by the Computer Security Institute (csi.com) suggests that losses caused by insider attacks account for between 20 and 80 percent of the entire organization's losses related to computer crimes.

Here are a few examples of possible criminal acts from an insider of a company:

- A computer staff illegally accesses employees' e-mails to steal information that could be used for malicious intent.
- An employee who is angry about the low bonus he receives brings down the entire company's computer system by deleting sensitive data records.
- A system administrator is not happy with his life and decides to change the code of legacy systems, creating bad data.
- A marketing salesperson steals sensitive data and sells them to a competitor.

As discussed later in this chapter, the IT security staff needs to work closely with other organizational units—in this case, the HR department, to deal with data security caused by personnel within the company. Most of the warning signs are not related to IT problems. Common profiles of an insider criminal may include: mental health disorders, personalities that conflict with authority, history of behavioral violations in the workplace, or personal financial problems.

We will discuss, however, a number of technology solutions that can help thwart insider attacks. These consist of limiting the level of authorized access to the employee's job responsibility, promoting the use of encryption, and enforcing the most stringent audit policy for mission-critical data.

Scope of Security Management

To maintain a safe computing environment, security must be applied to all possible areas that are exposed to security threats.

- ***Personnel security:*** The organization should have a policy that clearly identifies who has the authorization to enter, modify, and access data. Adequate checks, such as passwords, must be completed to grant role-based access to data. The risk here becomes increasingly important with the size of the users. Security checks on critical personnel are common in many large organizations.
- ***Application security:*** All mission-critical (software, hardware, firmware) applications are secure from unauthorized access. This includes all possible means, from password protection to secured physical vaults.
- ***Operating systems security:*** From personal laptops to highly distributed operating systems, major functions of the operating systems should be secured: memory management, access to I/O devices, file management, and hardware configuration. The IT staff should make available to all users a security guide for every operating system used in the organization. Guides includes steps to set and reset passwords, policy for file access authorization, and procedures to set certificates. A certificate is a mechanism to verify an identity on a computer system over a computer network. Most people only need a personal certificate for the secured system to recognize their ID entity and access privilege. When many restricted Web servers are involved, certification at the host/server level is required.
- ***Network security:*** Unauthorized viewing and tampering of networks is a much-sought-after target for hackers. Particular attention should be paid to communication devices that serve as a gateway to the organization's computing platform. Network bridges are simple devices that transparently connect two or more LANs. The bridges can also be used to enforce access restrictions, and localize where spoofing attacks can occur.
- ***Middleware and Web Services security:*** With the proliferation of open-source applications, middleware affords more possibilities for security breaches. A recent technology makes it possible to implement code-based access control. This technology allows authorized users to access data concurrently from numerous devices in a fast and secure manner. IT security staff should frequently review the middleware architectures and define a unified view of security across heterogeneous middleware systems, and provide a basis for decentralized policy for middleware security.
- ***Facility security:*** All physical rooms where information systems are installed should be fully protected with entry locks, security guards, and cameras. White-collar workers often leave their desktop computers unattended, and password information is left next to the computer. Local system administrators should be appointed to help with security.
- ***Egress security should be enforced:*** Policy for taking out sensitive documents should be clearly given to personnel. Sensitive data printed on paper should be stored in safes. Unused documents should be shredded. When sensitive equipment is sent out for maintenance or repair, proper security procedures must be enforced to ensure that the components are not modified without permission.

CASE EXAMPLE

CREDIT CARD FRAUD

A major problem is the theft of large numbers of credit card records. "Credit card fraud" is a broad term for theft and fraud by a criminal who uses someone else's credit card for unauthorized financial transactions.

A common credit card fraud is called "application fraud." The wrongdoer uses the stolen or fake documents to open an account in someone else's name, to build up information about this person for further malicious intent. Another type of credit card fraud is known as "account takeover." The criminal first gathers information about the target victim. He next contacts the victim's financial institutions to falsely report that the credit card was lost and requests a replacement. He then uses the real card for unauthorized consumption.

Here are two examples from the 2002 CSI/FBI report.[1b]

One Bug in a Software Package

In one case, MSNBC reported that a bug in one shopping cart software product used by 4,000 e-commerce sites exposed customer records at those sites. The FBI issued a public warning, but one small e-commerce site did not receive this warning message because it had bought the software through a reseller.

Within days, cybercriminals charged thousands of dollars on the credit cards of users of this small site, buying phone cards, gambling at gambling sites, and buying software off the Web. Instructions on taking advantage of the flaw circulated on the Internet underground, the URLs of other companies that did not obtain the patch were posted on chat rooms, and cybercriminals could even pick up the URLs using search engines.

Two Foreign Cybercriminals

The U.S. Department of Justice has a Web site that describes past cybercrimes. One involves two Russians who committed 20 crimes against two U.S. banks that offer online banking and a U.S. online credit card company. The two stole 56,000 credit card numbers, bank account information, and other personal financial information. Then they tried to extort money from the cardholders and the banks, threatening to publicize the sensitive information they had unearthed.

They also used the stolen credit card numbers to establish fake e-mail accounts, which they used to act as fake sellers and fake winning bidders on online auctions; they paid themselves using the stolen credit card numbers.

They gained access to this information by taking unauthorized control over many computers, including one belonging to a school district. They then used these compromised computers to commit their crimes. The Moscow computer crime unit worked with the FBI to apprehend these cybercriminals. It often takes such international cooperation to fight cybercrime. Power, from the Computer Security Institute 1b, notes that this one case is just an indication of what is happening.

Simple Steps to Protect Credit Cards

Fortunately, there are simple steps that can be taken to protect from credit card fraud:

1. Do not lend the card to someone else, or make it easy for people to have access to your card.
2. Do not write the PIN (Personal Identification Number) on the card.
3. Do not carry too many cards at the same time.
4. Write down telephone numbers of credit banks and keep them in a separate, safe, and handy place, and use them to report lost or stolen cards.
5. Immediately report lost or stolen cards.
6. Check your credit card receipts to make sure that the right amount is charged.
7. Check monthly statements carefully, or online statements regularly. Shred them.
8. Set automated notification via e-mail or mobile phone for large transactions. ■

An Array of Perils

In this section, we briefly describe a few most common approaches used by hackers. RSA Security Inc.,[3] a prominent network security firm, and the Security Division of EMC since June 2007, notes that it is easier to guard a bank vault than to guard every house in town. That is why many companies are outsourcing their data-center operations to data-center specialists with vault-like security.

Mobile computing and telecommuting also increase the possibility for cybercrime because the greater number of network openings provides more opportunities for illegal entry. E-commerce sites are also open to everyone, including hackers. And because the Internet does not have intrinsic security protocols, this public space is vulnerable.

In addition, the hacker community has become "a public club," says RSA, with hacker Web sites and newsgroups available to anyone who wants to learn hackers' tricks. Furthermore, hacker tools are becoming increasingly sophisticated and easier to use; and they are continually being revised to outsmart the countermeasures used by companies to protect themselves. It has become a cat-and-mouse game of continual one-upmanship. Securing an online business is not a one-shot deal; it requires constant vigilance.

RSA describes the following nine approaches hackers use:

1. ***Cracking the password:*** Guessing someone's password is easier than most people think, says RSA, because some people do not use passwords, others use the word "password," and still others use easy-to-remember words such as their child's name, a sports team, or a meaningful date. Hackers also use software that can test out all combinations, which is called "brute force" password detection.
2. ***Tricking someone:*** To get users to divulge their passwords, a con artist calls up an employee posing as a network administrator who needs the employee's password to solve an immediate (fictitious) network problem. It happens more than you think, says RSA.

3. ***Network sniffing:*** Hackers launch software that monitors all traffic looking for passwords or other valuable information. Because most network traffic is in clear text rather than encrypted (appearing as gibberish), sniffing can find information and write it to a file for later use.
4. ***Misusing administrative tools:*** Helpful tools can be turned against a network. For example, a well-known program written to uncover weak spots in a network, which is important for network administrators, has been used by hackers to find weak spots in target companies' networks. Interestingly, the program's name is Satan.
5. ***Playing middleman:*** Placing oneself between two communicating parties and either substituting one's own information in place of one of the parties' information or denying one party access to a session, such as denying a competitor access to an important online auction, is another common ploy.
6. ***Denial of service:*** This tactic floods a party, such as a Web site, with so much useless traffic that the site becomes overwhelmed and freezes. Legitimate messages are locked out, essentially shutting down the business for a period of time.
7. ***Trojan horse:*** A malicious program can be housed inside an innocent one or, worse yet, one that appears to be helpful.
8. ***Viruses or worms:*** These pieces of software run without permission. Their most common entry point has been as e-mail attachments. Once such an attachment is opened, the program is released and performs its task, such as destroying files (a worm) or replicating itself in e-mails sent to everyone in the e-mail directory. Internet-based viruses have attracted lots of attention, not just for PCs, but for wireless devices as well.
9. ***Spoofing:*** By masquerading as a legitimate IP address, hackers can gain access to a site. A site can masquerade as another Web site and redirect traffic to a fraudulent look-alike site that, for example, allows credit card information to be captured for later use.

Security's Five Pillars

To deal with this array of perils, setting up countermeasures for information security relies on five pillars that make up today's security techniques, according to RSA.[3]

1. ***Authentication:*** Verifying the authenticity of users
2. ***Identification:*** Identifying users to grant them appropriate access
3. ***Privacy:*** Protecting information from being seen
4. ***Integrity:*** Keeping information in its original form
5. ***Nonrepudiation:*** Preventing parties from denying actions they have taken

Authentication

Authentication means verifying someone's authenticity: They are who they say they are. People can authenticate themselves to a system in three basic ways: by something they know, something they have, and something they are. "Something they know" means "something only they know," generally a password or a mother's maiden name, for example. "Something they have" means "in your possession." In computer security, one possibility is a token that generates a code a user enters into the computer to gain access to, say, an e-mail system. Users just have to remember not to lose the token.

Or they may have a digital certificate, which will be discussed shortly. "Something they are" generally means a physical characteristic, such as a fingerprint, retinal scan, or voice print. These characteristics fall under the area called biometrics. Each type of user authentication has its strengths and weaknesses. RSA recommends choosing two of the three, which is called two-factor authentication.

Identification

Identification is the process of issuing and verifying access privileges, like being issued a driver's license. First, the user must show proof of identity to get a driver's license. Once the driver receives the license, it becomes the proof of identity, but it also states the driving privileges (able to drive an automobile but not a truck or a bus). Therefore, identification is like being certified to be able to do certain things.

In the Internet world, identification is moving toward application-level security; that is, authentication for each application. It requires users to sign on for each application, which many feel is a large burden. Some companies are taking a single sign-on approach. A more common trend now is to periodically check the identity of the users by asking additional personal questions (such as, in what city did you attend high school?) before letting the user enter the password.

Data Privacy and Data Integrity

These mean keeping information from being seen or disseminated without (privacy) or changed (integrity) prior consent. Both are especially important when information travels through the Internet because it is a public space where interception is more possible. The most common method of protecting data is encryption, to be discussed shortly.

Nonrepudiation

Nonrepudiation is a means of providing proof of data transmission or receipt so that the occurrence of a transaction cannot later be refused. Nonrepudiation services can prove that someone was the actual sender and the other the receiver; no imposter was involved on either side.

Technical Countermeasures

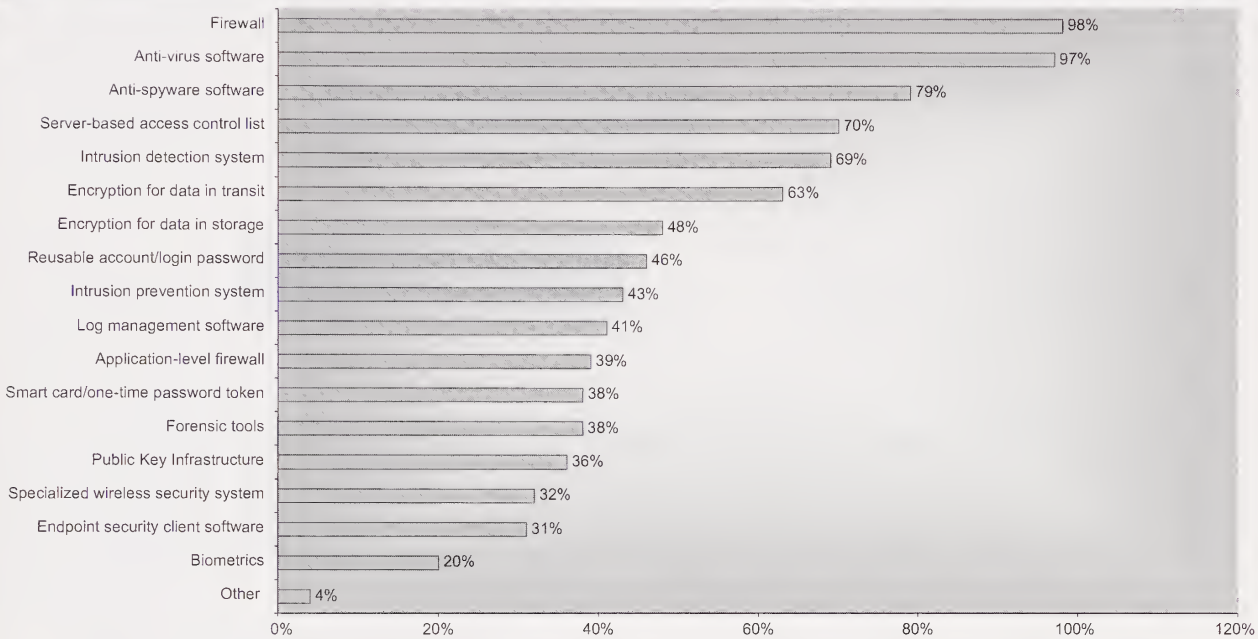
Figure 11-2 shows the types of security technologies used by the 616 security managers in the 2006 CSI/FBI survey. Some 98 percent used firewalls, 97 percent used antivirus software, and 79 percent used anti-spyware software.

To explain a bit more about countermeasures, following are three techniques used by companies to protect themselves: firewalls, encryption, and virtual private networks (VPNs).

Firewalls

To protect against hacking, companies install firewalls, which are hardware or software that controls access between networks. Firewalls are widely used to separate intranets and extranets from the Internet, giving only employees or authorized business partners access to the network. Typically implemented on a router, firewalls perform their job by filtering message packets to block illegal traffic, where "illegal" is defined by the security policy or by a proxy server, which acts as an intermediary server between, say, the Internet and the intranet. Proxy servers can look deeper into traffic than do packet filters, which just look at the header information on each packet. However, proxy servers

FIGURE 11-2 Security Technologies Used by Percent of Respondents



Source: Reprinted with permission of Computer Security Institute, 2006 CSI/FBI Computer Crime and Security Survey, Computer Security Institute, San Francisco, CA.

are slower than packet filters. Some products perform both. Without policy management, says RSA, firewalls may not be effective because they may just be treated as stand-alone devices. The most effective security programs create layers of security.

Encryption

To protect against sniffing, messages can be encrypted before being sent over the Internet. Two classes of encryption methods are in use today: secret key encryption and public key encryption. The most common secret key method is the Data Encryption Standard (DES) developed by IBM, the National Security Agency, and the National Bureau of Standards. Using this method, sender and receiver use the same key to code and decode a message. The level of security is a function of the size of the key. DES is widely used and available in many software applications.

The most common public key encryption method is RSA, named for the three developers: Rivest, Shamir, and Adleman. To send an encrypted message using RSA, two keys are necessary: a public key and a private key. As its name implies, the public key is known to many people and is not kept secret. However, the private key must be kept secret. The two keys are used to code and decode messages; a message coded with one can only be decoded with the other.

Figure 11-3 shows how an encrypted message is sent. First, the message is encrypted using the receiver's public key. The message is now secure—it can only be decoded using the receiver's private key, which is only known to the receiver. Note that the sender uses the receiver's public key, not a key belonging to the sender. If a secure message is to be sent back to the original sender, then the public key of the original sender would be used. Thus, for two-way secure communications, both parties must have a set of keys.

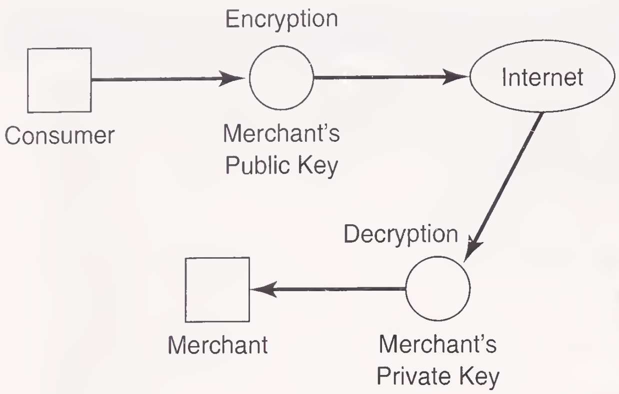


FIGURE 11-3 Sending an Encrypted Message

The RSA method is incorporated into all major Web browsers and is the basis for the Secure Socket Layer (SSL) used in Internet communications. However, full two-way secure communication requires all parties to have a public and private key. Most individuals do not have such keys, so most B2C applications requiring encryption, such as for the transmission of credit card numbers; these are only secure from the consumer to the merchant, not from the merchant to the consumer.

To protect against spoofing, firms need a way to authenticate the identity of an individual. This verification requires a form of digital ID. The most common form of digital signature uses the RSA encryption method. Because the private key is known only to one person and a message encrypted with that key can only be decoded with the matching public key, the private key provides a way of verifying that the message came from a certain individual. Figure 11-4 shows the basic process.

For digital signatures to work, though, a trusted third party must issue the keys to individuals and firms. These parties are called certification agencies and can be government agencies or trusted private companies. The agency issues a digital certificate containing the user's name, the user's public key, and the digital signature of the certification agency. See Figure 11-5. The digital certificate can then be attached to a message to verify the identity of the sender of the message.

Virtual Private Networks (VPNs)

Most offices now have a local ISP, so no matter where they are located in the world, the least costly way to create company-wide networking is to utilize the Internet and its TCP/IP protocols. However, the Internet is not secure because, for one thing, none of the TCP/IP protocols authenticate the communicating parties.

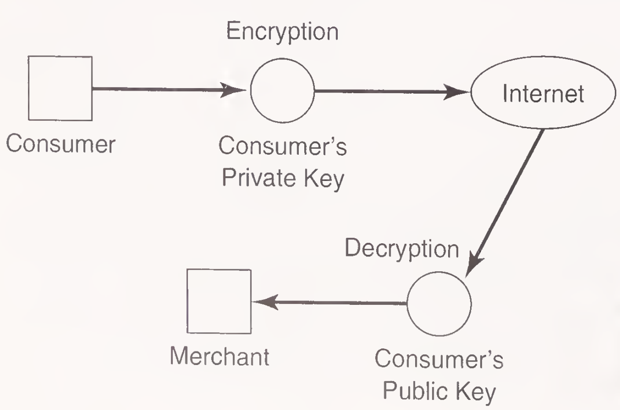


FIGURE 11-4 Sending a Digital Signature

User's name
User's public key
Digital signature of certificate issuer

FIGURE 11-5 A Digital Certificate

One approach to security has been to obtain a VPN from a CLEC or an ISP. A VPN runs over a private IP network, so it is more affordable than leased lines, and it is secure. VPNs use tunneling technology and encryption to keep data secure as they are transmitted.

Tunneling creates a temporary connection between a remote computer and the CLEC's or ISP's local data center, which blocks access to anyone trying to intercept messages sent over that link. Encryption scrambles the message before it is sent and then decodes it at the receiving end. While in transit, the message cannot be read or changed; hence, it is protected.

VPNs can be used in three ways:

1. ***Remote access VPNs*** give remote employees a way to access an enterprise's intranet securely by dialing a specific ISP, generally a large one with local telephone numbers in many cities. The ISP establishes a secure tunnel through its network to the corporate network, where the user can access e-mail and the intranet. This option offloads network management to the ISP, something most IS executives want to do.
2. ***Remote office VPNs*** give enterprises a way to create a secure private network with remote offices. The ISP's VPN equipment encrypts all transmissions.
3. ***Extranet VPNs*** give enterprises a way to conduct e-business with trading partners, advisers (such as legal firms), suppliers, alliance partners, and customers. These partners dial a specific ISP, which then establishes a secure link to the extranet.

Playing Cat and Mouse: Tools for Computer Security

With the increases in number and sophistication of computer attacks, the IT industry is also active in finding tools for computer users. The tools for computer security can be categorized in two ways:

- ***Hardware tools:*** These include locks, network cables with special coating to prevent cuts or interceptions, safes, and so on to physically secure the computer system.
- ***Software-driven tools:*** There are hundreds of kinds of software that are commercially available for organizations to implement into their existing computer environments. A proactive approach would be to install security scanners throughout the computer platform. The vulnerability scanner provides local and remote authentication. Another technology is called intrusion detection and packet sniffer. A packet sniffer analyzes the data traffic in a network. Through

protocol analysis, content searching, and various checkpoint routines, a typical intrusion detection system captures a packet of data from data streams being transported and analyzes its content. The sniffer searches for worms, looks for vulnerability points before the intruders find them, and scans all the network entry ports. To avoid slowing down the system performance with too much network monitoring, the IT staff can instruct the system how to monitor the organization's computing platform using policy-guided rules. A reactive approach is to use recovery tools after an attack is committed. A common tool is password crackers. These tools decode passwords that are scrambled by intruders or encrypt users' passwords for added security, record VoiP conversations, and analyze routing protocols.

The challenge for the organization is to keep up with the latest technologies that are available. The IT security staff needs to keep abreast of the latest developments and be able to understand the effectiveness of the new tools vis-à-vis the perceived threats to the organization. A key operational problem is to deal with a variety of specific and disparate tools for a wide variety of components that are part of the entire computing environment (such as operating systems, applications, databases, etc.). The issue is to find the most cost-effective combination of tools to maximize the overall protection. Furthermore, this combination must be constantly reconfigured to deal with the emergence of new threats.

Management Countermeasures

The trend in computer security is toward policy-based management: defining security policies and then centrally managing and enforcing those policies via security management products and services. Hence, for example, a user authenticates to a network once, and then a rights-based system gives that user access only to the systems to which the user has been given the rights. A finance employee might have the rights to company finance records, but a manufacturing employee might not.

The major problem these days is that enterprises cannot have both access to information and airtight security at the same time. Due to online commerce, companies want unimpeded information flow among a complex set of alliance partners. Thus, it is no longer feasible to define good as "inside the network" and bad as "outside the network," as in the past. Today, companies must make trade-offs between absolute information security and efficient flow of information. Although they might think technology can solve security loopholes, the human dimension is equally important—making employees cognizant of security threats they may encounter and teaching them how to strengthen the company's security measures. Today, due to the importance of computers in company operations, security decisions are not just technical; they are being influenced by business managers, which affects the bottom line.

Before any countermeasure can take place, companies must set up a sound mechanism for computer auditing. Audit logs can be used to help detect a security breach, or when a breach has been discovered, the security staff can trace how the incidents occurred.

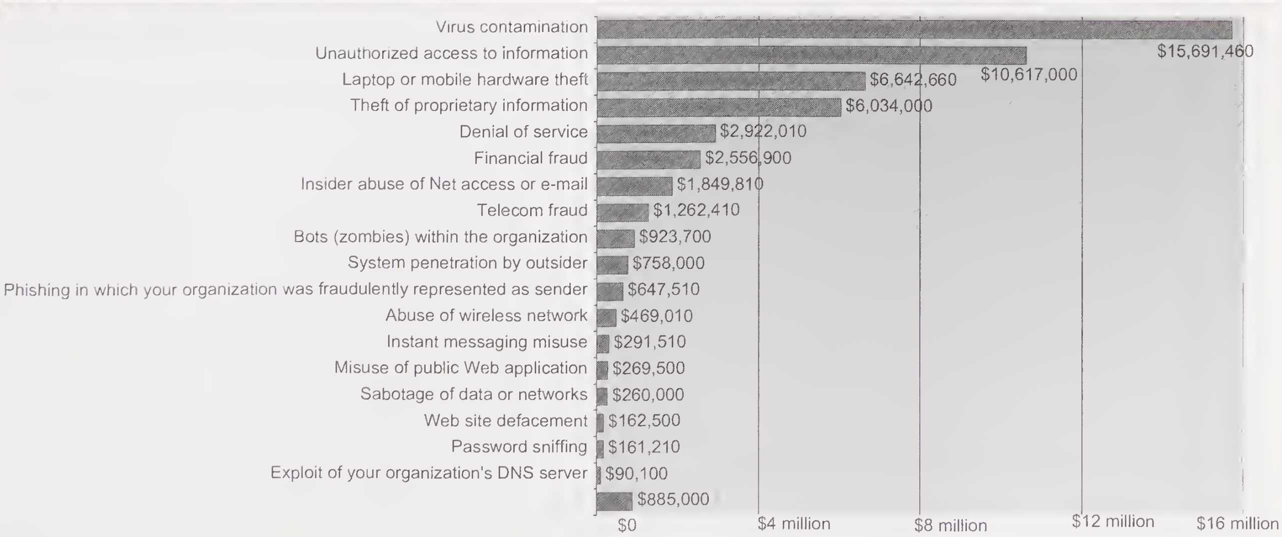
The 2006 CSI/FBI Computer Crime and Security Survey[1a] had five key findings that relate to how companies are managing security and the security management policies they have put in place.

- Most organizations conduct some form of economic evaluation and business analysis of their security operations using conventional tools such as Return on Investment (ROI), Internal Rate of Return (IRR), and Net Present Value (NPV).
- The compliance of the Sarbanes-Oxley Act raises the threat of information security.
- Over 80 percent conduct security audits.
- Virus attacks remain the source of the largest financial losses. Unauthorized access, damages related to mobile hardware, and theft of proprietary information are other key causes of economic losses.
- Most do not outsource cybersecurity, but the percentage of security activities outsourced is low.
- Cyberinsurance continues to be insignificant.
- Most respondents view security awareness training as important.

The CSI/FBI survey found that many organizations do not report a cybercrime to law enforcement because the negative publicity would hurt their stock price or their corporate image. Some do not report incidents because they believe a competitor will use that information to its advantage. Only a few see a civil remedy as the best course to take (hence, a reason to report a crime). And even though organizations may be aware of law enforcement's interest, they do not see that as sufficient reason to report a security breach. So there is not as much sharing of cybercrime information as some would hope.

Because airtight security is not possible, companies need to prioritize their risks and work on safeguarding against the greatest threats. To give an example of one company's approach to overall network security, consider this case from a Gartner EXP report.[4b]

FIGURE 11-6 Dollar Amount Losses by Type



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CASE EXAMPLE

AN INTERNET SERVICES COMPANY

This firm provides services to Internet professionals and performs security assessments.

Planning and Building for Security

When establishing network connections, the firm's starting point is to deny all access to and from the Internet. From there, it opens portals only where required, and each opening has a firewall and only permits specific functions, such as FTP or e-mail.

In essence, the company has put a perimeter around itself. It determines the worth of the information inside and spends the appropriate level of money to protect those assets. It can be hard to define the perimeter, though. For example, the company does work from client sites and that work needs to be protected as well.

It recognizes that it must also stay vigilant within the perimeter to avoid having a "soft chewy center." It uses a layered approach with numerous ways to protect each layer and some redundancy. For example, it worries about telephone hackers as well as computer hackers.

The IS organization is responsible for all in-house systems and all security. A central authority oversees all servers and workstations. In addition, all machines run the latest virus-detection software. When a system reboots, it accesses the central server where its virus definitions are checked. If they are not the latest ones, the newest versions are downloaded.

Finally, the company has disaster recovery plans that include having servers geographically separated. It recommends that clients do the same so that e-business sites can remain operational, at least partially, if some of the servers are hit by an attack or become overloaded.

Monitoring

The company views security on the Internet as a war of escalation. Every few weeks someone finds a clever new way to penetrate software, and a new type of attack is launched. Once the security team has closed one hole, attackers will find and attack another. The best the security team can hope to achieve is to deter attackers by closing more and more holes.

The security team therefore believes it needs to constantly "check the locks," which it does in the following ways:

- The team keeps track of the latest bugs found in systems. The company belongs to suppliers' bug alert communities. When it receives an alert, the team looks to see whether it applies to the company's systems. If so, the team assesses the vulnerability and takes the needed action.
- The team keeps up to date on the latest security attacks that have taken place around the world by subscribing to security organizations and constantly visiting their Web sites for the latest news.

(*Case Continued*)

- The team subscribes to hacker e-mail lists and bulletin boards to see what the bad guys are doing and talking about. The security team believes it must think like the enemy.
- Team members personally explore some threats by setting up a test system and trying various attacks on it—attacks they have read about on the e-mail lists and bulletin boards. It is fun for the security staff, it provides a break from the normal work, and it presents a welcome technical challenge.
- The team logs and monitors all incoming and outgoing traffic. A dedicated team manages the firewalls.
- A senior security person scans the company's Web sites monthly from a remote site, comparing the services being run on the servers with the official inventory of services that should be running on the servers. Major surprises are investigated. This person also checks to ensure that no servers are running known compromised software.

Education: The Key to Improving Security

The greatest security challenge is employee and customer apathy; they always say, "This cannot happen to us." Hence, the greatest security need is employee and customer education. The company tries to balance education with a taste of what could happen so that its security message is taken seriously without frightening employees and clients so much that they think any countermeasure is useless. Management has learned that fear-mongering becomes counterproductive if it is too scary or used too often.

Education is a two-way street, though. Businesspeople need to determine the value of the assets, but they also need input from IS on what is technically feasible to guard specific assets. For example, the company has alerted all its high-profile clients about the possibility of denial-of-service attacks. The bigger and more well-known the company and its Web site, the more it needs to be prepared for such attacks by having the technology and plans in place to identify and deal with attacks when they occur. Management warns, "If you have a determined adversary, they are going to keep trying until they get you."

The company has found that businesspeople do understand security when it is related to money. They understand that they, not the technicians, are the ones who need to justify security expenses because only they understand the worth of protecting different kinds of information. For example, they understand that protecting Web servers that contain public information requires keeping the servers from crashing. That type of protection costs less than safeguarding servers that house proprietary company or confidential client information, which must also protect the data from prying eyes; not every one can access it. ■

PLANNING FOR BUSINESS CONTINUITY

There is a big difference between disaster recovery and business continuity. In the past, executives expected their IS organization to focus on disaster recovery; that is, getting computers and networks up and running after a hurricane, flood, fire, or other disaster. September 11 taught them a broader issue—business continuity—that is, getting the business back up and running. Business continuity involves far more than IT equipment, notes Chuck Tucker in the Gartner EXP report, "September 11: Business Continuity Lessons."[4c]

Business continuity broadens the discussion to include safeguarding people during a disaster, documenting business procedures (instead of relying on certain employees who may become unavailable), and giving employees the tools and space to handle personal issues first so that they can then concentrate on work. Tucker notes that business continuity includes:

- Alternate workspaces for people with working computers and phone lines
- Backup IT sites that are not too close but not too far away (to be within driving distance but not affected by a regional telecommunications disaster)
- Up-to-date evacuation plans that everyone knows and has practiced
- Backed-up laptops and departmental servers, because a lot of corporate information is housed on these machines rather than in the data center
- Helping people cope with a disaster by having easily accessible phone lists, e-mail lists, and even instant-messenger lists so that people can communicate with loved ones and colleagues

In short, business continuity is a business issue. IT disaster recovery is just one component of it. Disaster recovery practitioners agree that (1) disaster contingency planning needs to be an integral part of doing business and (2) commitment of resources to a disaster recovery process must be based on an assessment by top management of cost versus risk. Companies essentially have two options for disaster recovery: use of internal or external resources.

Using Internal Resources

Organizations that rely on internal resources for disaster recovery generally view this planning as a normal part of systems planning and development. They cost-justify backup processing and telecommunications based on company needs during foreseeable emergencies. Companies use the following approaches to backing up their computer systems, data, and communication links with company resources:

- Multiple data centers
- Distributed processing
- Backup telecommunications facilities
- LANs

Multiple Data Centers

Over the past few years, to save money organizations have consolidated their multiple computer centers or outsourced them to a provider operating mainly from one data center. September 11 caused many executives to rethink the wisdom of having all corporate computing in one location. Multiple centers can provide emergency backup for critical services.

For backing up data, companies create protected disk storage facilities, sometimes called direct access data storage, or DASD farms. These farms are regularly refreshed with current operating data to speed recovery at an alternate data center. They are normally company-owned, unattended sites and remote from the primary data center. They house disk controllers and disk drives that can be accessed either online or in batch mode.

Distributed Processing

Other organizations use distributed processing to deal with disaster recovery. They perform critical processing locally rather than at a data center so that operations can continue uninterrupted when a disaster hits a data center. Companies that use this approach standardize hardware and applications at remote locations so that each local processing site can provide backup for the others.

Distributed processing solutions to disaster recovery can be quite costly when data redundancy between central and remote sites is required. Therefore, this alternative is most commonly used for applications that must continue to operate, such as order entry and financial transaction systems.

Backup Telecommunications Facilities

Companies appear to be handling telecommunications backup in two ways: (1) by utilizing duplicate communications facilities and (2) by using alternate technologies that they redeploy in case of an emergency. However, as Tucker notes, in New York City, companies signed up with different telecommunications carriers (without checking their carriers' routing), thinking that they had alternate communication routes. Then they discovered that 30 percent of Manhattan's telecommunications traffic, from many different carriers, went through Verizon's West Street switching office, which was destroyed on September 11.

Some companies turn to alternate communication technologies when their communication links fail, such as when the infamous Hinsdale fire destroyed the Hinsdale Illinois Bell Telephone Company central office switching station. The station handled 118,000 long-distance lines, 30,000 data lines, and 35,000 local voice lines, reports Jeff Bozman.[5] It served as a hub for some 30 local exchanges in northeastern Illinois. The fire disrupted telephone service to the area for four weeks. Local companies used at least two alternative technologies to handle their telecommunications needs during this emergency.

MONY Financial Services in Syracuse, New York, switched a satellite link from its smaller San Juan, Puerto Rico, office to its large Hinsdale office by installing a VSAT dish on the roof, reports Crockett.[6] It was used to communicate via satellite to a communication hub in New York City and from there via land lines to Syracuse. The San Juan office then instituted its own communication backup plan, using terrestrial lines to communicate to Syracuse.

Zurich Insurance Company, in Schaumburg, Illinois, established a line-of-site microwave link between headquarters and an AT&T switching office located about two miles away, reports Crockett. In fact, 38 temporary microwave links were established in the Chicago area.

September 11 taught the importance of restoring or relying on more personal forms of communication—e-mail, handhelds, instant messaging, intranets, and even paging systems. Business no longer relies just on data in data-center computers; much of it is now stored in laptops, departmental servers, and e-mail. Before September 11, few IS organizations had disaster recovery plans for these computers and systems.

LANs

Servers on one LAN can be used to back up servers for other networks. As with mainframe DASD farms, data servers used for such a backup need to be refreshed regularly to keep their data up to date. Keeping up to date is accomplished by linking the networks. Network master control programs permit the designating of alternate devices when primary ones fail.

Using External Resources

In many cases, a cost-versus-risk analysis may not justify committing permanent resources to contingencies; therefore, companies use the services of a disaster recovery firm. These services include:

- Integrated disaster recovery services
- Specialized disaster recovery services
- Online and off-line data storage facilities

Integrated Disaster Recovery Services

In North America, major suppliers of disaster recovery services offer multiple recovery sites interconnected by high-speed telecommunications lines. Services at these locations include fully operational processing facilities that are available on fewer-than-24-hours notice. These suppliers often have environmentally suitable storage facilities for housing special equipment for their clients.

Subscription fees for access to fully operational facilities are charged on a per-month basis. Actual use of the center is charged on a per-day basis. In addition, a fee is often charged each time a disaster is declared. Mobile facilities, with a mobile trailer containing computer equipment, can be moved to a client site and are available at costs similar to fully operational facilities. Empty warehouse space can be rented as well.

Recognizing the importance of telecommunications links, major disaster recovery suppliers have expanded their offerings to include smaller sites that contain specialized telecommunications equipment. These sites allow users to maintain telecommunications services when disaster recovery facilities are in use. They house control equipment and software needed to support communication lines connecting recovery sites with client sites.

Needless to say, companies now in the business of hosting corporate Web sites also handle disaster recovery for those sites.

September 11 pointed out a shortcoming of regional disasters: The backup sites fill up fast. In fact, one firm located in the World Trade Center declared a disaster with its provider four minutes after the first plane hit and was told that the closest available workspace facilities were hundreds of miles away. This company resorted to triage instead, notes Tucker, asking some employees to work from home and giving their workspaces at other locations to the displaced employees.

Specialized Disaster Recovery Services

Some suppliers of backup services can accommodate mainframe clients who also need to back up midrange machines. Others provide backup solely for midrange systems. Some will even deliver a trailer with compatible hardware and software to a client location.

Telecommunications firms also offer a type of recovery service, through network reconfiguration, where network administrators at user sites can reroute their circuits around lines with communication problems. Specialized telecommunications backup services also exist. Hughes Network Systems, in Germantown, Maryland, helped a company that had 49 of its pharmacies affected by the Hinsdale telephone switching station fire. Within 72 hours, Hughes installed a temporary network of VSATs at 12 sites. The 37 remaining sites had small satellite dishes installed within two weeks. Other firms offer data communications backup programs, where they will store specific telecommunications equipment for customers and deliver that equipment to the customer's recovery site when needed.

Online and Off-Line Data Storage

Alternate locations for storage of data and other records have long been a part of disaster planning. Services generally consist of fire-resistant vaults with suitable temperature and humidity controls. Several suppliers offer "electronic vaulting" for organizations that need to have current data off-site at the time a disaster occurs. These suppliers use two methods to obtain current data from their clients. One method uses computer-to-computer transmission of data on a scheduled basis. The other uses dedicated equipment to capture and store data at a remote location as it is created on the client's computer. This latter method assures uninterrupted access to data from an operationally ready disaster recovery facility selected by the client.

In summary, when disaster recovery needs do not shape the architecture of an enterprise's computer systems, the cost of reconfiguring the systems to provide the needed redundancy and backup can be prohibitive. In these cases, external backup alternatives may be a more cost-effective form of insurance. For e-business, however, mere backup capability does not suffice. Disaster recovery must be an integral part of system design, because companies need immediate rollover to backup facilities when operations are interrupted.

CASE EXAMPLE

UT AUSTIN RESPONDS TO DATA THEFTS

www.mccombs.utexas.edu; www.mccombs.utexas.edu/datatheft/

On April 23, 2006, officials at the University of Texas at Austin reported that an unknown person or persons had gained entry to the McCombs School of Business computer and gained unauthorized access to a large number of the school's electronic data. The incident occurred two days earlier with an estimated 197,000 records unlawfully accessed. The university conducted an investigation and discovered a security violation on Friday, April 21. Information that was accessed included social security numbers and possibly other biographical data

(*Case Continued*)

of alumni, faculty, staff, current and prospective students of the business schools, and recruiters.

The university swiftly made the news public and took immediate steps to deal with the security breach.

Executing Remediation Plan

The university put into place countermeasures to reduce vulnerabilities. It contacted almost 200,000 people who were determined to have been either directly or potentially affected by the incident. Whenever possible, 45,000 e-mails, followed by 80,000 letters, were addressed to those whose SSNs were compromised. Another additional 60,000 letters were sent to people who might have had nonsensitive information unlawfully accessed.

A Web site and an information call center with a toll-free telephone number were set up to assist people potentially affected by the data theft. There were more than 9,000 calls from concerned citizens, and the response teams followed up about 6,000 other calls. They addressed specific questions and provided updated information. Cautionary steps to deal with further identity theft were provided. The intention here was to do more than what what was required by legal notification requirements.

The computer center disabled several administrative programs. Sensitive data such as social security numbers were removed from the affected server and many administrative programs containing personal information were disabled. Additional security resources were increased to implement the recommendations that resulted from the security audits.

For sure, this security breach was a data theft, since intruders stole important pieces of people's personal identifying information. However, at the time of discovery, there was no assurance that it was an identity theft. An identity theft occurs when the stolen information is used for any fraudulent or other unlawful purpose. To assist individuals who sought to respond to identity theft, the university set up a Web site with specific step-by-step instructions. Individuals were advised to place a free "fraud alert" on their files with one of the three major credit bureaus in the United States (Equifax, Experian, and Transunion). A list of additional resources is also provided:

- Federal Trade Commission; www.consumer.gov/idtheft/
- Also see from the Federal Trade Commission, the booklet "Take Charge: Fighting Back Against Identity Theft"; www.ftc.gov/bcp/conline/pubs/credit/idtheft.htm
- Social Security Administration
- www.ssa.gov/oig/index.htm
- Social Security Fraud hotline (800-269-0271)
- www.ssa.gov/pubs/10064.html
- Department of Justice; www.usdoj.gov/criminal/fraud/idtheft.html
- U.S. Postal Inspection Service; www.usps.com/postalinspectors/id_intro.htm
- Identity Theft Resource Center (858-693-7935); www.idtheftcenter.org/index.shtml
- Privacy Rights Clearinghouse—Identity Theft Resources; www.idtheftcenter.org/index.shtml

(*Case Continued*)

- Internet Crime Complaint Center; www.IC3.gov
- National Fraud Information Center Hotline: 800-876-7060

Improving Overall Information Security The IT center of the business school set up a Data Theft Information Center and explained how the college has dealt with the incident:

- Security audit: The University of Texas Information Security Office conducted a full security audit. Independent consultant and major IT firms were hired to perform a comprehensive evaluation of the campus computer systems and application software.
- Countermeasures to reduce vulnerabilities: Many security steps were taken to secure the information stored on the computer servers.
- Cooperation with law enforcement authorities: The University involved the Cyber Crimes Unit of the Texas Attorney General Office, the Federal Bureau of Investigation, and the University Police Department. ■

SECURITY IS A CORE COMPETENCY

In a conventional sense, core competency refers to the ability of an organization to do well what it is meant to do to secure sustainable competitive advantage. A typical and direct measure of competency of a firm is the competitiveness of its products or services, those that provide benefits to customers and are hard for competitors to copy. With the pervasiveness of security threats, all organizations should look at security resources as a strategic investment. Appropriate security tools should be acquired, and skilled security personnel should be retained.

Security is often thought by many as a mere technological problem. This narrow view could do much disservice to the organization. Any business should look at security as a business problem, with threats that could bring to a halt any critical activity at any time. IT-related security should be a discussion item in every single business process within the organization.

Many businesses—such as banks, insurance firms, and health care providers—are required by law to adopt a number of security measures to protect the interests of the customers. John Steven[7] notes that businesses are now being held accountable for the security of their business applications by their customers, business partners, and the government.

RSA,[3] just to name a few leading security solutions providers, suggests that few necessary steps are required to reach an information-centric strategy:

- ***Create and communicate an enterprise software security framework:*** The roles, functions, responsibilities, operating procedures, and metrics to deal with security threats and attacks must be clearly defined and communicated to all involved staffs. A security administrator should be created. This is a critical position in the IS department. The role of the security administrator is to be the champion of security in his/her organization, work with all IT units, from infrastructure engineering to incident management, and to deal with both structural and incidental aspects of security threats.

- ***Knowledge management training:*** To create a culture for enforcing IT security, an organization should improve the security knowledge of its IT staff and community of users: security policy, standards, design and attack patterns, threat models, etc.
- ***Secure the information infrastructure:*** Along the IT-enabled business process or workflow, security checks using external programs should be identified to allow for monitoring and controls.
- ***Assure internal security policy and external regulator compliance:*** The organization should make sure that, based on IT risk assessment, security requirements are translated into features of the software design to resist attack. There are tools available to conduct penetration-testing risks. Regular audits and monitoring exercises should be conducted, with precise measures of effectiveness. It is crucial that the assurance effort comply with internal policies and external regulations.
- ***Governance:*** In any project that involves security, security experts must be called upon to participate in the design and implementation process of the system development or maintenance. Proper procedures should be clearly defined before any security breach occurs.

CONCLUSION

Information security has become an important management topic, yet it has no definite answers. It is too costly to provide all the security a company wants, and performing security checks on packets takes a lot of processor power, which can slow performance. Even with world-class technical security, management needs to make sure that all employees follow security policies, because companies are only as safe as their weakest link. In fact, that weakest link could be a supplier or contractor with secure access to a company's systems, yet poor security of its own. As repeated often in this chapter, security is as much a human problem as a technical problem.

The complexity of information security is pervasive, and is no longer the problem of the IT department. The CIO must mobilize all organizational units to enhance the organization's ability to withstand threats and to adapt to new risk environments. Security is not just a technological problem. It is a business problem, since all activities in a network-enabled world inherently carry some degree of security threat.

The biggest security challenges include managing the increasing complexity of security, assessing potential risks, raising the level of user awareness, enforcing security policies, and protecting against breaches.

The effectiveness of security management also depends on factors that are external to the organization. Technology vendors should provide products and services with embedded security features. Business partners should take security equally seriously. Security is also a regulatory problem with compliance requirements. Different countries have different ways of looking at the severity of information security.

Implementing an effective information security strategy requires substantial resources. Forward-looking organization should view security management as part of the core competency of the organization. As suggested by the National Institute of Standards and Technology (NIST), all businesses should put into place an information security governance that allows management structure and processes to establish information strategies that:

- are aligned with and support business mission and objectives
- are consistent with applicable laws and regulations through adherence to policies and internal controls
- hold people accountable for the security effort they are responsible for

As discussed in this text, information is a critical and invaluable resource, and should not be an area of risk. The ultimate goal of information security management is to nurture and sustain a culture of security in the organization.

QUESTIONS AND EXERCISES

Review Questions

1. What would be the most threatening security threats for the next five years?
2. Why are wireless applications becoming a new target for hackers?
3. Describe the five pillars of information security.
4. How does the Internet services company "check its locks"?
5. How did the University of Texas at Austin deal with a computer attack? Expand the notion of disaster recovery.
6. Discuss the human side of computer security.

Discussion Questions

1. Security is such an important area that every employee should be required to carry around a security token that generates a new password every time he or she logs on. Security threats are overblown; imposing on employees to carry a security token is too much to ask. Discuss both sides of this issue.
2. The Internet provides all the redundant routing and alternate sites an enterprise needs. It need not contract with a backup and recovery firm as Household International did. Present arguments against this belief.
3. Do an Internet search on "tools for computer security." Identify the latest products. Describe the organization that you are currently working for. Are these new tools useful for your organization. How would you convince your organization to adopt them.
4. Visit an organization Web site that has a plan for managing information security. A suggestion: The Fermi National Accelerator Laboratory (http://security.fnal.gov/reporting.html) (accessed May 2008). Examine the way the organization sets up its security procedures. Discuss the effectiveness of the site.

Exercises

1. Search articles about e-commerce security. Discuss with your teammates how e-commerce security differs from general information security. Are there any particular countermeasures that are unique to e-commerce? Relay your findings to the class.
2. Read several articles on Internet security. Present any new information to your class.
3. Visit a company in your local community. Learn about its disaster recovery and business continuity plans. Which threats are they aimed at? Which threats are not dealt with? What is it doing about Internet security?

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PART IV

SYSTEMS FOR SUPPORTING KNOWLEDGE-BASED WORK

This part consists of three chapters that discuss how computer technology can be designed and used to support three kinds of work: decision making, collaboration, and knowledge work. As shown in the book's framework diagram in the following figure, we distinguish between procedure-based and knowledge-based information-handling activities. Chapters 9 and 10 in Part III dealt mainly with building systems aimed at supporting procedure-based work. This part focuses on supporting knowledge-based activities: the systems that support people in performing information-handling activities to solve problems, work together, and share expertise.

Chapter 12 discusses supporting decision making by first presenting four underlying technologies—decision support systems (DSSs), data mining, executive information systems (EISs), and expert systems (ESs)—and some examples of their use. The chapter then discusses the fascinating subject of the real-time enterprise, which has a goal of gaining competitive edge by learning of an event as soon as possible and then responding to that event quickly, if necessary.

Chapter 13 deals with supporting collaboration by first describing various kinds of groups, different systems that support their collaboration, and finally how executives might think about managing virtual organizations, an increasing phenomenon these days.

Chapter 14 focuses on supporting knowledge work by presenting a model for thinking about how to manage knowledge. It ends with a discussion of computer ethics and intellectual capital issues in this Internet era.

The three chapters embrace the general concept of business intelligence that is currently being promoted by the IT industry. Broadly defined, Business Intelligence (BI) refers to information technologies that a business can use to make informed, timely, and effective decisions for the purpose of gaining competitive advantage.

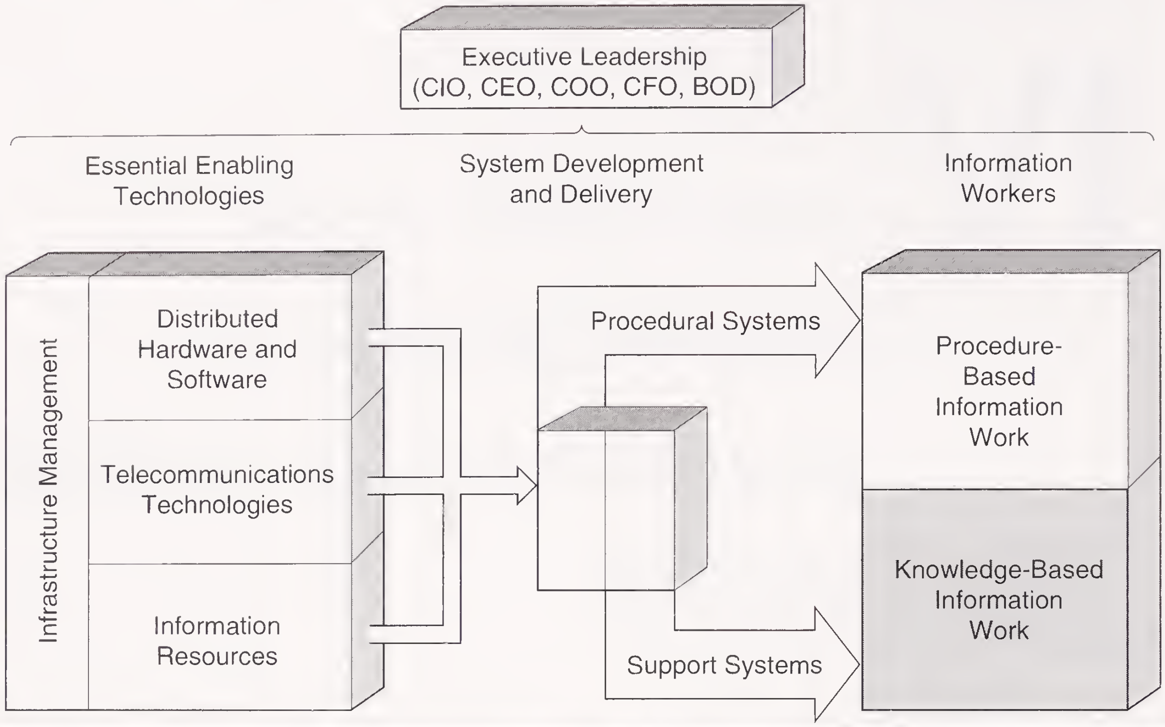


FIGURE P4-1 A Framework for IS Management

CHAPTER

12

SUPPORTING INFORMATION-CENTRIC DECISION MAKING

INTRODUCTION

Case Example: A Problem-Solving Scenario

TECHNOLOGIES-SUPPORTED DECISION MAKING

Building Timely Business Intelligence

Decision Support Systems

Case Example: Ore-Ida Foods

Case Example: A Major Services Company

Data Mining

Case Example: Harrah's Entertainment

Executive Information Systems

Case Example: Xerox Corporation

Case Example: General Electric

Expert Systems

Case Example: American Express

Agent-Based Modeling

TOWARD THE REAL-TIME ENTERPRISE

Enterprise Nervous Systems

Case Example: Delta Air Lines

Straight-Through Processing

Real-Time CRM

Case Example: A Real-Time Interaction on a Web Site

Communicating Objects

Vigilant Information Systems

Case Example: Western Digital Corp.

Requisites for Successful Real-Time Management

CONCLUSION

QUESTIONS AND EXERCISES

REFERENCES

INTRODUCTION

Inspired by the work of H. Simon in the late 1950s, and other noted scholars—J. March, R. M. Cyert, A. Twestky, and D. Kahaneman, just to name a few—organizational decision making has been a fertile area of research in cognitive science and organizational behavior. Thanks to these authors, we have gained more insights on how decisions are made in organizations. For some time, decision making in organizations has often been seen as a rational and coherent process. Relevant information is gathered. Problem issues are well understood. Objectives and preferences are well laid out. Alternative interests and perspectives are fully considered. As a result, an optimal solution is derived. Following Simon's theory of bounded rationality and heuristics of reasoning, decision makers are now recognized as not as rational. Their decisions are often influenced by power, incentives, and even ambiguity. Their information-processing capacity is limited. Their cognitive ability is reduced under stress or time pressure. More importantly, quite a few decision makers cannot even clearly formulate their own objectives or preferences. While it is important to admit these less-than-ideal realities, the role of scientific management is to identify ways that can enhance the quality of the decision-making process and outcome.

From an IT-supported decision perspective, the issue here is to figure out what and how IT can be used to help the decision maker get the information he needs, better formulate the problem, clarify his preferences, process complex reasoning, and better appreciate the impacts of the decision before it is being made.

Generally speaking, most of today's computer systems have some built-in features that help their users make decisions. The latest financial statement stored in a spreadsheet can help the CFO decide on this month's cash flow. A report on inventory printed from a DBMS can help the production manager decide on the next supplies order. In the mainframe era, the earliest commercial uses of computers aimed to automate such decisions as analyzing sales, updating accounts payable, calculating payroll payments, and recording credit card charges and payments. Since those early days of the 1950s and 1960s, the use of computers to support decision making has become increasingly sophisticated, either completely taking over complicated decisions (for example, automated stock trading systems), or supporting people who make complex decisions (for example, firm acquisition). A whole host of technologies has been aimed at the use of information systems. This chapter first discusses the basic principles of Business Intelligence, and elaborates on five of these technologies:

1. Decision support systems (DSSs)
2. Data mining
3. Executive information systems (EISs)
4. Expert systems (ESs)
5. Agent-based modeling

The chapter then concludes with a discussion of the hot topic of moving toward the real-time enterprise; that is, the pros and cons of being able to gauge the current state of affairs and make decisions nearer to when an event occurs.

Decision making is a process that involves a variety of activities, most of which deal with handling information. To illustrate such a process, here is a scenario about a vice president with an ill-structured problem and how he confronts it using a variety of decision-making technologies.

CASE EXAMPLE

A PROBLEM-SOLVING SCENARIO

Using an Executive Information System (EIS) to compare the budget with actual sales, a vice president of marketing discovers a sales shortfall in one region. Drilling down into the components of the summarized data, he searches for the apparent causes of the shortfall, but can find no answer. He must look further, so he sends an e-mail message to the district sales manager requesting an explanation. The sales manager's response and a follow-up phone call also reveal no obvious single cause, so he must look deeper.

The vice president investigates several possible causes:

- ***Economic conditions.*** Through the EIS and the Web, he accesses wire services, bank economic news letters, current business and economic publications, and the company's internal economic report on the region in question. These sources, too, reveal no serious downturn in the economic conditions of the region.
- ***Competitive analysis.*** Using the same sources, he investigates whether competitors have introduced a new product or launched an effective ad campaign or whether new competitors have entered the market.
- ***Written sales reports.*** He then browses the reports of sales representatives to detect possible problems. A concept-based text retrieval system allows him to quickly search on topics, such as poor quality, inadequate product functionality, or obsolescence.
- ***A data mining analysis.*** He asks for an analysis of the sales data to reveal any previously unknown relationships buried in the customer database and relevant demographic data.

The vice president then accesses the marketing DSS, which includes a set of models to analyze sales patterns by product, sales representative, and major customer. Again, no clear problems are revealed.

He thus decides to hold a meeting with the regional sales managers and several of the key salespeople. They meet in an electronic meeting room supported by Group DSS (GDSS) software such as GroupSystems by Ventana Corporation. During this meeting they examine the results of all the previous analyses using the information access and presentation technologies in the room, brainstorm to identify possible solutions, and then develop an action plan.

No discernible singular cause has led to the shortfall in sales, so the group decides that the best solution is to launch a new multimedia sales campaign that sales representatives can show on their laptop computers when they visit customers.

The vice president then enters a revised estimate of sales volume into the financial planning model, taking into account the new sales promotion plan,

(*Case Continued*)

and distributes it to the sales force in the region.

He holds a sales meeting in the GDSS room and by video conference launches the new campaign and trains sales personnel in the use of the multi-media presentation. ■

This scenario illustrates the wide variety of activities involved in problem solving. Where does the decision making start and stop? Which are the crucial decisions? It really does not matter because all the activities are part of the overall process of solving the problem. The scenario also illustrates the wide variety of technologies that can be used to assist decision makers and problem solvers. They all aim to improve the effectiveness or efficiency of the decision-making or problem-solving process.

TECHNOLOGIES-SUPPORTED DECISION MAKING

Building Timely Business Intelligence

Coined and popularized by the Gartner Group in the early 1990s, Business Intelligence (BI) is a broad set of concepts, methods, and technologies to improve context-sensitive business decision making by using information-centric support systems. As discussed in Chapter 1, the rapidly changing world of demand and supply requires businesses to act more proactively and swiftly. Managers should be able to gather, filter, and analyze large quantities data from a variety of sources in real time, or near real time, mode. They should be able to navigate through these terabytes of data to assess current market conditions and explore future business scenarios.

According to IDC, the worldwide market for analysis tools was $4.5 billion in 2005. Tools for advanced analytics reached $120 million in the same year. The market is still growing as *InformationWeek.com* indicated in its 2007 survey of 500 largest companies in the United States. Most of the BI software currently available in the market provide tools for metadata management, data transformation and integration, data quality, data analysis, analytics applications, financial planning and performance management, and enterprise reporting.

Central to BI Is the Notion of Sense Making

Sense making refers to the ability to be aware of and assess situations that seem important to the organization. With ambiguous and disparate data extracted from multiple sources, situation awareness implies an inductive and constructive process. On the other hand, situation assessment is the process of fitting observed data into a predetermined model. For example, Chapter 2 discusses Porter's Five Forces Model. To assess the competitiveness of the company, the manager will try to gather data and feed them in Porter's framework. While situational awareness is driven by the discovery of events or facts, assessment is bounded by the manager's education and training, past experiences, and cognitive capabilities.

In the context of an organization, the notion of sense making is extended to shared awareness and command and control. To achieve situation awareness, BI seeks to design an IT-enabled infrastructure to enhance collaboration among employees, and support them in the planning, execution, and monitoring of decisions. Operationally, the goal of BI is to help its user generate actions to control the assessed situation. BI models allow identification of business objectives, definition of constraints, evaluation of alternate solutions, and decision making. They include, but are not limited to, data and document warehousing, data and document mining, Web mining, scoreboarding, visualization, trend analysis and forecasting, multidimensional analysis, and neural networks.

Whereas the purpose of tractors, jackhammers, and steam engines has been to enhance humans' physical capabilities, the purpose of computers has been to enhance our mental capabilities. Hence, a major use of IT is to relieve humans of some decision-making tasks or help us make more informed decisions. At first, IT relieved us of procedure-based decisions—those that involved easily discernible procedures, such as data manipulation, sorting, and what-if analysis. Software now has progressed to the point where computers can make what-if analysis and goal-based decisions using integrated data-intensive systems with online analytical processing (OLAP) capacities. The following are five technologies that support decision making: DSSs, data mining, EISs, ESs, and agent-based modeling.

Decision Support Systems

The definition of DSSs that prevails today was described in *Building Effective Decision Support Systems,* by Ralph Sprague and Eric Carlson.[1] They define DSSs as computer-based systems that help decision makers confront ill-structured problems through direct interaction with data and analysis models. For example, the owner of a bank needs to select a Certified Public Accountant from a list of 30 candidates. Since none of them clearly stands out as the best candidate, the choice appears to be ill-defined. With the use of a DSS that helps list all the selection criteria, prioritize these criteria, input the evaluation of the banker, and rank order the candidates based on different points of view, the banker is getting a better appreciation of the role of the future CPA and how to look for the CPA who would best meet his expectations.

During the 1970s and 1980s, the concept of decision support systems (DSSs) grew and evolved out of two previous types of computer support for decision making. One was management information systems (MISs), which provided (1) scheduled reports for well-defined information needs, (2) demand reports for ad hoc information requests, and (3) the ability to query a database for specific data. The second contributing discipline was operations research/management science (OR/MS), which used mathematical models to analyze and understand specific problems.

The last two items have become the basis of the architecture for DSSs, which Sprague and Carlson call the Dialog-Data-Model (DDM) paradigm: the dialog (D) between the user and the system, the data (D) that support the system, and the models (M) that provide the analysis capabilities. They make the point that a good DSS should have balance among the three capabilities. It should be easy to use to support the interaction with nontechnical users; it should have access to a wide variety of data; and it should provide analysis and modeling in numerous ways.

The Architecture for DSSs

The model in Figure 12-1 shows the relationships among the three components of the DDM model. The software system in the middle of the figure consists of the database management system (DBMS), the model base management system (MBMS), and the dialog generation and management system (DGMS).

The dialog component. The dialog component links the user to the system. It can take any number of styles. A spreadsheet screen, a database window, an instant-messaging dialog box, a Web page to browse, and an online catalog are examples of input/output handled by the dialog component. One dialog style uses a mouse and a keyboard to access pull-down menus and move icons on a color screen to get a graphical presentation of analysis results. The Apple Macintosh introduced this style in the 1980s. Another one is to use a touch screen or a pen.

The current standard is the browser interface, with multimedia features embedded in the Web page. Lots of researches have been dedicated to the design of an effective man-machine interface. For example, when a computer screen is used for the computer system to dialogue with the user, certain basic design principles should be followed. These include, but are not limited to:

- The language shown on the computer screen should be clear, concise, and unambiguous.
- Not too much information is provided at the same time to avoid information processing overload.
- The choice of fonts and colors should not be so busy that they might distract the user from focusing on the task at hand.
- Screen navigation should be logical from the user's viewpoint, or better yet, customized to his/her particular needs.

With the growing integration of systems—from conventional use, window-based screens and the Web browser to a mobile device such as the cell phone or a personal digital assistant (PDA)—finding a seamless and uniform interface that optimizes the interaction between the system and the user is a challenge. The large computer screen can display a rather large amount of information at the same time. Conversely, a two-inch mobile phone can only display a few pieces of information at the same time. The challenge for the IS department is to help developers define an organization-wide general set of design principles to enhance the quality of interaction between the user and the system.

The data component. The main purpose of this component is to help the user select a set of data relevant to his decision problem. Data are either accessed directly by the user or are an input to the model component. Typically, summarized data, rather than transaction data, are used and put into extract files. Extract files are used for security, ease of access, and data integrity reasons. They keep the all-important transaction systems away from end users. Another important feature of this component is to retrieve selective data from external sources of information (for example, economic data from a research firm, or production data from a supplier). Most recently, the data component has taken the form of data warehousing (discussed in Chapter 7) and data mining (discussed shortly). The rationale of having a data component is that the greater the data the better the ability of the decision to comprehend the problem at hand.

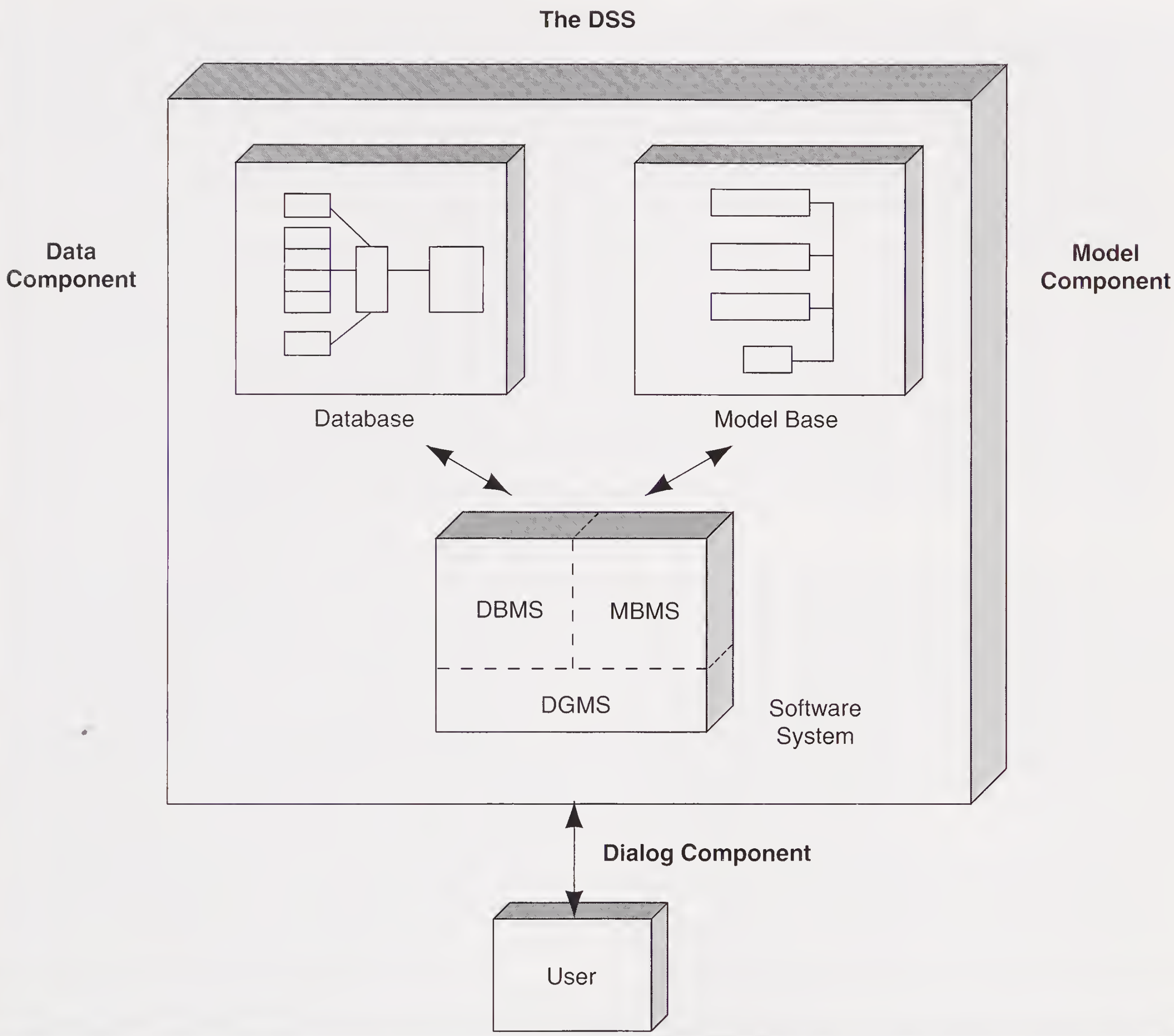


FIGURE 12-1 Components of a Decision Support System (DSS)

The model component. Modeling is the process of building a model of reality based on a situation that we know the answer, and try to apply to another situation that we have yet to find the solution. The model component stores a family of analytical models in a model base (a concept germane to a database for data) that the user can choose, and possibly integrate them together, to solve his decision situation. For example, the user can request a simulation model from the model base to weigh different market forces, and transfer the results of the simulation to a forecasting model that calls regression algorithms to predict sales. Models need to fit with the data, they need to be kept up to date; users need to understand and trust them; and if several models are used, they need to work together.

Basically, there are two kinds of DSSs: institutional and "quick hit." Institutional DSSs are generally built by professionals, often decision support groups. They are intended for organizational support on a continuing basis, and they are generally written using a dedicated computer language for business modeling. The following case example illustrates an institutional DSS.

CASE EXAMPLE

ORE-IDA FOODS

www.oreida.com

Ore-Ida Foods, Inc., is the frozen-food division of H. J. Heinz and has a major share of the retail frozen potato market. Its marketing DSS must support three main tasks in the decision-making process.

- ***Data retrieval,*** which helps managers find answers to the question, "What has happened?"
- ***Market analysis,*** which addresses the question, "Why did it happen?"
- ***Modeling,*** which helps managers get answers to, "What will happen if . . .?"

For data retrieval, a large amount of internal and external market data are used. External data, such as economic indexes and forecasts, are purchased. However, the company makes limited use of simple data retrieval. Only about 15 to 30 pages of predefined reports are prepared each sales period.

Market analysis is the bulk (some 70 percent) of Ore-Ida's use of DSS and is used to analyze, "Why did such and such happen?" Data from several sources are combined, and relationships are sought. The analysis addresses a question such as, "What was the relationship between our prices and our share of the market for this brand in these markets?"

Modeling for projection purposes offers the greatest potential value to marketing management. The company has found that, for successful use, line managers must take over the ownership of the models and be responsible for keeping them up to date. The models must also be frequently updated, as market conditions change and new relationships are perceived. ■

As this example illustrates, an institutional DSS tends to be fairly well defined; it is based on predefined data sources (heavily internal, perhaps with some external data), and it uses well-established models in a prescheduled way. Variations and flexible testing of alternative what-if situations are available, but such tests are seldom done during interaction with the ultimate decision maker.

A "quick-hit" DSS, on the other hand, is developed quickly to help a manager make either a one-time decision or a recurring decision. A quick-hit DSS can be every bit as useful for a small company as for a large one. One type of quick-hit DSS is a reporting DSS, which can be used to select, summarize, and list data from existing data files to meet a manager's specific information needs, such as to monitor inventory in a region, compare actual to planned progress on a project, or follow a trend. A second type of quick-hit DSS is a short analysis program, which can analyze data and print or display the data. These programs can be written by a manager, they generally use only a small amount of data, and they can be surprisingly powerful. Finally, a third type of quick-hit DSS can be created using a DSS generator, which builds a DSS based on the input data. As an example of a powerful short analysis that shows quick-hit DSSs in practice, consider the DSS used by the vice chairman of a services company with offices throughout the United States and Europe.

The typology of DSSs described previously has practical implications to top management. An end-user or a small group of people who need to quickly put together a decision tool to solve a particular problem typically initiates a quick-hit DSS. As such, the project scope is limited and likely ad hoc; it could be a one-time use and is developed by the end user. Development cost tends to be small and the benefits are derived from the learning process while the DSS is being developed and used. An example of this could be an Excel-based budgeting program over a period of five years. On the other hand, an institutional DSS requires full planning and budgeting. Its development can be expensive and requires a full approach to software development.

CASE EXAMPLE

A MAJOR SERVICES COMPANY

The vice chairman of the board at a major services firm was considering a new employee benefit program: an employee stock ownership plan (ESOP). He wanted a study made to determine the possible impact of the ESOP on the company and to answer such questions as: How many shares of company stock will be needed in 10, 20, and 30 years to support the ESOP? What level of growth will be needed to meet these stock requirements?

He described what he wanted—the assumptions that should be used and the rules that should be followed for issuing ESOP stock—to the manager of the information services department. The information services manager herself wrote a program of about 40 lines to perform the calculations the vice chairman wanted and then printed out the results. These results showed the impact of the ESOP over a period of 30 years, and the results contained some surprises.

The vice chairman presented the results to the executive committee and, partially based on this information, the ESOP was adopted. Some of the other executives became excited about the results of this analysis and asked if the computer program could be used to project their individual employee stock holdings for 10, 20, and 30 years. The results of these calculations aroused even more attention. At this point, it was decided to implement the system in a more formal fashion. The company treasurer became so interested that he took ownership of the system and gradually expanded it to cover the planning, monitoring, and control of the various employee benefit programs. ■

This example shows that simple programs of 100 lines of code are indeed practical and can be used to support real-life decisions. In this case, a 40-line program was adequate for the initial evaluation of the ESOP. Eventually, of course, the programs for this system became much larger, but the 40-line program started everything. This example also illustrates the concept of iterative development (a form of prototyping), which is a key concept in DSS development. Other examples of DSSs are given by Sprague and Watson in *Decision Support for Management*.[2]

Data Mining

The data component of the DSS architecture has always been a crucial part of the success of DSSs. Recently, however, many of the advances in DSSs have been in the area of data warehousing and data mining. The trend is just natural. Today's computer processing power is able to process reasonably fast terabytes of data. Data mining—sometimes known as data or knowledge discovery—is a technique that processes large amounts of data from different perspectives with the hope to discover some business patterns that are embedded in the data. For example, Oracle, one of the world's largest software providers, reports that one of its customers, a grocery store, uses its data-mining software to discover business patterns and predict sales. The business was able to find an association relationship of co-occurring buying pattern: Men who visited the store to buy diapers on Thursdays and Saturdays, also tended to buy beer. Later the store analyzes the data and discovers that grocery goers typically shop on Saturdays, and perhaps because they have a lot to buy for the upcoming week, beer was not a popular buy on Saturdays. These discoveries were not based on theories of consumer behavior. They emerge from data analyses. One possible application of this consumption pattern is for the store to place beer next to the diapers on Thursdays.

As noted in Chapter 7, data warehouses hold gigantic amounts of data for the purpose of analyzing that data to make decisions. The most typical use of data warehouses has been users entering queries to obtain specific answers. However, an even more promising use is to let the computer uncover unknown correlations by searching for interesting patterns, anomalies, or clusters of data that people are unaware exist. Called data mining, its purpose is to give people new insights into data. For example, data mining might uncover unknown similarities within one customer group that differentiates it from other groups. Data mining is an advanced use of data warehouses, and it requires huge amounts of detailed data. The most frequent type of data mined these days is customer data because companies want to know how to serve their customers better. Here is such an example: Harrah's Entertainment.

How does data mining work? Given access to a large set of data (for example, sales per items, per regions, weather conditions, holidays, sports events, etc.), a data-mining technique can use the following types of relationships and pattern recognition approaches:

- ***Classes:*** Data regarding a predetermined group are retrieved and analyzed. For example, a retail chain sorts sales data according to the time customers visit the store, and the types of goods they bought. This information could be used to develop customer profiles.
- ***Clusters:*** Data are grouped according to logical relationships or consumer preferences. For example, data can be mined to look for market segments or

consumer affinities. An airline could mine customer purchase data to determine what type of duty-free goods travelers would buy when they fly business class during business days. This information could be used to have a better selection of duty-free items for sale.

- ***Associations:*** Data are mined to find associations between them.
- ***Sequential patterns:*** Data are used to anticipate behavior patterns and trends. For example, a store discovers from its data that customers who bought sun-screen products also bought sunglasses.

Without getting bogged down in technical details, there are a wide variety of algorithms that could be used for data mining. A simple approach is to use advanced graphics tools to allow the business analyst to visualize data. Another technique is to use if-then rules to sort databases from certain business ideas. More advanced techniques include decision trees, neural networks, and genetic algorithms. Today, most providers of database management systems (DBMS) do provide an add-on data-mining module. The costs range between a few hundreds to millions of dollars.

CASE EXAMPLE

HARRAH'S ENTERTAINMENT

www.harrahs.com

Harrah's Entertainment of Memphis, Tennessee, is owner of 26 casinos around the United States, including the Rio in Las Vegas, Harrah's at Lake Tahoe, and Harrah's North Kansas City on a riverboat on the Missouri River.

To better know its customers, Harrah's encourages them to sign up for its frequent-gambler card, Total Rewards. In return for inserting the card in a gaming machine when they play it, gamblers can receive free hotel rooms, free shows, free meals, and other giveaways.

Some 25 million Harrah's customers have a Total Rewards card, reports Joe Nickell,[3] just by filling out their name, age, address, and driver's license number. When they insert the card in a machine, it tracks what they do. Thus, on Nickell's 4-hour-and-40-minute visit to the Rio in Las Vegas, Harrah's learned that he placed 637 wagers on nine slot machines, his average bet was 35 cents, and he lost $350.

Until its Total Rewards program began in 1998, Harrah's only knew how much money each of its 40,000 machines made, notes Nickell, not which customers were playing them. Furthermore, each casino operated independently. Customers might receive VIP treatment at one casino, but not at another.

When competition among casino owners increased in the late 1990s due to legalization of gambling on Indian reservations and riverboats, Harrah's realized it needed to reward its best customers to keep them coming back. But first it had to find out who they were, which was the rationale behind its Total Rewards program.

(Case Continued)

Harrah's estimated it was getting 36 percent of its customers' gambling money in 1998. It further calculated that a 1 percent increase would equal $125 million in more revenue, states Nickell. Thus, Harrah's goal has been to increase the gambling "wallet share" of each of its customers. During 2001, Harrah's calculated its share had increased to 42 percent.

Using Data Mining to Understand Its Customers

Harrah's mined its Total Rewards database to uncover patterns and clusters of customers. It has created 90 demographic clusters, each of which is sent different direct-mail offers—a free steak dinner, a free hotel room, and such—to induce them to pay another visit to any Harrah's casino.

Harrah's has gotten to know its customers well. From just a person's gender, age, distance from any casino, gaming machines played, and amounts of bets, it can fairly accurately estimate the long-term value of that customer. The company creates a gaming profile of each customer and a personalized marketing campaign, offering giveaways appropriate to that customer's cluster, all with the goal of encouraging customers to spend their gambling time at Harrah's rather than at competitors' casinos.

Over time, Harrah's compiles a profit-and-loss for each customer to calculate how much "return" it is likely to receive for every "investment" it makes in that customer. It also tracks how each customer responds to its direct-mail offers, ratcheting up or down its giveaways based on changes in that customer's expected long-term value.

Harrah's goes to this much trouble to know its customers, says Nickell, because it learned from mining its Total Rewards database that much of its $3.7 billion in revenues (and 80 percent of its profit) comes from its slot-machine and electronic-gaming-machine players. It is not the high rollers who are the most profitable. In fact, Harrah's discovered that only 30 percent of those who spend between $100 and $500 on each visit bring in 80 percent of Harrah's revenue and close to all its profits. These slots and gaming players are the locals who gamble often.

Using Data Mining to Improve Its Business

"Harrah's Entertainment has the most devoted clientele in the casino business," writes Gary Loveman, CEO.[4] That loyalty is reflected in its bottom line: Its 26 casinos increased their same-store revenues 16 quarters in a row. Data mining has shown Harrah's the link between revenue and customer satisfaction. Customers who report being "very happy with their experience at Harrah's" have increased their spending by 24 percent, whereas those who report being "disappointed" decreased their spending by 10 percent.

Harrah's strategy is to increase loyalty by treating its best customers well. In so doing, Loveman and his predecessor have followed a decidedly different strategy to the casino business than competitors. Others have built lavish facilities and amenities—dazzling attractions in their buildings, high-end shopping malls, spas, and such—to attract new kinds of customers, not just gamblers.

Harrah's has focused on its most lucrative customers—its local slots players—using what Loveman calls a "data-driven marketing" strategy. Rather than devise a marketing strategy first, Harrah's has

(*Case Continued*)

let the data suggest the marketing ideas based on its mining of customer satisfaction surveys and reward-card data. The data suggested that Harrah's could increase loyalty by focusing on same-store revenue growth by encouraging locals to visit their nearby Harrah's casino often using appropriate incentives. Data mining also showed that most locals prefer $60 in casino chips over a free hotel stay with two free dinners and $30 in chips.

To hone customer service even more, Harrah's has divided its Total Rewards program into three tiers—Gold, Platinum, and Diamond—with Diamond customers receiving the highest level of customer service, because they have the highest value. Through mining its customer satisfaction surveys, Harrah's discovered that these gamblers value fast service and friendliness. So Harrah's does its best to make sure they do not wait in line to park their car, check in at the hotel, or eat in the restaurant. And to encourage non-Diamond card gamblers to aspire to receive these same perks, Harrah's makes the differences in service obvious. Marketing to customer aspiration is working "wonderfully," notes Loveman.

Furthermore, because Harrah's sees customer satisfaction as being so important to increasing revenue, it links employees rewards to customer-satisfaction scores on the two important metrics: speed and friendliness. When a casino's rating increases 3 percent on customer satisfaction surveys, every employee in that casino receives a bonus. In 2002, during the recession, when gambling revenues only increased by 1 percent in one city, the Harrah's casino increased its customer satisfaction rating by 14 percent.

In addition, the company is using data mining to understand its individual slot machines, such as why customers prefer some machines over others. From what it has learned, Harrah's has reconfigured its casino floor.

In all ways possible—from the parking valets to the telemarketers to the individual slots themselves—Harrah's is using insights from its data-driven strategy to treat its best customers the way they say they want to be treated and thereby gain their loyalty and more of their gambling wallet share.

Within the first two years of operation of Total Rewards, revenue from customers who visited more than one Harrah's casino increased by $100 million. Due mainly to this program, Harrah's has become the second-largest casino operator in the United States, and has the highest three-year ROI in its industry, notes Nickell. ■

Executive Information Systems

As the name implies, executive information systems (EISs) are systems for use by executives. Originally, some people argued that CEOs would not use computers directly and quoted CEOs who agreed with them. But that has not been the case. Many senior managers have realized that direct access to organizational and external data is helpful. EIS is a particular type of application software that is dedicated to help executives:

- Gauge company performance: sales, production, earnings, budgets, and forecasts

- Scan the environment: for news on government regulations, competition, financial and economics developments, and scientific subjects
- While easing information overload

Using the DDM model described earlier, an EIS can be viewed as a DSS that:

- provides access to (mostly) summary performance data
- uses graphics to display the data in an easy-to-use fashion
- has a minimum of analysis for modeling beyond the capability to drill down in summary data to examine components

For example, if sales in a region are denoted as "red" (meaning, below planned targets), the executive can perhaps drill down by country, sales office, and maybe even salesperson to better understand where the shortfall is occurring (as in the opening scenario in this chapter). The experience at Xerox is an example of the successful development and use of an EIS. In many companies, the EIS is called a dashboard and may look like a dashboard of a car.

CASE EXAMPLE

XEROX CORPORATION

www.xerox.com

Paul Allaire became the executive sponsor of Xerox's EIS project while he was corporate chief of staff. Although he felt that an EIS would be valuable to the executive team, he insisted that it earn its usefulness, not that it be "crammed down their throats." In fact, the system began small and evolved to the point where even skeptical users became avid supporters.

Improved planning was a clear objective from the start. For example, Allaire describes the problem of getting briefing information to executives before regular executive meetings. Due to the time required to prepare the materials and mailing delays to international offices, many executives ended up reading 100 pages or more the night before a meeting without access to related information or time for discussions with staff. When the materials were put on the EIS, the executives had enough information or preparation time to make the necessary decisions.

The EIS helped make strategic planning more efficient and resulted in better plans, especially across divisions. Instead of each division preparing plans that were simply combined, the EIS allowed the executives to explore interrelationships between plans and activities at several divisions. The EIS played an important role at Xerox during Allaire's tenure. ■

Stories like the Xerox case appear frequently in the public and trade press. The implication is that computers are finally being used by executives to help them perform their job better. The underlying message is that executive use is just a matter of installing popular software packages, and the only reason more executives are not using computers is their timidity. However, the situation is not that simple. Successful IT support of executive work is fraught with subtle pitfalls and problems. Consider the following description of a failure.

Doing It Wrong

Hugh Watson, a professor at the University of Georgia, has worked with many corporations in the development of EISs. Watson describes a (hypothetical) company and its well-intentioned effort to develop and install an EIS.[5] The IS director at Genericorp had heard of successful EIS experiences. He thought that such a system would be valuable to his company, so he arranged for a presentation by a DSS vendor, which was well received by the executive team. After some discussion, they decided to purchase the product from the vendor and develop an EIS. The allocated budget was $250,000.

They assembled a qualified team of IS professionals who interviewed executives concerning their information needs (whenever the executives could find the time) and developed an initial version of the system consisting of 50 screens to be used by five executives. The response from these executives was quite good, and in some cases enthusiastic. Several of them seemed proud to finally be able to use a computer, says Watson.

With the system delivered, the development team turned it over to a maintenance team and moved on to new projects. The maintenance team was to add new screens and new users—in short, to evolve the system. Nine months later, little had happened, apparently because other systems maintenance projects had become more urgent. About this time, a downturn in revenue generated cost-cutting pressures on nonessential systems; the EIS was discontinued.

What went wrong? Watson identifies five problems that serve as a guide to the "hidden pitfalls" in developing a successful EIS.

1. ***Lack of executive support.*** Although it has been listed as a potential problem in system development for years, executive support is crucial for EIS for several reasons. Executives must provide the funding, but they are also the principal users so they need to supply the necessary continuity.
2. ***Undefined system objectives.*** The technology, the convenience, and the power of EISs are impressive, maybe even seductive. However, the underlying objectives and business values of an EIS must be carefully thought through.
3. ***Poorly defined information requirements.*** Once the objectives of the system are defined, the required information can be identified. This process is complicated because EISs typically require nontraditional information sources, such as judgments, opinions, and external text-based documents, in addition to traditional financial and operating data.
4. ***Inadequate support staff.*** The support staff must have technical competence of course, but perhaps more important is that they have an understanding of the business and the ability to relate to the varied responsibilities and work patterns of executives. A permanent team must manage the evolution of the system.
5. ***Poorly planned evolution.*** Highly competent systems professionals using the wrong development process will fail with EISs. An EIS is not developed, delivered, and then maintained. It needs to evolve over time under the leadership of a team that includes the executive sponsor, the operating sponsor, executive users, the EIS support staff manager, and IS technical staff.

Although EIS development is difficult, many organizations report that it is worth the effort. Avoiding the pitfalls identified by Watson improves the probability of a successful EIS. Many questions must be answered when considering an EIS. Some of the answers are specific to the organization—who it will serve, where and when it will be developed—so it would serve no purpose to discuss them here. However, the other questions—why, what, and how—have more general answers.

Why Install an EIS?

There are a range of reasons for wanting an EIS. The following motivations are listed in the sequence of strongest to weakest, as far as probable project success is concerned.

- ***Attack a critical business need.*** An EIS can be viewed as an aid to deal with important needs that involve the future health of the organization. In this situation, almost everyone in the organization can clearly see the reason for developing an EIS.
- ***A strong personal desire by the executive.*** The executive sponsoring the project may want to get information faster or have quicker access to a broader range of information. Or the executive might want the ability to select and display only desired information and then probe for supporting detail. Or the executive might want to see information presented in graphical form. Within divisions, once corporate management begins using an EIS, division management feels at a disadvantage without one.
- ***"The thing to do."*** An EIS, in this instance, is seen as something that today's management must have to be current in management practices. The rationale given is that the EIS will increase executive performance and reduce time wasted looking for information.

A strong motivation, such as meeting a critical business need, is more likely to assure top management interest in, and support of, the project. At the other extreme, a weak motivation can lead to poor executive sponsorship of the project, which can result in trouble. Thus, motivation for the EIS is fundamental to its success because it helps determine the degree of commitment by the senior executives.

What Should the EIS Do?

This question is second only to motivation as a critical success factor. It determines the extent to which executives will make hands-on use of the system. It is important that all the people associated with the project have the same understanding of just what the new system is expected to do and how it will provide executive support.

In general, EIS and dashboards are used to assess status. At their heart, both should filter, extract, and compress a broad range of up-to-date internal and external information. They should call attention to variances from plans and also monitor and highlight the critical success factors of the individual executive user. Both are a structured reporting system for executive management, providing them with the data and information of their choice in the desired form. Both are for monitoring what is going on in the company and in the outside world. With this information at hand, executives can work to resolve any problems they uncover.

An EIS or a dashboard can start small and quickly with this data-and-information approach and still accomplish something useful. For example, EIS developers asked the company president of one large insurance company the 10 things he would look at first after returning from vacation. He gave them this list. Two weeks later, they gave him an EIS "system" with those 10 items listed on the main menu as the first iteration of the EIS. The president was delighted and was soon asking for more!

This data-and-information approach uses information the executives already get or would like to get. But the EIS provides it faster, in more convenient form, pulling information together that previously had to be viewed separately and using graphics to aid comprehension. Here is another example of an EIS in the form of a dashboard.

To sum up, the main purpose of an EIS is to help managers learn about their organization, work processes, and how their business is related to the external environment. Another key feature of an EIS is the ability to get data in a timely manner, if not in real time. A major difference between an EIS and a management information system (including personnel management, inventory management, sales, marketing, and production) is not the focus on micro-management. EIS should not be used for the user to gain competitive power. Information should be shared along a team-based structure. EIS should not be used for the user to identify problems and finger-point at colleagues or subordinates. The intent is to promote proactive management as opposed to reactive management with learning, continuous improvement and informed decision making.

Therefore, an organization should select an EIS that facilitates the job of its executives, one that consists of achieving the business mission and objectives.

Like data-mining software, most commercial EISs are available as an add-on to an existing corporate-wide DBMS or ERP. In many industries (for example, pharmaceuticals or food), vendors are selling application-specific EIS to track predetermined trends of a particular industry.

CASE EXAMPLE

GENERAL ELECTRIC

www.ge.com

In Spring 2001, the CIO of General Electric (GE) received the first executive dashboard.[6] Now, most senior GE executives have a real-time view of their portion of GE. Each dashboard compares expected goals (sales, response times, etc.) with actual, alerting the executive when gaps of a certain magnitude appear. The CIO's dashboard, for instance, shows critical GE applications. Green means the system is up and running OK, yellow means there is a problem, and red means the system is down. When systems remain red or yellow for a given time, the CIO can have the dashboard system send an e-mail to the developers in charge. The CIO can also pull up historical data to see whether the event appears to be one-time or recurring.

GE's goal is to gain better visibility into all its operations in real time and give employees a way to monitor corporate operations quickly and easily. The system is based on complex enterprise

(*Case Continued*)

software that interlinks existing systems. GE estimates that it saves $1.6 billion a year from the system.

GE's actions are also moving its partners and business ecosystem closer to real-time operation. For example, GE has installed online kiosks at some Home Depot stores. Customers can order an appliance; choose a delivery date and time; and learn, at that moment, whether that delivery can be made.

Likewise, GE has installed sensors on a number of its products—turbines, aircraft engines, and locomotives, to name a few. These sensors record what is happening on its attached object and transmit that data via satellite to a GE remote monitoring center. If, for instance, there is something wrong with a jet engine, GE learns of that event in real time from the sensor, uses its systems and people to determine a probable cause, and notifies the airline. Likewise, GE can tell its customers how efficiently a GE turbine is running, in real time, and work with the customer on improving that efficiency. ■

Expert Systems

Expert systems (ESs) are real-world applications of artificial intelligence (AI). AI is a group of technologies that attempts to mimic our senses and emulate certain aspects of human behavior, such as reasoning and communicating, says Harvey Newquist,[7] a well-known consultant and columnist in the field. Unlike conventional economic theories or operations research that uses mathematics to model decisions, AI uses reasoning. For example, to predict sales of a product, a manager can use a regression equation to plot the time series of past sales and tries to extrapolate sales for the next period. Also, he can apply a market demand model to estimate the impact of a possible price increase on sales. In the AI world, the manager can implement a business rule that says, "If sales continue to grow for 12 months in a row, then inform management that sales will likely go up for the next period."

Alternately, the manager can build a network of arguments to represent a chain of business reasoning: "If the competitor increases its sales price, the company may follow; if price is increased by more than 25%, sales volume can decrease significantly." In the AI jargon, the relationships between sales, sales price, volume, market demand, etc., is called a semantic net. AI technologies include other applied techniques such as fuzzy logic (approximate reasoning versus precise reasoning), natural language processing (interacting with the computer using a human language), and neural networks (inferring a pattern from seemingly unrelated and related observations).

AI has been a promising technology for at least 40 years. In the early 1990s, that promise finally began to unfold, quietly. In particular, ESs, also called knowledge-based systems, became one of several system development methodologies. They have become a prolific application of AI. The auto industry uses them to troubleshoot robots and check cars for noise and vibration. Telecommunications firms use them to diagnose switching circuits. Financial services firms use them to choose financial planning and tax planning alternatives. And the list goes on.

ESs are not new. The first was the Logic Theorist developed in 1956 by Allen Newell and Herbert Simon of Carnegie-Mellon University together with J. C. Shaw of the Rand Corporation. The field changed in the 1970s with the introduction of two AI languages, LISP and Prolog, which made the systems easier to develop. They brought ESs out of the lab and into businesses. The field changed again with the introduction of PC-based tools, called shells, that used conventional languages, such as C. Today, under the term "intelligent systems," many application-specific systems embed AI features. These include computers installed in vehicles that automatically stabilize the wheel traction in a dangerous turn, washing machines that use fuzzy logic to make sure that linen is not damaged, health care appliances that can interact with a central computer at the hospital when it is needed, and production machines that find the most cost-effective mix of raw materials.

The Components of an Expert System

An ES is an automated analysis or problem-solving model that deals with a problem the way an expert does. The process involves consulting a base of knowledge or expertise to reason out an answer based on the characteristics of the problem. Clyde Holsapple and Andrew Whinston[8] define an ES as a computer-based system composed of:

- A user interface
- An inference engine
- Stored expertise (in the form of a knowledge base)

Note that this definition looks a lot like the description of a DSS given earlier in the chapter.

The user interface is the interface between the ES and the outside world. That outside world could be another computer application or a person. If a person is using the system directly, the user interface contains the means for the user to state the problem and interact with the system. Some systems use multiple-choice graphics, voice, and even animation in the interface. When the system is interacting with another application, though, the interface is the program that presents the facts to the expert system.

The inference engine is that portion of the software that contains the reasoning methods used to search the knowledge base and solve the problem. The knowledge base consists of a set of logics or rules and facts. An example of facts is: sales are low, number of complaints is high. An example of a rule is: if sales decrease and customer complaints increase, then quality may be an issue. The inference engine links different facts and reasoning to reach a solution. When data are needed for inference, and the inference engine cannot find any facts or derived thoughts from the knowledge base, it asks the user questions or attempts to connect to other systems. Furthermore, and unlike conventional systems, ESs can deal with uncertainty. Users can answer, "Yes (0.7)," meaning, "The answer is probably yes, but I'm only 70 percent certain." In these cases, the system may produce several possible answers, ranking the most likely one first.

Knowledge Representation

Knowledge can be represented in a number of ways. Following are three possibilities: cases, nodes in a network, and rules.

Case-based reasoning (CBR). One way to represent knowledge is as a case. ESs using this approach draw inferences by comparing a current problem (or case) to hundreds or thousands of similar past cases. A negotiator who engages in a labor dispute using his experience with an earlier and similar case is using case-based reasoning. CBR is best used when the situation involves too many nuances and variations to be generalized into rules.

Evan Schwartz and James Treece[9] provide an excellent example of a CBR system: the Apache III system used by the intensive care unit at St. Joseph Mercy Hospital in Ypsilanti, Michigan. When 35-year-old Sharon entered the hospital with a potentially fatal respiratory disease, the physicians and nurses in intensive care entered her vital statistics and medical history into a workstation running Apache III. The system drew on records of 17,448 previous intensive care patients to predict whether Sharon would live or die. Its first prediction was that she had a 15 percent chance of dying.

As the statistics were entered daily, the system compared her progress to the base of previous cases. Two weeks later, the prediction of death soared to 90 percent, alerting the physicians and nurses to take immediate corrective action. Then, literally overnight, her chance of dying dropped to 60 percent, and 12 days later to 40 percent. She did recover. The intensive care unit's director credits the system with catching the increased likelihood of death days before his staff would have seen it. The Apache III system is helping the unit respond faster and control costs better.

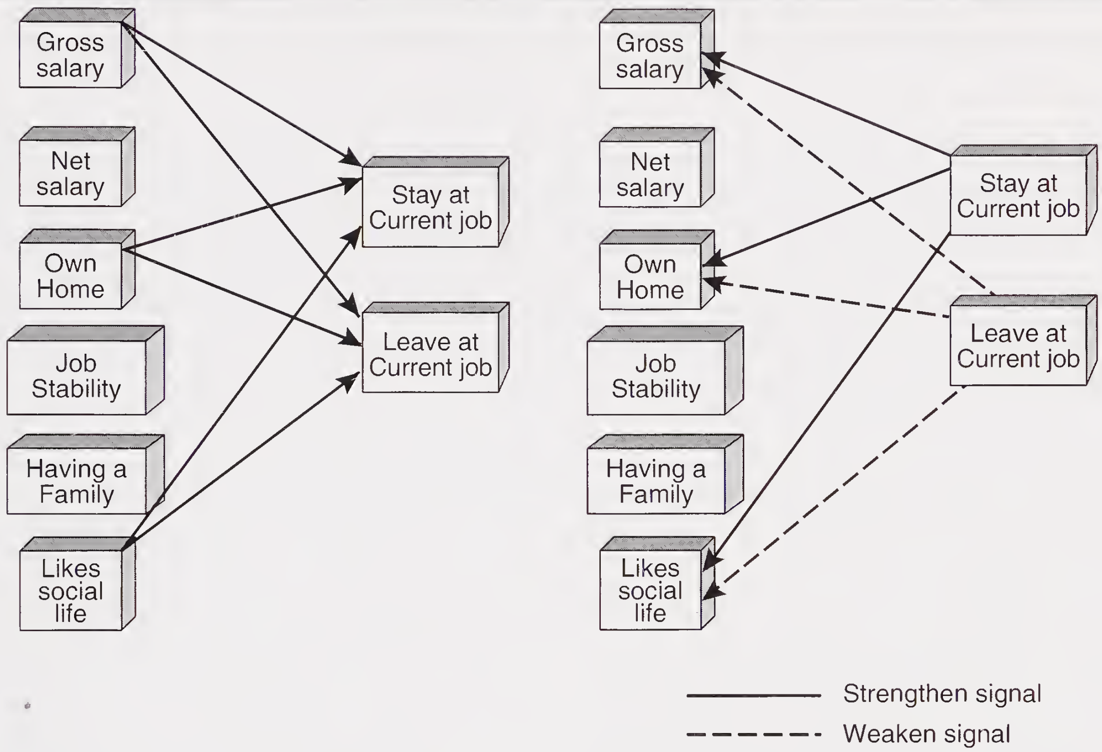
Neural networks. A second way to store knowledge is in a neural network. Although they are not seen as expert systems, neural networks are a type of decision-making system. They are organized like the human brain. The brain is a network of neurons—nerve cells—that fire a signal when they are stimulated by smell, sound, sight, and so forth. As Brian O'Reilly[10] explains, scientists believe that our brains learn by strengthening or weakening these signals, gradually creating patterns. A neural network contains links (called synapses) and nodes that also fire signals between each other. Neural networks are more intelligent than the other forms of knowledge representation discussed here because they can learn.

We present a good description of how a neural network learns by describing how a simple one might evaluate credit applications. As shown in Figure 12-2, the first layer of this neural net has six "neurons" that represent the criteria for distinguishing good credit risks from bad credit risks. The six criteria are gross salary, net salary, own home, job stability, having a family, and likes social life. Each of the six is connected to the two neurons in the second layer: stay at current job and leave current job.

To train the system to distinguish between the two, the network is fed the example of an applicant with a gross salary who owns a home and likes social life. Each of these three neurons sends a signal of equal strength to both the stay at current job and leave the current job neurons because it has not been trained.

The network is trained by telling the two second-level neurons the outcome of this previous loan: It was paid back. The profitable neuron sends a signal back to the three saying, in effect, "You are right, send a stronger signal next time." The leave the current job neuron, on the other hand, replies with, "You are wrong, send a weaker signal next time." The network is then given many more examples so that it learns the predictors of stay at the current job and leave the current job, readjusting its signal strengths with each new case.

FIGURE 12-2 Training a Neural Network



Source: Brian O'Reilly, "Computers That Think Like People," *Fortune*, February 27, 1989, pp. 90–93.

Once the network is trained, the gross salary neuron might send a signal worth 10 points to the stay at the current job neuron, whereas the home-owner neuron might send only 2 points. And the job stability neuron may send 2 points to the leave the current job neuron and a minus 2 points to the stay at current job one. Because liking a social life is irrelevant, it will send zero points to both. New applications will be evaluated based on these learned patterns.

Neural networks have been used by an automaker to detect defective motors, by oil drillers to describe the progress of underground rock cracking based on sensor data, by a manufacturer to track manufacturing variations to determine the optimum manufacturing conditions, and by computer manufacturers to recognize hand printing.

Rule-based systems. A third way to store knowledge in an ES knowledge base is through rules. In fact, this is the most common form of knowledge representation. The rules are obtained from experts who draw on their own expertise, experience, common sense, ways of doing business, regulations, and laws to state the rules. Rules generally present this knowledge in the form of if-then statements. The number of rules determines the complexity of the system, from a few to many thousands. Rules are appropriate when knowledge can be generalized into specific statements. Knowledge acquisition is a tedious and expensive process. However, once transferred to the ES, and validated with real-life situations, the knowledge in the expert system can be deployed to automate a number of highly structured and well-defined decisions that would have been taken by human experts, an expensive resource that can be used for more productive tasks.

One of the first commercially successful ESs was built by American Express. It is still in use today and is actually a fundamental part of the company's everyday credit card operation. It is a rules-based ES. Here is that story.

CASE EXAMPLE

AMERICAN EXPRESS

www.americanexpress.com

In 1988, American Express (AmEx) implemented the Authorizer's Assistant, an ES that approves credit at the point of sale. It started as an R&D project, took two years to develop, and was put into production with 800 rules. Today, it has over 2,600 rules and supports all AmEx card products around the world. Its purpose is to minimize credit losses and catch fraud. It saves the company millions of dollars a year and has been a phenomenal success.

Whenever an AmEx card is run through a point-of-sale device, the transaction goes into AmEx's credit authorization system (CAS), which is a very important system for AmEx because, in essence, it gives away money. CAS is implemented worldwide and operates 24/7. It is such a significant system that the company president is notified if it is down for 45 minutes or more.

Co-processor systems, such as the Authorizer's Assistant, have been added to CAS. The Authorizer's Assistant authorizes credit by looking at whether cardholders are creditworthy, whether they have been paying their bills, and whether a particular purchase is within their normal spending patterns. It also assesses whether the request for credit could be a potential fraud. Before deploying Authorizer's Assistant, transactions that were not automatically approved by CAS were referred to a person for analysis and a decision. The most difficult credit-authorization decisions are still referred to people, but the Authorizer's Assistant has automated judgment to raise the quality of authorization decisions.

Authorization decisions are driven by the type of credit charge—store, restaurant, and so on. They are also influenced by whether cardholders are in their home city, on vacation, or traveling. A hotel bill or charges in a city other than where they reside would point to the latter. To detect fraud while someone is on vacation, the credit authorizer looks at the number of charges per day. An appropriate question for the system to ask would be, "Is the cardholder's spending velocity 'in pattern' (following his or her typical spending pattern)?" Customer-servicing issues and credit policies are also taken into account in the authorization decision. For example, a restaurant charge needs to be handled differently from a camera store charge, because the restaurant charge happens after the service has been rendered and the purchase, unlike a camera, cannot be resold. AmEx also does not want to embarrass a cardholder in the social setting of a restaurant.

(*Case Continued*)

Development of the System

The Authorizer's Assistant is a rule-based expert system, and in creating the rules, AmEx had to refine its company policies. One example was the commonly used phrase "sound credit judgment." Before the system was built, this phrase was often used but never defined. Developing the system forced the company to define the phrase in quantifiable rules.

A rule might be framed in terms of the question, "Does this person shop at this store or often buy this kind of merchandise?" If the answer is "yes," the charge would be "in pattern." If the amount is high, another rule might ask, "Does the cardholder pay his or her bill on time and is his or her 12-month credit history good?"

The rules were generated by interviewing authorizers with various levels of expertise. Five were assigned to work with the developers. Some were the top experts (who made correct decisions at least 90 percent of the time); others had a track record of being right only 80 to 89 percent of the time. Both types of experts were used so that the developers could compare good and not-so-good decisions.

To codify the experts' knowledge, the developers studied individual charge histories in detail, broke down the decision process into its components, and focused on each one to refine it. Sometimes they also proposed cases to the experts and recorded the information they asked for to make a decision.

Two kinds of knowledge are captured in the Authorizer's Assistant: policy knowledge and judgment knowledge. Policy knowledge is like textbook knowledge. Judgment knowledge is applied to bend the rules set down in the policy to benefit the cardholder (and keep his or her business). This type of knowledge is very important because it enhances customer service in the eyes of cardholders. Thus, the rules in the system protect the company against loss and the cardholder from embarrassment.

The seven developers also spent several weeks working in the credit authorization environment so that they could understand what the experts were talking about. The system was designed to mimic how people made credit authorization decisions. The knowledge engineers (developers) thus had to develop expertise in credit and fraud as well as in the analysis of cardholder charge patterns. In essence, they acted as credit authorizers for a short time, talking to real cardholders and making authorization decisions on the telephone on the fly. This experience helped them realize how time-sensitive authorization decisions can be. The cardholder may be waiting at an airline counter to get the charge approved; a delay could cause the cardholder to miss the flight. The system had to be designed to deal with this type of customer-sensitive situation; AmEx does not want to embarrass a cardholder by bringing him or her to a telephone unnecessarily.

The vice president of risk management states that the system can be adapted quickly to meet changing business requirements. For example, if a large manufacturing company falls on hard times, AmEx can change the rules that apply to the cities where that company is a major employer so that it can respond compassionately and quickly to credit issues that inevitably will arise. In all, management reaction to the Authorizer's Assistant has been very positive. ■

Degree of Expertise

The degree of expertise in an ES can be characterized by the kind of assistance it might provide to a person. It might function as an assistant, a colleague, or a true expert.

As an assistant, the lowest level of expertise, the ES can help a person perform routine analyses and point out those portions of the work where the expertise of the human is required. The Dipmeter Advisor, developed by Schlumberger Ltd., falls into this category. It reads charts produced by instruments that have been lowered into an oil well that is being drilled. Reading such charts, looking for a small amount of significant data, is a tedious job for humans. The ES reads the charts and indicates those portions where human experts should concentrate their attention.

As a digital co-worker, the second level of expertise, the system and the human can "talk over" the problem until a "joint decision" has been reached. In this use, the human may employ the "why" and "how" features of the ES to understand the system's train of logic. ESs move beyond the capabilities of DSSs because they are not only able to solve a problem but also explain to some extent how they solved the problem, and provide a reliable means of solving similar problems. When a colleague system seems to be going down the wrong track, the human can put in more information to get it back on track to reach a joint decision.

As an expert, the highest level of expertise, the system gives answers that the user accepts, perhaps without question. This means that the system performs as well as the top 10 to 20 percent of the human experts in the field.

Agent-Based Modeling

Agent-based modeling is a simulation technology for studying emergent behavior; that is, behavior (such as a traffic jam) that emerges from the decisions of a large number of distinct individuals (drivers), notes Eric Bonabeau, president of Icosystem, which builds such modeling systems.[11] Each driver is an agent with his decision-making ability that helps him drive the car. When all drivers are involved in a heavy traffic, without having to talk to each other, they collectively manage the traffic in a "self-organized" manner. Concurrently, they negotiate turn, decide when to change lane, when to reduce speed to let other take over, etc. Somehow, the traffic flow is rather satisfactory.

In agent-based modeling, the simulation contains computer-generated agents, each making decisions typical of the decisions an individual—the drivers in the example above—would make in the real world.

A software agent is a program that performs a specific task on behalf of a user, independently or with little guidance. Like a human agent, a software agent possesses certain skills and knowledge to interact with the user(s) or other applications (cooperation, communication, command and control). A software agent consists of the following components:

- User-agent interface to interact with the user or another software application or software agent
- Processing engine to perform the intended task
- Procedure repository that store data that are needed to run the intended task

Agents are the result of a paradigm shift in developing appplication software. Software is no longer regarded as a preprogrammed, predetermined tool. Rather, it is considered as an autonomous assistant to the users—simulating a human relationship, hence the word "Personal Assisant" in the software development literature.

Here are some examples. If modeling a day at a theme park, the agent representing a family of four would make different decisions than the agent representing teenagers on a date. Bonabeau believes modeling the confluence of a huge number of individual behaviors underlies understanding the mysteries of why businesses, markets, consumers, and other complex systems behave as they do. In modeling the behavior of highly complex systems via individual agents, agent-based systems often arrive at counterintuitive results. He states that this decision-making technology can be used to predict the unpredictable, and he gives numerous examples of how it has been used. Here are just a few.

- Nasdaq was going to switch its tick size from eighths to decimals, believing that the change would allow stock buyers and sellers to negotiate more precisely and decrease the buy–ask price spread. Using agent-based modeling, with agents representing all the players in its stock market, each making decisions based on real-world strategies, Nasdaq found that the smaller tick size would actually increase the buy–ask price spread because it reduced the market's ability to do price discovery.
- A European retailer wanted to redesign its incentive plan for its country managers. At the time, incentives were based on having the fewest stock-outs (a product running out of stock on the shelves). However, this incentive encouraged hoarding, spoilage, and high-cost rush orders. Agent-based modeling recommended basing incentives both on low stock-outs and on storage costs, because it would connect managers' local behavior with the organization's global performance.
- Southwest Airlines wanted to revamp its cargo operations. The dispatchers loaded cargo onto the flight that would reach the destination soonest. But the result was piles of packages at the end of the day, high security costs, and endless loading and unloading of packages. Agent-based modeling found that costs would be lower and packages would arrive just as quickly by putting them on a plane that would eventually land in the destination city.[12]
- A company planned to change its recruiting practices from hiring college graduates who fit its company culture to hiring experienced people. Agent-based modeling demonstrated that this change would lead to higher staff turnover (which the company had expected) and a decrease in the company's knowledge base (which the company had not expected). Thus, if it was to change recruiting practices, it would need to find ways to capture the knowledge of experienced employees before they left.

These five seemingly competing technologies that support decision making often overlap and combine. For example, some DSS products incorporate tools and techniques from AI. In the form of agents, DSSs are providing the delivery vehicle for ESs, knowledge representation, natural language query, and voice and pattern recognition. The result is intelligent DSSs that can suggest, learn, and understand managerial tasks and problems. Likewise, data mining is often part of a DSS or EIS. The next section demonstrates how these decision support technologies and other technologies are being mixed and matched to form the foundation for the real-time enterprise.

TOWARD THE REAL-TIME ENTERPRISE

The essence of the term "real-time enterprise" is that organizations can know how they are doing at the moment rather than waiting days, weeks, or months for needed information, as has been the case. It is often equated to an airline pilot trying to fly the plane using time-delayed sensors or trying to drive a car without split-second information about what is happening on the highway. The real-time enterprise would be one that is able to function based on real-time information.

Through IT, organizations have been able to see the status of operations closer and closer to real time. The Internet is giving companies a way to disseminate closer-to-real-time information about events, such as a large customer order or cancellation, a supply-chain disruption, weather or governmental disruption, important news, and so forth.

The notion has gotten to the hype point. It is prominent in vendor advertising. That means the notion has some validity, but it is not as easy to achieve as vendors might lead you to believe. This real-time reporting is occurring on a whole host of fronts. Following are just five of those fronts: enterprise nervous systems (to coordinate company operations), straight-through processing (to reduce distortion in supply chains), real-time CRM (to automate decision making relating to customers), communicating objects (to gain real-time data about the physical world), and vigilant information systems (to move to a sense-and-respond culture).

Enterprise Nervous Systems

One approach to the real-time enterprise is to build an enterprise nervous system. In an interesting white paper from Tibco and Gartner,[13] the two companies state that an enterprise nervous system (the technical means to a real-time enterprise) is a kind of network that connects people, applications, and devices. This system differs from many past systems in four ways:

1. It is message based, which means that applications, devices, and people communicate with each other via messages. As the Internet has shown, sending messages is a very efficient and effective way of dispersing information among huge numbers of parties.
2. It is event driven, which means that when an event occurs—a car arrives at a dealer's lot, a passenger boards a plane, a factory ships a truckload of parts—that event is recorded and made available.
3. It uses a publish-and-subscribe approach, which means that the information about the event is "published" to an electronic address and any system, person, or device authorized to see that information can "subscribe" to that address's information feed, which is automatically updated whenever a new event occurs. Portal technology has a similar self-service characteristic. A company posts information on its portal, and if you are authorized to see that information, you can access it when you want, or subscribe to receive it automatically in real time. This approach is one way to inform hundreds, thousands, or millions of people or systems of an event in real time in a format customized to their system or device.

4. It uses common data formats, which means the data formats used in disparate systems are reduced to common denominators that can be understood by other systems and shared.

Here is an example of one such nervous system.

CASE EXAMPLE

DELTA AIR LINES

www.delta.com

Delta Air Lines has implemented an enterprise nervous system that is, over time, incorporating the disparate systems the airline had in the late 1990s. At that time, Delta had 60 million lines of code, 70 databases, and 30 technology platforms, most of which did not communicate with each other or share their data, notes Tom Stewart.[14]

Now, Delta has a nervous system that has gotten rid of over 30 of the databases and one-fourth of the code, and the consolidation is continuing. This system manages the airline's gate operations. Delta has 2,200 flights a day, one every 39.3 seconds, says Stewart. Each is managed by the system, in real time. When a flight has a gate change, for example, everyone who needs to know about that change—gate attendants, baggage handlers, caterers, passengers—gets the data in the appropriate way. Passengers, for instance, receive the information on screens above each gate.

The system was installed by the Feld Group, notes Stewart, led by Charlie Feld, the former CIO of Frito-Lay, who installed a real-time system at Frito-Lay and has gone on to do the same at a number of other companies. At Frito-Lay, all of the sales force had laptops to record every sale in real time; all the executives had PCs to see the sales. As a result, Frito-Lay took back $40 million less in stale product each year, sales force paperwork dropped by 40,000 hours a year, and Frito-Lay's revenue increased from $3 billion to $4.2 billion in just three years.

At Delta, Feld drew on software from Tibco, which provides the foundation for the enterprise nervous system. Feld believes the best way to get a real-time enterprise is to use a publish-and-subscribe approach using EAI products. Using the Tibco products, which include a type of messaging middleware, disparate applications can talk to each other. The software puts the data in these systems into common forms so they can be understood by the numerous applications.

Generally, to start down this EAI path, a company needs a system that is large enough to affect customers, impress the CEO, and intrigue the IT organization, states Stewart. At Delta, this first system was a new gate-and-boarding system. The system is big, it is used by

(*Case Continued*)

60,000 Delta employees and 100 million customers, and it affects everything from maintenance crews to reservation clerks to Delta's frequent flyer program. Formerly, the various functions had their own systems and databases. The new system replaced them all with one set of data. Now, when an event occurs, it ripples to everyone. Delta is now expanding those ripples out to its partners who also serve its passengers: caterers, security companies, and such. ■

Straight-Through Processing

The notion of a real-time enterprise has generated two buzzwords worth knowing. One is zero latency, which, according to Gartner EXP, was coined in 1998 and means reacting quickly to new information (with no wait time). The premise is that faster action leads to a competitive edge.

The second term is straight-through processing, which means that transaction data are entered just once in a process or a supply chain. The Delta example shows straight-through processing within an enterprise. The notion applies even more in supply chains. In fact, reducing lags and latency in supply chains is a major goal these days.

As the *Economist* points out, supply chains experience a bullwhip effect when they do not have straight-through processing. A customer order can trigger a company to generate an order to its supplier, who, in turn, generates its own orders to its suppliers. But generally, these orders are larger because the supplier wants to compensate for unforeseen events. Those upstream suppliers, in turn, order from their suppliers, and their orders are often larger as well. Moving upstream through the supply chain there is increasingly greater variance from the original order. If the customer then cancels the order, that cancellation ripples through the supply chain with the upstream firms experiencing the bullwhip effect (a small change by a customer results in a huge change upstream).

Real-time information through the supply chain would likely reduce that ever-growing discrepancy from reality and thus reduce the bullwhip effect. In short, if this supply chain had straight-through processing, the original customer order would be entered only once and all suppliers at all levels in the chain would see the original order and respond accordingly. This is a tall task, but the approach being used is similar to the enterprise nervous system with events, messaging, and publish-and-subscribe features.

Real-Time CRM

Another view of a real-time response might occur between a company and a potential customer, perhaps via a customer call center or a Web site. Following is an example of real-time automated decision making using some of the technologies discussed in this chapter.

CASE EXAMPLE

A REAL-TIME INTERACTION ON A WEB SITE

www.ssaglobal.com

As an illustration of a real-time interaction via a Web site, consider an example from E.piphany,[15] a company that sells real-time CRM software as a component of its suite of CRM products. E.piphany was acquired by INFOR SSA Global. Its CRM software is now called an Infor CRM Solution. Following is the sequence of events (1 to 11), as noted in Figure 12-3:

1. A potential hotel guest visits the Web site of a hotel chain that uses CRM software.
2. The site visitor clicks on a hotel in the Orlando area. Information on that real-time event flows to the real-time server powered by the software.
3. The server initiates a number of requests to create a profile of that customer.
4. It may request past history of interactions with that customer from the data mart. Those interactions would include not only Web site interactions but also call center interactions, hotel stays, and so on.
5. The server may request past billing information from the chain's ERP system.
6. It may want past purchase history from the hotel's e-commerce system.
7. Using all those pieces of information, the server then uses its analytics to make some real-time offers to the Web site visitor.
8. If it is off-season in Orlando, hotel management may have created a business rule that says, "For any repeat customer considering booking at least a 2-night stay at this hotel in off-season, offer a 20 percent discount." If, indeed, this customer has stayed at the chain before, the server can make that offer on the spot, probably in a very noticeable pop-up box on the Web site.
9. Or the server might use the real-time mining tool to make an offer based on the customer's past stays at the hotel, having mined that information from the compiled profile. For instance, it might ask if the customer still wants a king-size bed in a nonsmoking quiet room, as in the past.
10. Or, using the collaborative filtering technology, based on preferences of other hotel guests with a similar profile, the system might offer three special choices: a laptop computer in the room, a bottle of wine, or a half-hour massage at the hotel's spa. Generally, the real-time

(Case Continued)

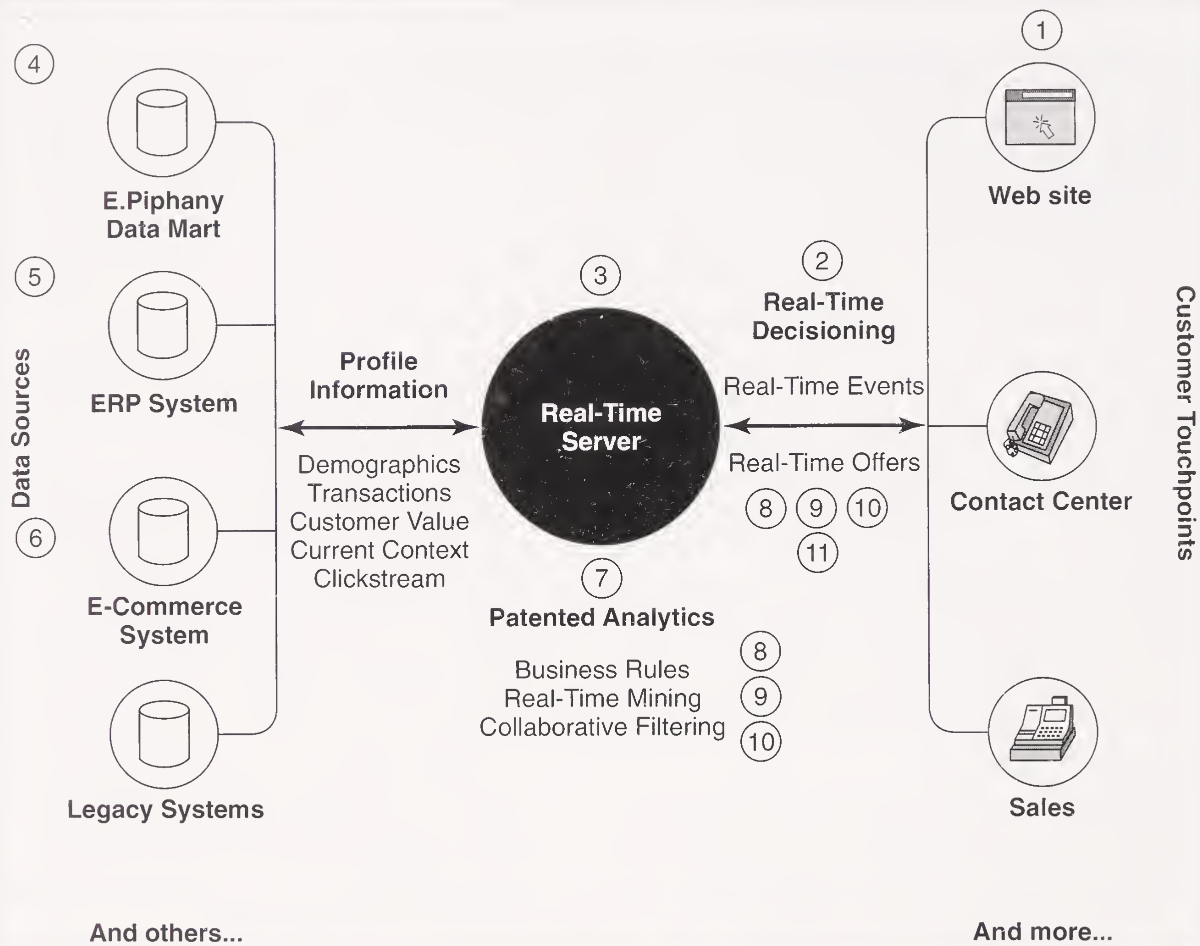


FIGURE 12-3 A Real-Time Interaction on a Web Site

Source: Reprinted with permission of E.piphany, Inc.; www.epiphany.com (now www.ssaglobal.com).

mining and collaborative filtering tools are used together.

11. The Web site visitor's responses to all the offers are recorded and taken into account by the software and used when making offers to other Web site or call center visitors.

In a call center, the call center representatives would have the same kinds of technology support for making decisions and verbally making these offers (and recording responses) over the phone.

Besides the real-time nature of this interaction, another feature is that the system learns from each interaction. Thus, it includes the latest responses in its real-time decision making and offers, keeping up with trends and honing its knowledge of clusters of customers and noncustomers. ■

Communicating Objects

The notion of the real-time enterprise is intriguing for yet another reason. The *Economist* articles on the subject mention sensors and tags that provide information about the physical world via real-time data. We take the editorial freedom of calling them communicating objects.

A communicating object can tell you what it is attached to, where it is located, where it belongs, and a lot more information about itself. Technically speaking, such an object is a radio frequency identification device (RFID). It is a small chip that contains information about the object it is attached to, such as a jet engine, a hotel uniform, or a package—anything someone wants to keep track of.

As Glover Ferguson[16] of Accenture explains, communicating objects are also called smart tags. They can be as small as a match head, and they are implanted on a wafer surrounded by a coil of wire that serves as the tag's antenna. The antenna allows the tag to be polled by a reader that passes within a few feet. The tag can be passive (read only) or active (send out signals). Those that are larger can be read from farther away. Any number of tags can be read by a reader at once, so multiple items on a pallet can be read simultaneously, not one at a time, even in harsh weather conditions. Most importantly, these tags can carry far more information than their predecessors' bar codes. They can carry the history of an item, not just its ID code and price.

In 2003, RFID became a hot technology because Wal-Mart announced that by January 2005 it wanted its top suppliers to place RFID tags on all pallets, cases, and high-ticket items. (Wal-Mart's schedule has since been extended.) The U.S. Department of Defense announced its own initiative the same year. Foreseeing the impact of RFID technology in 1997, the Uniform Product Council (UPC) began an initiative called "Sunrise 2005" to encourage retailers to make their systems RFID compliant by that time. The UPC recognized that bar codes have 11 digits, but that the electronic product codes (EPCs) used by RFID have 13 digits. Retrofitting legacy systems to accommodate the two additional digits is akin to the Y2K challenge CIOs faced in the late 1990s. Efforts to retrofit the old bar code system to the new EPCs required for RFID will be mammoth.

RFID presents a number of potentially other large costs to CIOs. The tags can accumulate histories of products. How much more storage and bandwidth will a company need to capture and communicate all these data? Where should the data be stored and for how long? What sorts of new programs will be needed to analyze the data? In short, CIOs need to understand how well their existing architectures and infrastructures can accommodate RFID and the changes that will be needed, notes Levinson, a writer for cio.com.[17] And, as will be noted in Chapter 14, advocates of consumer privacy are concerned about RFID tags placed on individual products.

Ferguson believes smart tags are going to transform industries because one day they will talk to one another, which will change how work is handled. For example, Seagate, the disk drive manufacturer, has a smart tag on each individual disk it manufactures. Each type of disk must go through a specific sequence of processes, depending on its type. The checklist on the tag directs it through the correct sequence and ensures that each step is completed before the next one begins. The tags have allowed Seagate to uncover more sources of production errors than in the past, notes Ferguson. A key is the object's ability to capture new information.

Communicating objects are also major theft-prevention devices because they are cheap enough to affix to often-stolen items, such as cartons of liquor and PC motherboards. In the case of motherboards, when one is illegally taken off-site, it can automatically be disabled by the owner, thereby preventing its use. Tags can even be more effective than a set of keys in safeguarding a location, notes Ferguson. People entering an area may be required to wear an RFID wristband. Likewise, these tags can keep people with Alzheimer's disease in appropriate areas, sending out a warning when they are beyond the bounds of their facility or are near a dangerous area, such as a staircase.

Ferguson notes that this technology gets really interesting when objects begin communicating with each other, which he calls object-to-object communication. Theft prevention is a stand-alone application, and new forms of inventory management (say, by a business partner) are a "four walls" application. At first, PCs were stand-alone and used within companies. But the Internet unleashed entirely new uses of PCs and their successors. The same will happen with smart tags, predicts Ferguson.

With these objects, a whole new "silent commerce" will emerge. "Fresh" fish will be able to tell you if they are really fresh, because their smart tag can tell you whether they have been frozen at any time since being caught. Variable pricing could become more of the norm. In Singapore, for instance, cars carry smart tags, and drivers are charged variable prices for where they drive in the city and when. The prices are set to encourage or discourage driving at different places at different times. It is an example of real-time traffic control.

Vigilant Information Systems

The premise of the real-time enterprise is not only that it can capture data in real time, but also that it has the means to act on that data quickly. One theory for how to act fast was espoused in the 1950s by Colonel John Boyd, a U.S. Air Force fighter pilot.[18] He believed he could win any dogfight in 40 seconds (or less). In fact, he put money on his ability. He challenged any fighter pilot, stating that starting from any position of disadvantage he would have his jet on the challenger's tail within 40 seconds or he would pay the other pilot $40. He is said to have never lost a bet, even to pilots in superior aircraft.

He called his theory the OODA (Observe, Orient, Decide, Act) loop because it consisted of the following four actions:

- Observe where the challenger's plane is,
- Orient himself and size up his own vulnerabilities and opportunities,
- Decide which maneuver to take, and
- Act to perform it before the challenger could go through the same four steps.

Boyd's goal was to operate inside his challenger's loop, that is, to take the four steps faster. By outthinking other pilots, he could outmaneuver them, which often led to confusing them. An OODA loop is shown in Figure 12-4.

Western Digital has used this type of thinking to move itself closer to operating in real time with a sense-and-respond culture that aims to operate faster than its competitors.

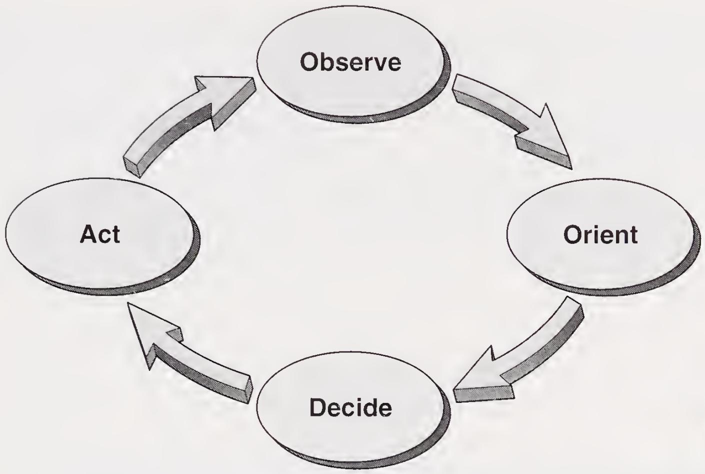


FIGURE 12-4 An OODA Loop

CASE EXAMPLE

WESTERN DIGITAL CORP.

www.westerndigital.com

Western Digital, with headquarters in Lake Forest, California, manufactures hard drives for PCs, storage systems, and home entertainment systems. It has nearly 17,000 employees, revenues of $3 billion a year, manufacturing plants in Malaysia and Thailand, and customers around the globe.

The industry has short product cycles and experiences intense competition, which keeps product quality high and prices low. Western Digital's main challenge has been to keep up with customers' relentless demands for more storage and faster access while keeping its costs down.

Companies that have not kept up have not survived. Western Digital has survived, even excelled, notes Robert Houghton, Western Digital's CIO, and his coauthors.[19] IT and OODA-loop thinking have been part of this success, providing management with integrated data to manage enterprise-wide and the ability to respond to changes more rapidly.

The Underlying Vigilant Information System

Houghton's IS organization built what they call a vigilant information system (VIS), which Houghton et al. define as a system that is "alertly watchful." It is complex, and it builds on the firm's legacy systems. It essentially has four layers, as shown in Figure 12-5:

- ***Raw data layer.*** The first (bottom) layer consists of raw data from customer orders, customer payments, costs of drives, test data on drives, and so on.
- ***Functional application layer.*** The second layer, the observe layer, consists of the transaction systems (ERP, point of sale, logistics, etc.)

(*Case Continued*)

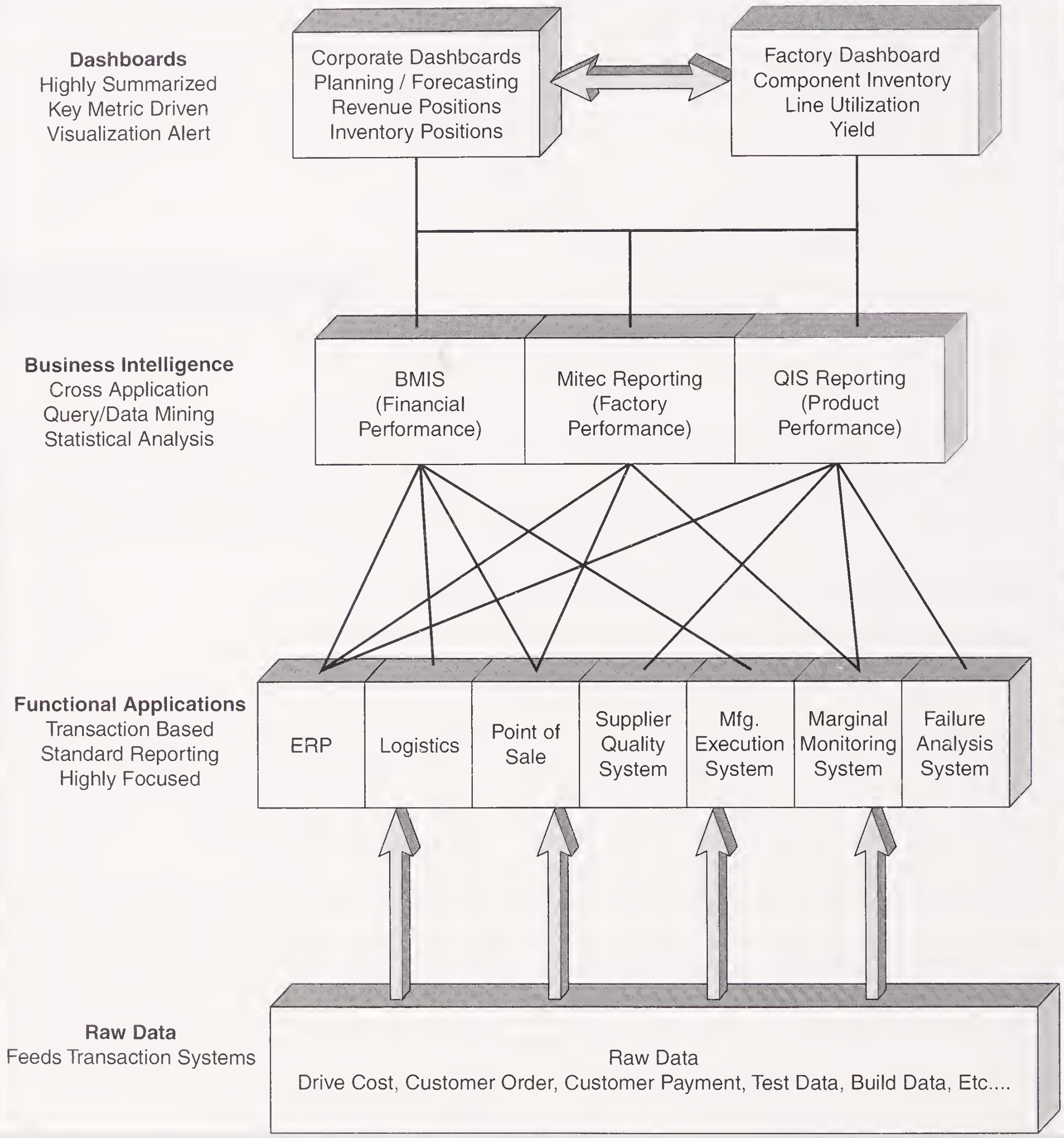


FIGURE 12-5 Architecture of Western Digital's Vigilant Information System

Source: R. Houghton, O. El Sawy, P. Gray, C. Donegan, and A. Joshi, "Vigilant Information Systems for Managing Enterprises in Dynamic Supply Chains: Real-Time Dashboards at Western Digital," *MIS Quarterly Executive*, Vol. 3, No. 1, March 2004, pp. 19–35. Used with permission.

that Western Digital uses to run its business. Each application performs its specific functions using the raw data from the first layer.

- ***Business intelligence layer.*** The third layer, the orient layer, consists of analysis and reporting systems that use data from the data

(*Case Continued*)

warehouse (drawn from the second layer systems) to analyze Western Digital's performance—financial, factory, and quality performance.

- ***Dashboard layer.*** The top layer, the decide and act layer, consists of two types of dashboards, one for use in factories (to optimize operations) and one for use by corporate (to plan and forecast). The dashboards display key performance indicators and metrics, they permit drill down, and they issue alerts when data are not within preset boundaries. Western Digital employees use this layer to decide what to do and, in some cases, initiate actions via the dashboard.

The dashboards give factory and corporate management real-time visibility into operations. Houghton et al. define real time as being "sufficiently vigilant for the process being monitored." Thus, for the factory dashboards, real time means "as close as possible to real time." For the corporate dashboards, real time means "after the data has been validated and synchronized among the data feeds so that all the noise has been filtered out." It is the links between these four layers that have turned Western Digital's formerly disparate systems into a coordinated vigilant information system that funnels the appropriate real-time data to the dashboards.

The Changed Business Processes

As important as the underlying VIS is, it had to be complemented by appropriate business processes to give Western Digital a way to operate inside its competitors' OODA loops. Management knew that new dashboards on their own would not change the company's decision-making culture. Therefore, three new company policies were drafted to leverage the VIS:

1. The company's strategic enterprise goals must be translated into time-based objectives and aligned across the company so that management has one set of metrics to manage.
2. Key performance indicators (KPIs) must be captured in real time, and be comparable, so that teams can compare operations across groups and business units, thereby improving performance company-wide.
3. Decision making should be collaborative, to coordinate actions company-wide. To achieve this new style of working, the dashboards have become the focal point in many regularly scheduled meetings, and teams have worked to ensure that people with different expertise are involved in the meetings, from afar, if necessary. It has taken teams quite a while to figure out what information others need to participate in decision making while being "virtually there" rather than in the room.

Each dashboard contains its appropriate real-time metrics and KPIs, and each metric and KPI has its own target level and a variance setting. When a variance is exceeded, the appropriate executive is alerted.

The Shop-Floor OODA Loop. The shop-floor supervisors in the factories, who manage closest to real time, operate on

(*Case Continued*)

the tightest OODA loop. They receive a page or a flashing light on their dashboard when one of their variances is violated. The time from alert to action is often minutes, rather than the former hours or days. Sometimes, they can diagnose and resolve the problem using their dashboard because the dashboards can be used to initiate actions.

The Factory OODA Loop. The production managers, who oversee multiple production lines, operate on an OODA loop that is not as tight as the shop-floor OODA loop. They, too, receive alerts, but a more important use of their dashboard is at their daily production meeting, where they assess yesterday's performance and discuss ways to improve operations. The "yesterday problems" already handled by the shop-floor supervisors are filtered out. So the production managers only see the unresolved issues, which reduces their information overload and quickens their OODA loop, note Houghton et al. As a result, their daily production meetings have dropped from 5 hours to 1.5 hours. These meetings involve 15 people, so the dashboard system provides production managers significant time savings in these meetings alone. The system has also reduced micro-management; there is no longer haggling about who has the right data because they all see the same data.

The production managers also use their dashboard in a learning mode, performing "health checks" of the operational aspects of the factory to see what is and what is not functioning well. Western Digital has learned that the shorter the OODA loop, the more frequent the health checks need to be, state Houghton et al.

The Corporate OODA Loop. Corporate executives receive alerts on their dashboards, and they find they can uncover root causes faster because of the dashboards, note Houghton et al. But they mainly use their dashboards to perform health checks for the enterprise as a whole. Their OODA loop is not as tight as the factory loop, but their decisions often affect the factories. Many decisions require consultation with others, so people routinely send screen shots or references to screens to others so that they all see the same data when discussing an issue.

Benefits of the VIS

The VIS has, indeed, quickened all three OODA loops and helped to link decisions across them. Management's goal is to be able to initiate a change in the factories in the same work shift as the company receives a change request from a customer. When it reaches this speed of responsiveness, it believes it will gain market share, note Houghton et al.

Corporate performance has already improved measurably. Margins have doubled since the dashboards were implemented over three years ago. Management attributes the increase, in part, to the dashboards because they have helped improve data visibility, supply-chain management, and demand planning.

The VIS is moving Western Digital toward a sense-and-respond culture where it learns and adapts quickly in a coordinated fashion. The sensing (observe and orient) is handled by the VIS, whereas the responding (decide and act) is handled by the people. In this environment, timing is important. There is no point in accelerating sensing if no action can be

(*Case Continued*)

taken, and there is no point in accelerating responding if there is no fresh information. The two need to be in sync, note Houghton et al., which is how Western Digital's three-nested OODA loops now work. ■

Requisites for Successful Real-Time Management

Given the advantages of more real-time activities, what are the disadvantages? Glover Ferguson[16] believes that object-to-object communication could compromise privacy. He asks, "At what point does an object's ability to track, record, and communicate with other objects invade an individual's rights?" There is no cut-and-dried answer; it depends on the circumstances. It is a political issue, not a technical one, and many CEOs are going to face this question in the future, Ferguson believes. Does knowing the exact location of a company truck every minute of the day and night invade a driver's privacy? Can citizens disable their smart cars to drive where they please without being tracked? The answers, notes Ferguson, lie in CEOs understanding the context of the use of smart tags and the sensitivities that can arise in those contexts.

Omar El Sawy[19] points out that in the era of speed, a situation can become very bad, very fast—much faster than in a slower economy. He believes that speed must be balanced with caution. People in a high-speed environment need deep visibility into the workings of their environment and must watch constantly for signals that something bad is likely to happen.

It is worth noting that when the New York Stock Exchange allowed programmed trading (stock trading by computers rather than people), the exchange learned after a bad experience that it also had to introduce "circuit breakers" to stop deep dives in the market caused by the systems reacting so quickly to actions by other systems. Enterprises may need to introduce similar kinds of circuit breakers when they depend heavily on systems to make decisions and perform actions for them.

Keeping these disadvantages and challenges in mind, there are, however, a number of critical areas where a company can successfully deploy real-time management.

- ***Real-time data and real-time performance indicators:*** Management uses a variety of performance indicators to keep track of the organization's effectiveness. Not all metrics need to or can be in real time. Not all aspects of the organization need to be provided in full detail. Attention should focus on a few high value-added real-time data that could make a difference for the users. Cost information during a sales transaction would be an example. Therefore, the company should conduct an assessment to clearly identify what key activities need to have real time (see Chapters 1 and 2), and what performance indicators are needed in real time to help users adjust their decisions.
- ***Technology readiness:*** Running a real-time platform requires substantial computing resources. Ideally, an inter-organizational ERP would be adequate

to feed the data into a system that is capable of selecting, filtering, and compiling data to send them in real time to the designated users. Without an integrated and seamless platform, creating real-time data may slow down other activities. As discussed throughout this text, mobile and Web Services are a requisite for the real-time enterprises.

CONCLUSION

It is obvious from this discussion of diverse technologies that use of IT to support decision making covers a broad swath of territory. Some technologies aim to alert people to anomalies, discontinuities, and shortfalls. Others aim to make decisions, either as recommendations to people or to act on behalf of people. Handing over decisions to systems has its pros and cons; thus, their actions need to be monitored. CIOs need to alert their management teams to potential social and economic effects of computer-based decision making because errant computer-based decisions have devastated corporate reputations and cost a lot of money. Vendors are pushing toward the real-time enterprise. However, the use of IT for these purposes should give pause so that the ramifications can be explored.

It is also important for managers to comprehend the potentials and the limitations of technologies. As discussed in Chapter 14, we raise some economic, social, and ecological issues related to the use of IT in organization.

QUESTIONS AND EXERCISES

Review Questions

1. What is a DSS?
2. What is the architecture of a DSS, as suggested by Sprague and Carlson? Summarize the attributes of each component.
3. What is an institutional DSS? Give an example.
4. Explain how Harrah's Total Rewards program works.
5. What is an EIS?
6. What are the pitfalls in EIS development identified by Watson?
7. Describe three kinds of knowledge representation.
8. What does the Authorizer's Assistant do and how does it do it?
9. What is agent-based modeling?
10. What is a real-time enterprise?
11. In what four ways does an enterprise nervous system differ from many past systems?
12. What is a smart tag and how might it be used?
13. Describe the four parts of an OODA loop. What is the goal of OODA-loop thinking?
14. Describe the three OODA loops at Western Digital.
15. Explain the potential dark-side aspects of a real-time enterprise.

Discussion Questions

1. Expert systems are dangerous. People are likely to depend on them rather than think for themselves. If the system contains bad logic, bad decisions will be made and lawsuits will result. Argue for and against this claim.
2. An enterprise cannot be managed from a computer, no matter how slick the executive dashboard. Do you agree or disagree? Discuss.
3. Smart tags intrude into people's lives. There is going to be a revolt against using them to track people's movements. Argue for and against this claim.

Exercises

1. If you have ever used a spreadsheet, an ES, or a DSS, describe one of your uses and what decisions the system helped you make.
2. Find one or more current articles on the real-time enterprise. Present new information in the articles to the class.
3. Visit a local company and find out if and how it uses the technologies in this chapter to support decision making: DSS, data mining, ESs, EIS, agent-based modeling, enterprise nervous system, straight-through processing, real-time CRM, and communicating objects (RFID).

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CHAPTER

13 SUPPORTING IT-ENABLED COLLABORATION

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INTRODUCTION

In her book, *The Company of the Future*, France Cairncross[1] states that the company of the future will be a collection of online communities, some internal, some that reach outside the organization's boundaries into its business ecosystem, some that are designed and formed outright, and some that just grow on their own. She believes that a main job of executives and managers is to foster these communities and the collaboration they engender. A major job of CIOs is therefore to provide the technology to support online communities and online collaboration. Cairncross is not alone in her thinking.

TEAMS: THE BASIS OF ORGANIZATIONS

In the *Harvard Business Review*, Peter Drucker's[2] article, "The Coming of the New Organization," became the most reprinted article in the article's first year. Apparently it struck a responsive chord. In that article, the late Drucker stated that organizations are becoming information based, and that they will be organized not like a manufacturing organization, but more like a symphony orchestra, a hospital, or a university. That is, each organization will be composed mainly of specialists who direct their own performance through feedback from others—colleagues, customers, and headquarters.

According to Drucker, this move is being driven by three factors. One, knowledge workers are becoming the dominant portion of labor, and they resist the command-and-control form of organization. Two, all companies, even the largest ones, need to find ways to be more innovative and entrepreneurial. Three, IT is forcing a shift. Once companies use IT to handle information rather than data, their decision processes, management structure, and work patterns change.

For example, spreadsheets allow people to perform capital investment analyses in just a few hours. Before this technology was available, these investment analyses generally had to be based on opinion because the calculations were so complex. With computing, the calculations became manageable. More importantly, the assumptions underlying the calculations can be given weights. In so doing, investment analysis changes from being a budgeting question to being a policy question, says Drucker, because the assumptions supporting the business strategy can more easily be discussed.

IT also changes organizational structure when a firm shifts its focus from processing data to producing information. Turning data into information requires knowledge, and knowledge is specialized. The information-based organization needs far more specialists than middle managers who relay information. Thus, organizations are becoming flatter, with fewer headquarters staff and more specialists in operating units. Even departments have different functions. They set standards, provide training, and assign specialists. Work is done mainly in task-focused teams, where specialists from various functions work together as a team for the duration of a project.

To Drucker, team-based organizations work like hospitals or orchestras. Hospitals have specialty units, each with its own knowledge, training, and language. Most are headed by a working specialist, not a full-time manager. That specialist reports to the top of the hospital, reducing the need for middle management. Work in the units is done by ad hoc teams that are assembled to address a patient's condition and diagnosis.

Symphony orchestras are similar. They have one conductor, many high-grade specialists, and other support people.

Drucker claimed that we have entered the third evolution in the structure of organizations. The first, which took place around 1900, separated business ownership from management. The second, in the 1920s, created the command-and-control corporation. The third, happening now, is the organization of knowledge specialists.

Why should IS executives be interested in supporting groups? Robert Johansen,[3] of the Institute for the Future and an author of two books on group working, notes that systems that support groups are important because most people spend 60 to 80 percent of their time working with others. Yet, from informal polls he has taken, people seem to feel they are most productive when they are working alone. Thus, they are not happy about how they work with others. This finding reveals a need for systems that support groups.

Groupware—electronic tools that support teams of collaborators—represents a fundamental change in the way people think about using computers, says Johansen. The nature of the tasks people need to work with others are different from the typical tasks they need to work alone. Thus, groupware is different from typical individual office automation software.

Groupware that takes full advantage of IT needs to be just another part of corporate information systems. The products need to be built on existing platforms—e-mail systems, LANs, departmental systems, and public network services, such as the telephone or the Internet. Use of these technologies must advance beyond the "horseless carriage" stage and lead to new organizational structures, he believes.

Given these three opinions on the importance of group working and the need for systems to support such collaboration, we turn to exploring the kinds of groups that exist and the kinds of systems that support their collaboration.

UNDERSTANDING GROUPS

Collaboration is all about getting work done in a group, rather than individually. However, groups differ from one another, and their work styles vary, depending on a number of factors. Here are some characteristics of groups.

Groups in Organizations

Not all groups are the same. Different types emerge for different tasks. Some of the characteristics that differentiate groups include membership, interaction, hierarchy, location, and time.

Membership

Groups can be open, where almost anyone can join. Or they can be closed, where membership is restricted. Actually, a gray scale between open and closed indicates the degree of difficulty in gaining membership.

Interaction

The group can be loosely coupled, where the activity of each member is relatively independent of the other members. Salespeople who have their own sales territories often fall into this category. Or the group can be tightly coupled, such as a project team where the work of each member is tied closely to the work of the other members. As in the case of gaining group membership, group couplings range widely from loose to tight.

Hierarchy

A group can be just one part of a chain of command. Large public events, such as at the Olympics or the Rose Parade, for instance, are planned and conducted by a hierarchy of committees. At the top is an ongoing committee that sets the general plans years in advance and selects the site and the top people for putting on each event. The top committee then oversees the work of the various detail committees. In addition, each of the detail committees may have subcommittees working on specific portions of their responsibility. This same hierarchy of committees occurs in large IT projects, such as implementing ERP, or in defining IT policies, such as an enterprise's overall IT architecture.

Location

Group members may be collocated or dispersed. In the past, location influenced how they collaborated. When collocated, they could meet face-to-face. When dispersed, they either had to travel or use video conferencing to read each others' body language. But IT is making long-distance personal contact easier. More and more, teams and groups can work together effectively while remaining dispersed. In some cases, groups in Asia perform their work on a project and then pass that work on to a European group when their Asian workday ends. The European group progresses the work, then passes it to a group in the Americas when the European workday ends. In this type of group working, location allows round-the-clock work. This work style has become a common phenomenon.

Time

There are two aspects to the time dimension of group work: duration of the group and time intensity of the work. The work of some groups is short-lived. An ad hoc committee might be formed to uncover the root cause of a recurring problem, for instance, and then disband once that cause has been found. Other groups last for a long time; functions in an organization, such as HR or finance, are examples.

On time intensity, some groups' members work full-time on the group's work. Other groups only require intermittent work by their members. Of course, time intensity usually varies—high intensity at times interspersed with low intensity at other times.

These characteristics illustrate that providing computer-based support for groups is not uniform because of the many variations in group work. Initially, support was for intra-company groups. However, the Internet has led to the ability to provide worldwide support for global teams that cross organizational lines. The main issues are what types of groups need support and why.

Types of Groups

Here is a list of just a few of the many, many kinds of groups. Each group has a different need for IT-enabled collaboration support.

- Authority groups involve formal authority (and often hierarchy), such as boss and subordinates or team leader and team members. Membership is closed and coupling is tight, but location is irrelevant in more and more cases, and generally these groups work full-time. In matrix management, people may have two bosses, one technical and one administrative.

- Intra-departmental groups can have members all doing essentially the same work, full-time, often under the same boss. Membership is closed, seniority generally exists, and interaction can range from tight (only do one job, on their own) to loose coupling (work with their neighbor). Location is generally close, but, as in the case of globally dispersed departments serving different parts of the world, they can be dispersed. These groups generally rely on LANs, departmental computers, and intranets to collaborate.
- Project teams generally have members who work full-time to accomplish a goal within a specific schedule. Generally, membership is closed, coupling is tight, and a hierarchy can exist. To obtain the expertise they need, these teams often have dispersed membership. They also have a limited duration: to the end of the project. Some teams bring in experts to fill special needs. For instance, a team creating a document might call on an editor near the end or a graphics person to add diagrams and handle document formatting.
- Interdepartmental work groups pass work from department to department (purchasing, receiving, accounts payable) in a chain, forming a super group. Membership is closed, coupling is tight, and hierarchy tends not to be present. In support areas, such as finance, HR, and even IT, companies have been creating shared services departments that collocate people doing similar work. Formerly, these people were in remote offices, perhaps performing several jobs. Now they work full-time on one job in a center of expertise. In some cases, the function has been outsourced, which generally moves the entire function to the provider's site.
- Committees and task forces are formed to deal with a subject area or issue. Generally, neither requires full-time participation. Committees are usually ongoing; task forces just deal with the issue and disband. Membership may not be quite as closed as a project team, and interaction might not be as tightly coupled. Generally, the work is not full-time; although, in the case of a merger, an IT architecture team may need to temporarily work full-time to design the IT architecture of the merged enterprise.
- Business relationship groups are relationships with customers, groups of customers, suppliers, and so on. Membership often is closed in that a new organization may have to earn acceptance. Interaction is loosely coupled. A hierarchy is not likely, but favored customers and suppliers can have dominating influences. Generally, these are meant to be long-lived, but that may or may not be true, depending on changes in the business ecosystem.
- Peer groups meet to exchange ideas and opinions. Examples are fraternal organizations, repairmen who call on each other for help, and prospects called together for a sales presentation. Membership can range from relatively open to closed, and the interaction tends to be loosely coupled. Hierarchy usually is not much in evidence. Often the group has dispersed members who meet face-to-face rarely but may keep in close contact electronically.
- Networks are groups of people who socialize, exchange information, and expand the number of their personal acquaintances.
- Electronic groups include chat rooms, multi-user domains, user groups, and virtual worlds, all formed on the Internet to socialize, find information, entertain themselves, gain comfort, or just experiment with the online world. Membership is

generally wide open, interaction is loosely coupled, there is usually no hierarchy, and the members are widely dispersed and most likely never meet face-to-face.

- "Communities of Practice" (CoPs) is a term coined by the people at the Institute for Research on Learning[4] to refer to a group of people who work or socialize together for so long that they have developed an identifiable way of doing things. Such communities arise naturally at school, at work, in volunteer organizations, and in sports clubs. Some CoPs form as a way to share ideas about a technology they all use (as in the case of some engineers at National Semiconductor; see Chapter 14). Others form as a way to get work done faster and more easily; they informally devise shortcuts and practices. Generally, CoPs have open membership. They last as long as their members see them as useful.
- "Network armies" is a term coined by Richard Hunter of Gartner EXP[5] in his book *World Without Secrets: Business, Crime, and Privacy in the Age of Ubiquitous Computing*, to mean a widely dispersed group of people that forms to further a cause. Hunter sees the open source movement as a network army. So are most grassroots movements, such as groups opposed to globalization, terrorist organizations, and animal rights activists. Leaders emerge and membership is usually open. Network armies increasingly use electronic means to further their agendas.

These final two types of groups—communities of practice and network armies—are probably unfamiliar because they have only recently been identified. They are likely to increase in the future because they take advantage of IT, they have the flexibility to form and act quickly (which is an advantage in our faster-moving world), and they could increasingly wield power. Thus, we delve into each a bit more.

Communities of Practice

The "father" of CoPs is Etienne Wenger, who identified them and has studied them since authoring the definitive book on CoPs, *Communities of Practice: Learning, Meaning, and Identity*.[6] In an article with William Snyder of Social Capital Group,[7] Wenger and Snyder point out that CoPs are all about managing knowledge (the subject of the next chapter); that is, capturing and spreading know-how, ideas, innovations, and experience. CoPs are an organizational form that complements other means for sharing knowledge. In fact, in some enterprises, CoPs form the foundation of their knowledge management efforts. Wenger and Snyder define them as informal groups that form around a passion for or expertise about something. This "something" can vary from deep-water drilling to check processing, they note. The subject matter really does not matter; the goal in forming a CoP is to share members' experiences, expertise, and problems.

Though informal, some CoPs have had a profound effect on their enterprise by driving strategies, creating new lines of business, spreading best practices, solving seemingly intractable problems, retaining people, and increasing the level of expertise in some areas. To date, few enterprises have formally recognized CoPs or supported them. Without support, CoPs can be difficult to organize and then sustain.

Being informal, CoPs resist being managed. However, some enterprises have seen their value and have learned how to nurture them. Wenger and Snyder believe these enterprises are the forward-thinking ones. They have learned how to provide the infrastructure and climate for these self-organizing entities to form of their own volition, meet and share via numerous channels (face-to-face, e-mail, IM, video conferencing), and even strengthen the organization's formal mechanisms. As an example, consider DaimlerChrysler and its support of CoPs, which began in the Chrysler Corporation in the late 1980s.

CASE EXAMPLE

DAIMLERCHRYSLER

www.daimlerchrysler.com

In the late 1980s, when Chrysler Corporation was about to go out of business because of competition from Japanese auto companies, CoPs played a large role in its survival, write Etienne Wenger, Richard McDermott, and William Snyder in their book *Cultivating Communities of Practice*.[8] In the late 1980s, it took Chrysler five years to bring a vehicle to market; competitors took as little as three. To compete, management had to reinvent how the company worked. Its organizational structure at the time was functional, with design units passing vehicle designs to manufacturing units that then passed back the designs after modifying them for manufacturability.

To reduce this iterative process, which added significant time to development, the company reorganized into "car platforms," such as Jeep, minivan, truck, or small car. Engineers and other workers reported to only one platform. This change reduced development time to 2.5 years—a significant improvement. However, it also led to multiple versions of parts, uncoordinated relationships with suppliers, and mistakes repeated among the platform groups, write the authors.

Employees with similar jobs needed to communicate across the platforms, but the new structure did not foster that interchange. So, some began meeting informally. Rather than formalize these cross-platform groups, they became known as Tech Clubs; in essence, CoPs that were supported and sanctioned by top management.

They began to take responsibility for their area of expertise by conducting design reviews. They even revived the old idea of creating "engineering books of knowledge," which are databases that store the information engineers need to do their job, such as compliance standards, lessons learned, and best practices. Such books only succeed when the users "own" them and naturally keep them up to date as part of their everyday work.

Once community members within Chrysler saw the value of their book to their work, ownership took hold. They now spend much of their meeting time debating the items that should be in the chapters, and the wording that should be used, to be sure what they state is correct. The books are intended to deal with the real problems they face. Wenger,

(*Case Continued*)

McDermott, and Snyder point out that the engineers find these debates and discussions to be just as important as the final documents because they learn a lot from interacting with their peers. Thus, while they are building practice standards they are also building a community. The two go hand-in-hand in successful CoPs, the authors note.

The Chrysler division now has over 100 Tech Clubs, and a team is introducing the concept to its parent, DaimlerChrysler. In fact, this team helps Tech Club coordinators in the United States and Germany launch their clubs, produce useful knowledge resources for members, and keep their clubs vibrant and relevant. The Tech Club support team also helps ensure that the clubs are working on common technology platforms so that they can share knowledge across clubs.

Wenger, McDermott, and Snyder point out that these Tech Clubs provide DaimlerChrysler with the crucial matrix structure they need to have engineers focus on their platform yet share their knowledge across platforms without the administrative headaches that formal matrix structures have required. ■

Supporting Collaboration

Although CoPs cannot be designed, they can be nurtured. Wenger and Snyder[6] believe companies need to perform three nurturing acts to garner benefits from CoPs: identify potential CoPs, provide them with an infrastructure, and measure them appropriately.

Identifying Potential CoPs

To identify potential CoPs, companies can provide the means and experience for developing them by providing CoP consultants. Thereby, an employee interested in forming a CoP can explore the possibility with someone who understands CoPs and can help the employee interview potential members to see what sorts of problems the community should address to provide real value to members. The employee and consultant can then plan an initial activity to not only address the identified problems, but also link them to the company's agenda. But to even get off the ground, the members need to personally "connect" to the group's intent; otherwise, people will not participate.

Providing a CoP Infrastructure

To provide a CoP infrastructure, executives need to give CoPs legitimacy because they lack resources and formal standing in the enterprise. Sometimes that means extolling the contributions of CoPs and the people who organize them, instituting compensation systems that reward collaboration, and budgeting money to build IT systems that CoPs need. In some instances, membership is not open; an employee must be recognized as an expert to be invited to join. Thus, there is formal recognition of the esteem of belonging. Having executive sponsors also provides a kind of

CoP infrastructure, as does linking them to a corporate university, if one exists, or paying for them to participate in CoP activities. Providing support to organize events is also a form of infrastructure.

Measuring CoPs

To measure CoPs appropriately often means measuring their contributions in non-traditional ways because their effects may not be immediate. Their contributions may only show up in the formal organization (on a team or department's work), not in the community's work. It is not always possible to identify a good idea as originating in a CoP. To assess CoPs, note Wenger and Snyder, listen to the stories members tell about their CoP, such as how a comment at a CoP gathering spurred an idea, solved a major problem, or accelerated a project. Such anecdotes generally do not count in formal measurement programs, but collecting stories systematically can paint a picture of the kinds of contributions specific CoPs are making. In some cases, such collections of stories can even lead to estimates of money saved or revenues generated.

CoPs are emerging first in knowledge-based enterprises. But to flourish, executives need to understand their characteristics and how they work. Wenger and Snyder see CoPs as an emerging business form that will be as familiar in the near future as business units and business teams are today.

Network Armies

As noted earlier, Richard Hunter[5] coined the term "network army," which he defines as a set of individuals and communities aligned by a cause. They have moral and intellectual influencers as opposed to formal leadership. Major differences may exist among members' overall beliefs. As an example, consider the civil liberties community in the United States, which includes members from both the left and right wings of the dominant political parties. Network armies are as permanent as their common agenda; their cohesive force is their value system. Their communications are in open forums that anyone can join. Modern communication technologies, including the photocopy machine, the fax machine, and most recently the Internet, have dramatically increased the reach of network armies.

Network armies have existed for a long time, but they can now appear suddenly with a lot of power because of three developments: (1) high-speed information flows due to a common language (English) and communication system (Internet), (2) the geometrically expanding power of networks (adding one person geometrically increases the number of interconnections), and (3) the international visibility now afforded just about any cause. Network armies go about their business in the open; anyone can join in or listen in to their discussions. As a result, says Hunter, the network army is the social and political structure that suits a world without secrets.

One of the intriguing observations Hunter makes about network armies is that hierarchies (like traditional businesses, governments, and armies) have a tremendously difficult time fighting network armies because they have no single leader; they are like a hydra with many heads. They are so dispersed and part of the fabric of society that they are difficult to find, let alone fight. Hunter believes network armies are on the rise. Here is an example of a network army.

CASE EXAMPLE

THE OPEN SOURCE MOVEMENT

Richard Hunter[5] of Gartner EXP believes that the open source movement is a prime example of a network army. Open source means that (1) the complete source code must be distributed with any and all distributions, and (2) anyone can modify and redistribute the code to anyone to use. A prime example of open source software is Linux, the operating system whose kernel was written by Linus Torvalds. The opposite of open source is proprietary software, which is sold only in its compiled state (undecipherable by humans) and is not allowed to be changed except by the developer.

Open source is mainly about how software is developed, enhanced, and managed. The open source movement is a community with a shared culture, where people earn their membership by the quality of the code they produce. Members are volunteers; no one is paid. They do it for fun (they love to code), to hang around with other like-minded developers ("fiery brains," says Hunter), and to be part of a worthy cause. Torvalds' goal in developing Linux was to "write software that does not suck." He reasoned that the best way to do that would be to let interested software developers chip in and improve any part that attracted them. Thus, it is a culture of mavericks who want lots of personal autonomy, guided by minimal conformance.

The movement has a massive flat structure with four "influencers" (including Torvalds), six to eight distributors who package versions, some 200 project leaders who manage active projects, and some 750,000 volunteer developers (as of late 2001). The number is probably higher now. The developers follow the influencers because they have the same values. This flat structure is possible, says Hunter, because the Internet allows the influencers to communicate directly with the developers, and vice versa. Hence, the influencers know what the volunteers think, which can make it harder for them to lead as well as to mislead. In addition, all communications are open via bulletin boards, e-mail lists, and other Internet-based channels that anyone can join.

Hunter notes that when he and his Gartner colleagues critiqued the viability of open source software in 1999, they believed it would capture 15 percent of the server operating system market. "We did not realize this was a disruptive technology that could change the software world," he notes. Less than two years later, after "getting it," he and his colleagues significantly increased their assessment to predicting that open source would be used in 80 percent of businesses by year-end 2003.

Hunter believes it is not wise to underestimate the claims of network armies, as Microsoft apparently did. One of the grave mistakes a business can make is to become the nemesis of a network army, and that is what Microsoft did in 1998. Until that time, the open source movement's only goal was to write useful software. However, in August 1998, Microsoft saw the open source movement as a threat and wrote an internal paper

(*Case Continued*)

that proposed ways to eliminate it. That study, of course, fell into the hands of an open source member, states Hunter, because this is a world without secrets. The open source movement always distrusted Microsoft, and that distrust hardened into rage once the study was published on the Web under the moniker "The Halloween Papers."

Microsoft's past tactics for addressing competitors are not appropriate for dealing with a network army, writes Hunter. There are no open source revenues, so Microsoft cannot undercut prices (as it did in bundling its browser into Windows and destroying Netscape). There is no one to negotiate with, so the movement cannot be bought and then taken apart (as many past competitors have been).

All "negotiations" with a network army must be in public, notes Hunter, and consist of actions, not words, which is what Microsoft is now doing. Its executives are arguing against the movement in public forums, hoping to dissuade executives from using open source software. But when it first denied, and then acknowledged, that it was using such software itself to support Hotmail and other services due to the superiority of the open source software, Microsoft lost credibility. Open source members only believe actions. They want people to do the right thing because they see their cause as a moral one.

Hunter believes Microsoft thought it was up against a rival business and tried to use the tactics it used successfully against other businesses. However, a network army is more like a religion than a business, and you do not fight a religious movement by telling its members that they are worshippers of an evil, false god. Better to find some way to work with them on projects of mutual interest as a means of establishing personal trust. However, Microsoft did not want to coexist with anyone, so it has taken a different route. It is a dangerous route, Hunter believes. Businesses that face a network army cannot make it go away without addressing the underlying issues. Treating a network army like a business is bound to backfire. ■

Having explored types and characteristics of groups, we turn our attention to systems to support collaboration.

SYSTEMS TO SUPPORT COLLABORATION

The activities of groups can be divided into two generic categories. One is communication and interaction. Communication means transmitting information from one person to another or to several others; interaction means back-and-forth communication over time. Two, groups are involved in decision making and problem solving. The members reach a decision or form a consensus. Both types of group activities are needed in collaboration. Historically, systems supporting group work have originated from one or the other of these two major functions. Office systems, and in particular e-mail, support people-to-people communication. Researchers in the area of computer-supported cooperative work generally have emphasized technology to aid communication, such as enhanced computer conferencing and systems to assist two or more people to work on the same project. On the other hand, group DSS work has evolved from the DSS community and focuses on reaching a conclusion, decision, or consensus, even though it includes technology to support communication.

A second way to view the work of groups is the way the late Geraldine DeSantis and Brent Gallupe[9] did in one of the early frameworks. Their matrix has proximity of group members on one dimension (together/dispersed) and duration of interaction on the other (limited/ongoing). Note that their matrix is relevant for both communication and decision making. For example, decision making has been the intent of decision rooms, whereas LANs are usually perceived mainly as supporting communication.

Groups in close proximity and with a limited decision-making duration might use a decision room where every attendee uses a computer to participate in the group's deliberations. An example of such a room is presented shortly. Groups that are dispersed and have a limited decision-making duration might use decision rooms connected via video conferencing. Or, as at one highly advanced lab with two facilities, they might communicate via video walls. Standing by one wall allowed employees to converse in real time with someone standing by the wall at the other site. People would meet at the wall to make decisions or just to converse (as a person would when happening upon a colleague in a hallway).

Close-proximity groups with ongoing decisions could use a local decision network, IM, or perhaps a chat room on an intranet. Dispersed groups with ongoing decisions could also use an intranet, if appropriate, or a secure decision system. An example is presented shortly.

Yet a third way to categorize the work of groups uses a variation of the DeSantis-Gallupe matrix by having time on one dimension (same time/different time) and place on the other (same place/different place). This third view has become dominant, so it is used here. Bob Johansen of the Institute for the Future (IFTF) is a leader in the field of groupware. He and his colleagues at IFTF extended the DeSantis-Gallupe matrix to form the time/place framework shown in Figure 13-1.

The two values, either same or different, on each dimension designate whether the group members are communicating and interacting over time and/or distance. The "same time/same place" cell in the upper left, for example, includes electronic meeting support systems. The "different time/different place" cell in the lower right incorporates such communication-oriented systems as e-mail, computer conferencing, and use of Lotus Notes.

Until recently, there has been little integration among the systems in the cells, even though it is clear to researchers and developers that supporting collaboration must aim to permit anytime, anyplace group working. But that is changing. Systems used by individuals are also being used by groups, as demonstrated by Western Digital's use of digital dashboards (Chapter 11). In addition, systems used in meetings are also being used to "extend" those meetings over time after the participants have dispersed. For instance, a IBM's Lotus Notes database might be used in a meeting as well as outside of it. Instant messaging is used in both settings, as are the dashboards at Western Digital (Chapter 11). The Internet has aided in extending the use of systems among the cells.

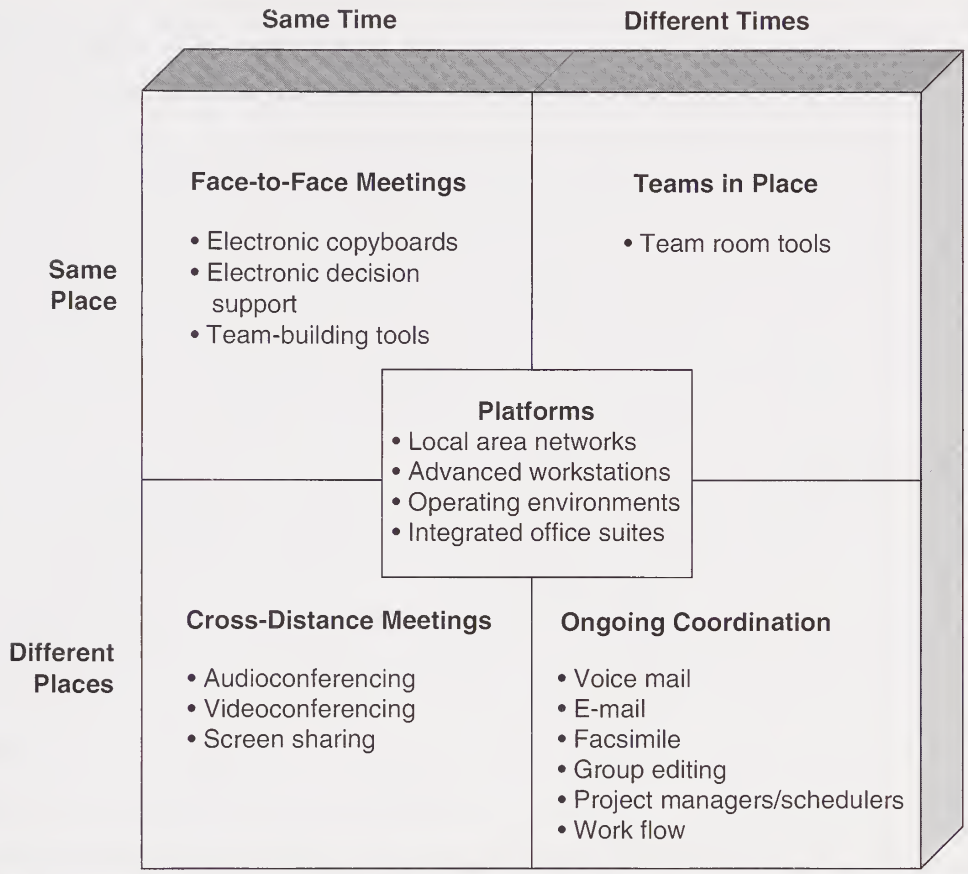


FIGURE 13-1 Groupware Options

Source: Courtesy of Robert Johansen of the Institute for the Future, www.iftf.org.

Supporting "Same Time/Same Place" Collaboration

Supporting "same time/same place" collaboration has generally meant supporting meetings, and a lot of work has focused on this area. One study found that the average executive in a U.S. company spends more than 800 hours a year in meetings. Not only does this figure represent a large portion of total work hours (on the order of 30 percent), but even worse, the executives reported that they considered about 240 of those hours to have been wasted in useless meetings.

The Problem with Meetings

From the many meetings we have attended, many shortcomings have been evident. Meetings often have no agenda or only a superficial one. No problems are clearly spelled out in advance, and no specific action items are proposed to address the problems. If actions (or motions) are proposed, alternatives are not fully considered. If documentation about the issues has been provided before the meeting, some members choose not to study it; they expect to be briefed at the meeting. The chairperson may do little or no follow-up between meetings to see that the members carry out their assignments.

Some meetings are doomed from the start. Key people arrive late or do not attend at all. Necessary information is not readily available. Some group members have forgotten to fulfill their assignments. Then the meeting chairperson may do a poor job of managing the meeting time. Discussion may be allowed to wander from the subject.

Time may be spent on briefing attendees or on routine matters—reviewing and correcting minutes of prior meetings, getting committee progress reports, and so on. Such meetings tend to run over their allotted time, with important items receiving poor consideration. Often, too, a few people dominate the discussion; not infrequently, these people are repetitious, saying the same things over and over. Conversely, some people do not speak up and contribute their ideas.

Finally, many meetings are wasteful from a cost standpoint. A meeting involving even a few managers and professionals costs hundreds of dollars per hour in salaries alone; large meetings can easily cost thousands of dollars per hour. If travel is required, costs are even higher. Add to these considerations the fact that the participants are unavailable for other activities while tied up in the meetings.

IT Can Help

The goals of systems for improving meetings are to (1) eliminate some meetings, (2) encourage better planning and better preparation for those meetings that must be held, and (3) improve the effectiveness of meetings that are held. Some of the typical supporting features include calendaring, scheduling, information gathering and filtering through database manipulation, spreadsheet applications that allow what-if analysis and goal seeking, group idea generation and prioritization, and interactive voting.

Eliminate some meetings. The most likely candidates for elimination are the meetings that do not call for a group decision or group action but are simply for group updating. Progress report meetings are an example, particularly if progress (actual progress versus planned progress) can be reported frequently by e-mail, the company Intranet, or an electronic team meeting place. Meetings where key people cannot attend or where needed information is not yet available can be canceled at the last moment. E-mail, voice mail, and IM systems allow the word to be spread rapidly. Intranets allow progress and status reports to be posted in a form that is easily available to everyone. In short, some of the work done in meetings can be shifted from the "same time/same place" cell to the "different time/different place" cell in the time/place matrix.

Better preparation for meetings. Computer conferencing can play a significant role in improving preparation for meetings. A computer conferencing system is actually a form of enhanced e-mail. Participants can log on at their convenience, read all entries made by others since they last logged on, and make their contributions. In the planning stage of a meeting, such a system can be used to obtain reactions to the proposed agenda, and those reactions might spur debate and alternatives. Furthermore, routine matters may be handled before the meeting, such as review and approval of minutes, receiving committee progress reports, voting on routine action items, and so on. Group members can give attention to these matters at their convenience, saving valuable synchronous meeting time for more important business. The chairperson can also use the conferencing system for follow-up activities. Finally, the system can provide a written record of pre- and post-meeting communications.

Improve the effectiveness and efficiency of meetings. One of the major benefits of meeting support systems is improved meeting efficiency and effectiveness. Meetings are more effective when the ideas generated by the group are more creative and everyone in the group is actively involved. Meetings are more effective when group commitment happens quickly. Following is a case in point.

CASE EXAMPLE

TEXAS INSTRUMENTS

www.ti.com

Before Burr-Brown Corporation merged with Texas Instruments, it was headquartered in Tucson, Arizona, and manufactured and sold electronics parts to other electronic manufacturers. It had about 1,500 employees and $180 million in annual sales.

When the University of Arizona, also in Tucson, created a decision room in its IS department, the CEO of Burr-Brown decided to use it for management's three-day annual strategic planning meeting. He was so pleased with the results that the firm used it again the following year for the same purpose.

The Decision Room

The room has 24 workstations arranged in a semicircle on two tiers. Up to 48 people can use the room, two persons per workstation. In an adjacent control room is the file server, and at the front of the room is a facilitator's control station, as well as a rear projection screen for video, slides, and movies, and a white board. All the participants' workstations and the facilitator's workstation are connected by a LAN.

The university has developed a number of decision-room software tools, and more than 100 groups have used their decision room. That software is marketed under the name a family of tools such as ThinkTank and QuickVote by GroupSystems.com.

ThinkTank, a newer version of the Electronic Brainstorming System, is the most popular of the tools; it is used by more than 70 percent of the groups. Like most of the tools, it allows participants to simultaneously and anonymously key in ideas on a specific question. After an idea is entered and sent to the file server, the participant can see the ideas entered by others.

After the brainstorming portion of a meeting, many groups use the Issue Analyzer to organize the ideas. A Voting Tool ranks ideas and a Topic Commenter attaches comments to ideas already in the system. Finally, the groups can use the Policy Formation software to study alternatives. Most group "discussions" using these tools are done via keyboards rather than by talking. However, some other tools do encourage face-to-face discussions.

Burr-Brown's Use of the Room

Burr-Brown's annual strategic planning meetings had always been held off-site, with some 9 to 10 executives attending. When they used the decision room, 31 executives attended. The IS department at the university provided a meeting facilitator to help plan the meeting and then facilitate it.

During the meeting, the facilitator explained each tool before it was to be used. The facilitator also kept participants on track and was the neutral leader of the meeting so that Burr-Brown's CEO could attend as a participant. In addition, an assistant facilitator and three other assistants also were present. They helped the

(*Case Continued*)

participants use the hardware and software, made copies of the documents generated by the system, and so on.

Before the meeting, several planning meetings were held to settle the meeting agenda. Each of the 11 divisions was asked to prepare a document to describe its one-year action plan and rolling five-year plan, including objectives and projected budgets. Participants received these plans before the meeting.

The agenda for the three-day meeting was:

- Day 1: Long-term strategy planning
- Day 2: Short-range action planning
- Day 3: Wrap-up in both areas

The meeting began with the group using the workstations to generate ideas about expected corporate performance in the coming years. They then organized these ideas to create the framework for discussing each division's plans.

For the next day and a half, they entered comments on the five-year strategic plans and one-year action plans of each division, one division at a time.

They also spent some time brainstorming ways to accomplish the year's objectives and then ranking the ideas. The group settled on specific actions they would take on the top seven issues.

On the last afternoon, they divided into four groups to discuss important topics face-to-face. The planning meeting ended with the four groups presenting their recommendations.

Executives' Reactions

After the three-day session, the participants were asked to summarize their reactions to the decision room. They reported the following.

- It increased involvement. One senior vice president commented that the decision room allowed them to do in three days' time what would have taken months. The CEO noted that the past sessions could not be larger than 10 people to be manageable; and in those sessions, only two or three people really spoke up. With the decision room, 31 people were able to attend without hampering deliberations, and the group's comments were much more open than in the past.

  During one one-hour electronic brainstorming session, 404 comments were made, with the fewest number of comments from any of the 24 workstations. Seven workstations contributed more than 20. Thus, contributions were relatively evenly distributed across the group.

  The group had mixed reactions about the efficiency of the system. In a post-session questionnaire answered by 26 participants, 11 stated that it was more efficient than past meetings, 9 said it was not, and 6 were neutral. However, the majority agreed that the facilitator was important in helping them use the room.
- The planning process was more effective. Several executives mentioned two aspects of the session that enhanced its effectiveness. The main one was anonymity. Due to anonymity, more people asked more questions and made more suggestions than they did in the former meeting format where all discussion was verbal, which identified the contributor.

(*Case Continued*)

Second, the planning process itself was extremely educational, said the CEO. "People walked in with narrow perceptions of the company and walked out with a CEO's perception. This is the view that is sought in strategic planning, but is usually not achieved," he commented three months after the session. This type of education had not happened at previous planning sessions.

One Year Later

One year later, 25 executives participated in a two-day session. About 16 had attended the year before. This year, the intent of the meeting was different. It was to critique plans so that their impact on others and the support they needed from others were more explicit.

After the CEO described the firm's objectives and the economic climate, the planning session began with the group critiquing the previous year's results, company-wide. The two-day session ended with each business unit manager commenting on the ideas received about his or her particular unit and how those ideas might affect the unit's action plan.

From the previous year's session, they learned that brainstorming is effective if the groups are structured properly. A large group can consider a few issues, such as corporate objectives, and present ideas on those topics. But a large group cannot "converse" because of the large number of ideas to consider.

For "dialogs," Burr-Brown found it best to form several small groups, with each group addressing a few issues. One person puts in a statement, another person comments on it, then someone else comments, and so on. In the second year, they conducted small-group dialogs and found them effective.

The company also learned that the discussion room is not a substitute for a planning process. It is excellent for generating many ideas in a short time. However, because face-to-face interaction is reduced, people are less likely to make commitments and agree on courses of action than in a face-to-face setting. Therefore, Burr-Brown does not use the room to reach consensus.

The communications manager recommends that others planning to use such a room tell the participants about the room beforehand. Just send them an e-mail that describes the room and includes a photograph, he suggests. Also, explain to participants how their comments will be used because the use probably will affect how they answer questions.

In all, Burr-Brown participants were pleased with the candor and objectivity the decision room elicited. They believe its use has enhanced their annual planning meetings. ■

SYSTEMS TO SUPPORT COLLABORATION

Supporting "Same Time/Same Place" Presentations and Discussions

A second "same time/same place" situation that can benefit from group support tools is traditional presentation-discussion sessions found in classrooms, conference sessions, and business meetings. Robert Davison and Robert Briggs[10] explored the advantages of using a Group Support System (GSS) in a presentation-discussion session held in a workshop setting. The system was similar to the one used by Burr-Brown. Each member of the audience had a workstation, all interconnected by a LAN, with a public screen to show the group's interactions. The presenter had a separate screen for audiovisuals used in the presentation.

To begin their exploration, Davison and Briggs made the following seven hypotheses about the potential advantages and disadvantages of attendees using a GSS at the workshops:

- ***More opportunities for discussion.*** Using a GSS would eliminate the need to divide available airtime among potential speakers because participants could contribute simultaneously. The parallel, non-oral communication channels would multiply the time available to the audience. In addition, because they would be communicating online, the participants could interact with each other during the actual presentation, which further multiplied available airtime.
- ***More equal participation.*** Because the GSS provides many parallel communication channels, loud or strong personalities probably would not dominate the discussion. Unlike oral discussions, the amount contributed by one person was expected to be independent of the amount contributed by others. This expectation was more likely to lead to a more equal distribution of discussion among the attendees.
- ***Permanent record of discussion.*** The GSS would capture a permanent electronic transcript of the online discussion. Thus, both participants and presenters could access the details long after the discussion was over.
- ***Improved feedback to presenters.*** With unrestricted airtime for audience members and a permanent record of their discussion, presenters anticipated more comments as well as more detail in those comments. Furthermore, the anonymity allowed by the GSS would reduce some participants' concerns about negative repercussions if they contributed unpopular, critical, or new ideas. Thus, the presenters could receive more unfiltered critical analysis of their work using the GSS.
- ***Improved learning.*** The GSS was also expected to reduce attention blocking; that is, the loss of attentiveness caused by people trying to remember what they want to say during the presentation. Working in parallel, participants could record ideas when they occurred, then return their attention to the presentation. With more discussion time, reduced attention blocking, increased participation, improved feedback, and a permanent record, GSS users would retain more knowledge from a presentation than when they used conventional methods.
- ***Remote and asynchronous participation.*** In addition, people who do not attend a presentation could still benefit by reading and contributing after the event. However, this opportunity does not mean replacing all face-to-face conferences and presentations with distributed online interaction. Many people find casual conversations in hallways and over meals to be as valuable as formal presentations.
- ***Potential negative effects.*** Despite such benefits, Davison and Briggs were concerned that online discussions during presentations might be a mixed blessing. Human attention is limited, so online discussions might distract participants to the point where they lose the thread of the presentation. Such distractions could

outweigh other benefits. Furthermore, the online discussions could digress from the concepts in the presentation or even devolve into flaming. In addition, the anonymity of online discussion could hinder the evolution of a social community among the participants.

To explore these hypotheses, Davison and Briggs conducted some experiments at a conference known for its interactive workshop-like sessions.

CASE EXAMPLE

HICSS

www.hicss.hawaii.edu

As part of the annual Hawaii International Conference on System Sciences (HICSS), 43 participants attended a three-hour tutorial on business process reengineering. The workshop had 24 laptops placed around two sets of tables, along with two large screens—one to show the PowerPoint slides for the presentation and the other to show the contents of the electronic discussion. To overcome concerns about politeness, the presenter encouraged the participants to use the equipment by saying that he considered typing while he was talking to be both polite and desirable. However, only eight comments were submitted during the three hours. Similarly low levels of participation occurred in two later nine-minute paper presentation sessions. Again, informal interviews revealed a widespread fear of rudeness.

Davison and Briggs hypothesized that because the attendees had not used a GSS during a presentation, they might not imagine how nonintrusive it could be. They also hypothesized that participants might not realize how easy the software was to use. Therefore, the following day, they used the GSS for three 90-minute sessions. Each session had three paper presentations.

As each session began, the moderator asked participants to use the GSS to respond to the question, "What are the most pressing research issues facing the technology-supported learning research community?" Everyone contributed an idea and then responded online to an idea contributed by someone else.

The first presenter told the group that the oral discussion following the presentations would draw from the online discussion. Two subsequent speakers asked for online responses to specific questions. All others asked for critical feedback about their presentations. As soon as the first speaker began, members of the audience started typing. Participants contributed 275 comments during the three sessions, ranging from 20 to 54 per presentation. About 94 percent of comments were presentation related, with no instances of flaming. Furthermore, during other sessions with no GSS, oral contributions to the post-presentation discussions came from no more than four people.

(*Case Continued*)

Observations in the GSS-supported sessions showed that contributions came from all over the audience.

One Year Later

During the following year, Davison and Briggs refined both their GSS methods and their questionnaire. They then conducted a more rigorous follow-up study at the next HICSS conference. The study addressed three primary research questions: What effect would GSS have on participation and perceived learning? Would the GSS be perceived as a detrimental distraction? What effect would GSS use have on the perceived value of the presentations and discussions?

At this conference, 34 laptops in a workshop setting let participants have a clearer view of the large public screen. All GSS-supported sessions began with a brief hands-on activity related to the session topic. A moderator invited online participation at the beginning of each presentation, and most presenters added their encouragement. Participants were urged to raise key issues from the online discussions during the post-presentation discussions. After the sessions, Davison and Briggs administered their survey questionnaire. They received data from 173 participants. Of those, 73 reported having used GSS, whereas 70 reported they had not.

Results of the Survey

From the survey, Davison and Briggs learned that GSS users were significantly more willing to participate in the discussions than non-GSS users, and they reported doing so at significantly higher levels. The participants in both the GSS-supported and standard presentations had equal opportunity to contribute to oral discussion and did so at approximately equal rates. However, the participants who used the GSS also contributed hundreds of comments to the online discussions, so their overall participation was substantially higher. Furthermore, a much higher percentage of the audience got involved in the GSS discussion than in the oral discussion. Thus, it appears that the GSS may have accomplished its primary purpose: to increase participation and learning. But at what cost?

Overall, participants were comfortable with the amount of distraction and digression in the sessions. Only three GSS users and four non-GSS users reported negative reactions—too few for meaningful statistical analysis. Thus, the GSS did not appear to create widespread perceptions of undue distraction or digression.

No online flaming occurred, and nearly all the online contributions were relevant to the presentations. Content analysis of the online transcripts suggested that participants grasped the key concepts of the presentations, which is further evidence the GSS did not distract them from the oral delivery of information.

Overall, the respondents also reported receiving positive value from the conference sessions and the GSS. This response suggests that the GSS enabled the groups to increase the quantity of something they valued—the discussions and feedback—without reducing its quality. Many participants chose to take electronic transcripts with them at the end of each session, whereas others downloaded transcripts from the Internet. Thus, the value derived from the discussion was extended beyond the walls of the presentation hall. ■

Supporting "Different-Place" Collaboration

One of the most promising uses of groupware is ongoing coordination by groups who work in different places, and perhaps at different times. With the increasing marketplace emphasis on cycle-time reduction, companies can use the globe and its three main regions (Europe, Asia, and the Americas) to extend their workday to round-the-clock by passing work from groups in one region to the next at the end of each one's workday, as the following personal example attests.

> *I had that experience for the first time a few years ago. On one of my first writing projects, the author of the report, who worked in England, e-mailed me his thoughts and questions on the topic at the end of his workday. During my workday, while he was sleeping, I did some thinking and research on the topic, and e-mailed my thoughts and findings back to him at the end of my day. While I slept, he worked. He and I worked this way, swapped long e-mails, for about 1 week. But we got at least 2 weeks' worth of work done. It was tremendously exhilarating and productive without either of us having to work long hours.*

One of the results of using IT to support collaboration is the formation of virtual teams; they exist in space, but not in one place. Some never meet face-to-face. These teams often form to handle a project, then disband after the project is complete. They tend to operate in three cells of Johansen's matrix.

- ***Same time/same place.*** Typically, the team meets face-to-face initially to develop the basic plan and objectives.
- ***Different time/different place.*** They then communicate by e-mail and do data gathering and analysis separately.
- ***Same time/different place.*** If their technology is strong enough, they may have audio or video conferences to discuss developments and progress toward goals.

Following is a case example of a successful virtual team, as described in the award-winning paper to the Society for Information Management by Carman et al.[11]

CASE EXAMPLE

BOEING-ROCKETDYNE

www.boeing.com

Boeing-Rocketdyne is the major U.S. manufacturer of liquid-fueled rocket engines, which are used to launch communication satellites. When the company faced significant competition and price pressures from Eastern European companies, it initiated a project called SLICE (Simple Low-Cost Innovative Engine). SLICE's business objectives were dramatic: Reduce the cost of the rocket engine to one-tenth, get the engine to market 10 times faster than the Space Shuttle's main engine, and increase

(*Case Continued*)

the useful life of the rocket engine by 300 percent. In short, it was a breakthrough project. So much so that none of the senior technical managers thought the goals were possible, and these managers, as a group, had hundreds of years of experience designing rocket engines. Only one advanced program manager was willing to give the project a try.

The team faced many challenges. The first was work style. To get the best people on the project, they needed to come from different disciplines and different organizations. Management would not allow them to be taken off their regular work, so they could not be collocated. They had to work virtually, using electronic collaboration technology, without holding face-to-face meetings. Furthermore, the members had not worked together as a team, so they had different product experiences and used different design processes. Finally, they had to submit only one design, a design that Rocketdyne's conservative senior management would accept.

Despite these challenges, the project was a tremendous success. It lasted 10 months, during which time the team held 89 online meetings using a collaborative technology called the Internet Notebook. The members created and critiqued 20 designs and submitted more than 650 entries into the notebook. The seven senior technical managers who reviewed the project at its conclusion stated that it had surpassed its objectives. The design was approved for the next phase: testing the assumptions about how the liquid would flow through the components.

The design accomplished the following:

- The engine's thrust changer had only six parts, down from more than 450.
- The manufacturing cost was estimated to be $1.5 million, down from $20 million.
- Quality was predicted to be Nine Sigma, up from the industry standard of Six Sigma, which meant one failure in 10 billion.
- Development cost was $47,000, down from $4.5 million.

The team was awarded the Department of Defense's Advanced Research Program for "validating a process for virtual collocation teams."

In addition, none of the team members spent more than 15 percent of his or her time on the project, the team stayed within its budget (even though the project took longer than expected), and the total engineering hours were one-half normal using the collaborative technology.

Lessons Learned

Why was the team so successful? Carman and his colleagues studied the life of this project and suggested the following success factors.

A Prior Formal Agreement on Sharing Intellectual Property Was Crucial. Boeing-Rocketdyne anticipated the need for close cooperation on some significant projects well before the SLICE team was formed. Therefore, they began developing a partnership agreement to govern such teams. It turns out that the legal aspects of intellectual property are complicated, so they need time to be defined. Because this agreement was in place when the SLICE team began its work, the team members could move ahead quickly without being concerned about who was able to know what.

The Technology Had to Fit the Team's Virtual Meetings. The team's collaborative

(*Case Continued*)

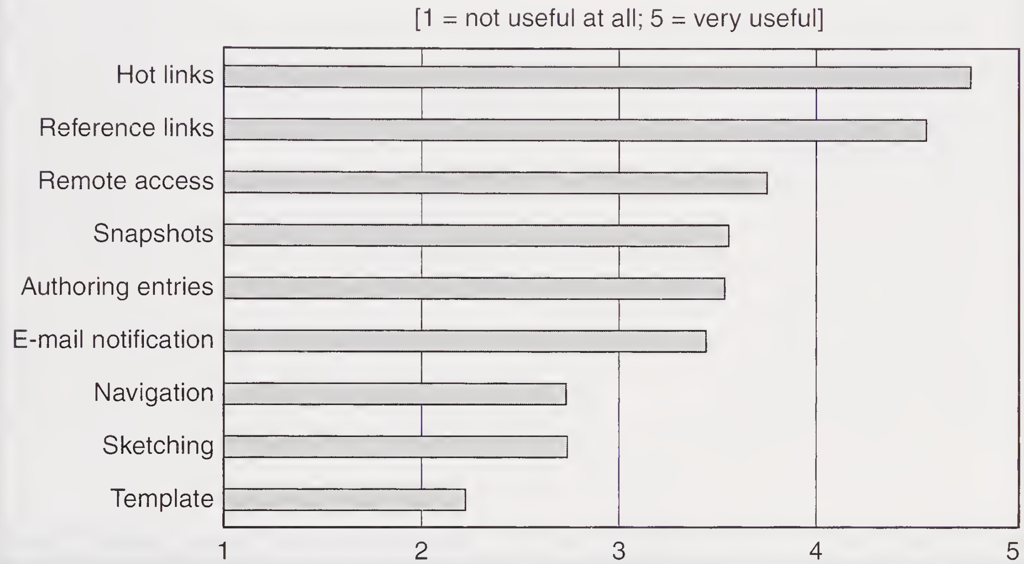


FIGURE 13-2 Ratings of Notebook Features for Information Retrieval

Source: Reprinted with permission of R. Carman et al., "Virtual Cross-Supply Chain Concept Development Collaborative Teams: Spurring Radical Innovations at Boeing-Rocketdyne," first-place winner of 2000 paper competition of the Society for Information Management.

technology—the Internet Notebook—was developed by a third party based on the list of requirements drawn up by several of the team members. The technology allowed the team members to

- Access the notebook from anywhere.
- Create, comment on, reference-link, search, and sort entries that could consist of sketches, snapshots, hotlinks to desktop applications, texts, or templates.
- Use an electronic white board for near-instantaneous access to entries.

Thus, from the outset, the team had a technology suited to its needs, at least as the team initially defined them. The team focused its early discussions on creating a coordination protocol for facilitating its collaborative use. Figure 13-2 shows how the team members rated these features.

The team adapted ways of working that required it to change the fundamental way the members were used to collaborating: from face-to-face discussions to complete reliance on technology, from sharing information sparingly (only when someone needed to know the information) to sharing all information with everyone all the time, and from using personal collaborative tools (such as company-specific e-mail systems) to using a single system. Initially, the team believed that all information would be captured and shared among all members all the time. The result would be a much greater emphasis on knowledge management and retrieval, beyond just communication.

Being Creative Required New Rules of Engagement. The team learned that its ability to be creative required meeting three requirements:

(*Case Continued*)

1. Jointly understand problems, possible solutions, analysis methods, and language.
2. Interact frequently as a team, with all members "present," to share work-in-progress, brainstorm ideas, and test out solutions.
3. Be able to create new information quickly based on a particular conversation or problem, and then equally quickly discard information that was no longer needed.

The team members discovered they needed to adapt the traditional work practices of a collocated team to function as a creative body. Figure 13-3 shows how the need to be creative is accommodated in collocated teams, and what the SLICE team members learned they would need to do to adapt these needs to their non-collocated situation.

The Focus of the Team's Effort Changed over Time. As the project evolved, the team learned that it had to shift its thinking

FIGURE 13-3 Structuring Core Processes for Virtual Teams

Core Needs of Creative Teams	*Practices of Colocated Teams*	*Practices Adapted by Virtual Teams*
Development of shared understanding	• Lead engineer is "spoke-in-the-wheel" for coordinating information and consolidating ideas into new design proposals, which constitute the shared understandings of the team.	• From spoke-in-the-wheel coordination (with lead manager/engineer in center) to democratic coordination • Encourage development and use of common-language metaphors
Frequent opportunities for interaction with team members	• Colocation allows for frequent and spontaneous interaction.	• Coupling use of knowledge repository with frequent teleconferences • Allowing one-on-one discussions when need arises but documenting results for everyone
Rapid creation and sharing of context-specific transient information	• Most discussion is verbal and undocumented, and it is hard to capture the context.	• Promote only minimal cataloging of new information, even to the extent of restricting it to "touchstones" and "placeholders" • Timely and frequent discussions of new entries in knowledge repository to enable members to learn the context

Source: Reprinted with permission of R. Carman et al., "Virtual Cross-Supply Chain Concept Development Collaborative Teams: Spurring Radical Innovations at Boeing-Rocketdyne," first-place winner of 2000 paper competition of the Society for Information Management.

(*Case Continued*)

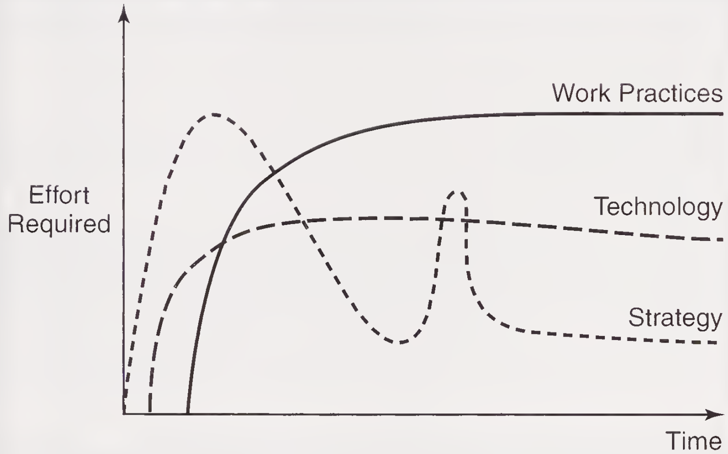


FIGURE 13-4 Effort Distribution over the Team's Life Cycle

Source: Reprinted with permission of R. Carman et al., "Virtual Cross-Supply Chain Concept Development Collaborative Teams: Spurring Radical Innovations at Boeing-Rocketdyne," first-place winner of 2000 paper competition of the Society for Information Management.

among three components, from thinking about strategy (how to fulfill the partnership agreement), to implementing a technology that would support collaboration of the dispersed team structure, to actual work practices that would leverage the technology. It learned that the strategy practices needed to be in place before the work or technology practices so that members did not have to be concerned with both doing the work and negotiating information-sharing arrangements at the same time.

Furthermore, the team discovered it needed the technology in place before it could think about work practices because the work style depended on the support technology. Along the way, members also learned that the technology had to be flexible enough to be adapted to different ways of working because some of their initial work practices did not work as well as hoped. So, over the course of the project, they evolved their practices, and the tool had to support this evolution.

Figure 13-4 shows the allocation of effort over the course of the project among these three components of the project: strategy, technology, and work practices. As can be seen, the team needed to focus on both the technology and its own work practices over the entire span of the project. For example, a technology facilitator was required to attend all teleconferences so that problems could be fixed immediately. Members never knew when someone would not understand how to perform a particular operation or a server would go down and communications would need to be rerouted. In addition, throughout the project, as the team found work practices not working, members devoted some effort to decide on better ways of working. In the end, this attention paid off.

As noted, the SLICE team at Boeing-Rocketdyne was immensely successful, in large part due to the advanced collaboration technology it used. As usual, though, the technology was necessary but not sufficient. The team also needed a carefully developed partnership agreement in place before work began and work practices to leverage the technology, which needed to evolve as the team members discovered a technology's usefulness. ■

As this discussion of systems to support collaboration has shown, there is a spectrum of group working situations and many types of IT-based support. Furthermore, use of collaboration software can change structure within one enterprise, working relationships between enterprises, and working relationships between people in different parts of the world.

MANAGING IT-ENABLED WORKFLOWS

From a strict operational perspective, workflow deals with the automation of business processes. A workflow can be a one-time-only process. Also known as ad hoc workflow, this is a collaborative process that coordinates a team that works together to achieve a task. A more common form of workflow is one that is set up to enhance the efficiency of transaction-oriented and mission-critical tasks such as production and manufacturing and order processing.

A workflow management application defines all the business processes, from the start to finish, including all exception conditions, tracks process-related information and the status of each instance of the process as it gets executed. This definition requirement already constitutes an opportunity for the company that uses workflow to examine or reexamine their business procedures and ways to enhance their efficiency. An efficient workflow is one that is capable of identifying the best procedural routes (either serial, parallel, or conditional), and is able to document and make use of business rules to ensure the proper load balancing.

Among different approaches to modeling a workflow, Winograd and Flores[12] focus on coordination and communication. For every workflow loop, there is a "customer" and a "performer." The performer executes a task for a customer, and the customer will move on to become the performer in the task that follows. The loop is defined as coordination between the customer and the performer is sequence of actions: proposal, agreement, performance, and satisfaction. Tasks are defined by the requests and commitments expressed in the loops. A workflow process is a collection of these loops with links between them. Procedurally, this is how the mechanism works. In the first phase (request), a customer asks the performer for an action. Based on the pre-approved task description, the performer agrees to the request in the second phase (commitment). In the third phase (performance), the performer fulfills the task and reports its accomplishment. In the fourth and final phase (satisfaction), the customer receives the outcome of the task, accepts the report, and expresses his/her satisfaction or dissatisfaction. The ultimate goal here is customer satisfaction.

Workflow management technology provides a mechanism for planning and controlling how teams work together. There exist a variety of computer-supported tools to manage workflows in organizations. Some are PC-based and grow out from the project management technologies. At the other end of the spectrum, sophisticated workflow systems are installed on client-server platforms. They are capable of supporting highly distributed work environments, with a massive integration of technologies.

What should management expect from an IT-enabled workflow? First and thanks to its automation and coordination capacities, the system should significantly improve the efficiency of business processes. Since the sequencing of processes is predetermined with a proper and timely routing of electronic information, time savings can be significant. The development of automated business rules should also eliminate the majority, if not all, of the ambiguities in executing business policies. Second, workflow systems should help enhance the effectiveness of the organization. With all well-defined tasks structured and automated, employees are now given more time to focus on other tasks that need more context-dependent decision making. Advanced workflow technologies have decision support technologies embedded, such as visualization, decision modes, and simulation. An example of workflow applications is reported by Mak et al.[13]

SUPPORTING NEGOTIATION

The Wisdom of Difference

According to Tung Bui from the University of Hawaii and Melvin F. Shakun[14] from New York University, negotiation may be characterized as a motivated process by which antagonists, with some initial conflict or disagreement, seek to find an agreeable solution that make all of them better off. As such, negotiation involves both cooperation and conflict—cooperation to create value (increase the size of the pie) and conflict to claim it (take as big a slice of the pie as possible). Typically, the negotiation process begins with a party's awareness of the conflict, either at the goal, judgment, or solution levels.

Goal conflict occurs when a party apparently seeks divergent or incompatible outcomes, if necessary, at the expense of the other parties. Entering a bargaining situation with the parties perceiving the existence of incompatible outcomes often leads to a distribute bias. This win-lose perception in turn tends to generate more hostility and mistrust. Hence, the chance of reaching a common solution is diminished.

Judgment conflicts differ from goal conflicts, in that, while parties may share the same goal, they disagree over the best way of achieving it. Differences often reside in deferent interpretations of the same factual information. First, parties may believe that they have information, which the others do not have, and thus they presume that others may have come to an incorrect assessment and conclusion. Alternatively, the very same parties may contend that, even if others possess the right information, they may make the wrong conclusion anyway. Research has shown that people who feel wronged by the other side due to misunderstanding or perceived differences in norms and goals could experience feelings of disapproval, blame, anger, and hostility. This negative feeling could trigger hostile actions resulting in deadlocks.

The acceptance of a solution is a function of the extent to which negotiation parties perceive that the proposed solution is a fair one. Again, fairness depends on the involved parties' judgment of the situation based on their own view of equity and justice, their needs to reach a solution, and their own understanding of what the others think about the problem. Furthermore, a party's perception of how they and the other parties are being treated may affect the decision outcome.

Given the characteristics of negotiation described above, the negotiation process is an evolving one. Session after session, negotiators fine tune, or even change completely, their initial goal, judgment or solution. Under the best conditions, this process is refined and validated through rounds of discussion until all parties accept the outcome. Supporting the negotiations entails providing means that could help antagonists find rightness in problem representation and negotiation solution.

Negotiation Support Systems

For almost two decades, Bui and Shakun have led a research mini-track on Negotiation Support Systems at the Hawaii International Conference on System Sciences. The purpose of the annual meetings is to gather researchers interested in using technology to support negotiation. Computerized models of negotiation derive from a number of disciplines. These include, but are not limited to, economics, operations research, management science, applied psychology, organization science, and applied artificial intelligence. Negotiation Support Systems (NSS) are computer assistance for negotiations. Their design and use have centered on key foci:

Group decision and/or conflict resolution models to help negotiators reduce discord and increase the chance of reaching consensus. Models found in the NSS-related literature include those derived from game theory, multiple objective optimization, theory of social choice and voting, and rule-based advisory system. A recent trend is to use negotiating software agents. In a decision environment under intense data processing and time pressure, autonomous agents negotiate with others. Bui[15] describes a model of tele-medicine where a software agent from a hospital negotiates with software agents of insurance companies to find the most cost-effective insurance coverage for its patients. Another example is the use of automated Web Services to negotiate shipping costs on B2C e-commerce.

Rich communications media to enhance information and communication exchange between antagonists. It is important for the party to have all the relevant information during the negotiation process. It is also important to share some of this information to the other side. Sometimes, data need to be aggregated or reformatted before they can be sent. Some other times, past documentation, including past agreement, audio/video clips, or archived photos, needs to be presented.

Perhaps the most useful contribution of NSS is its ability to assist the negotiators in interactive information elicitation and in processing it in a transparent and structured manner. Transparency refers to the ability of the decision maker to define, understand, and assess the problem correctly. Via user-friendly interface and structured modeling and representation, the decision maker has a better opportunity to clarify, for him, the problem, and present it is a more systematic manner to the other side. Like the feature of DSS, structuredness refers to the extent to which the problem is formulated in a systematic manner (for example, using tables to lay out and display prioritized goals, graphical representation to visualize preferences, and formula to allow what-if analysis). By imposing a certain level of structured in problem formulation, NSS can also be used as a shared and common language for mutual understanding. A joint and open modeling effort may be to the advantage of all parties.

Another critical benefit of NSS is its ability to provide continuity to negotiation. Observations of real-life negotiations that have ended with successful outcome suggest that temporary interruptions of the negotiation process can help to enhance the chance of reaching a final agreement. A break can be useful in allowing highly emotional parties to calm down, thus bringing them back to a more rational mind-set. However, discontinuities of negotiation, in particular those that are rather long and tedious, can be detrimental to negotiation outcomes. Motivation is waning, problems and issues are forgotten, and the urgency of seeking a consensus is gone. In an NSS environment, thanks to Internet-based connectivity and advanced modeling, information access and exchange can be sustained and interactive processing is near real time.

This ability not only helps negotiators increase the chance of finding a compromise, but also frequently guides them in reaching a better-than-expected solution. An example of using negotiation software for labor negotiation can be found in Bui and Shakun.[14]

MANAGING CRISES AND EMERGENCY RESPONSE

Crises: Perception and Cognition

A crisis is an event that has either occurred or impending to occur. A crisis is characterized by the fact that it occurs as a surprise, threatens one or more valued goals, and leaves little time for response. It threatens life or property or both on a wide scale. It can be limited to a small locale or may extend over a large area, and is not necessarily limited within national boundaries. As an example, the tsunami of 2004 in Southeast Asia was never thought of as a possible natural disaster by the inhabitants or the governments in the region. Even governments with vast resources are victims of surprise when they fail in their intelligence and planning. In a global context, the process of intelligence gathering, information sharing, and coordinated planning have proved to be of a close to insurmountable level of complexity.

According to Billings,[16] the three factors influencing the extent of perceived crisis are (1) perceived value of possible loss (high importance), (2) perceived probability of loss (high uncertainty), and (3) perceived time pressure (immediacy). These three elements themselves are determined by technological, cultural, social, and economical factors. They have imperative implications when dealing with a crisis of global proportion. It is possible that an untrained decision maker may misjudge an event and not pay adequate attention to the severity of an emergency. If the theater of a crisis is far away and the network systems to monitor the events are nonexistent or rudimentary, the crisis management team may not fathom the seriousness of a situation.

Despite all the training, in during a real emergency team members may experience (1) reduced attention span both across time and space, (2) loss of memory and abstract ability, (3) diminished tolerance for ambiguity, (4) deterioration of verbal performance and visual motor coordination, (5) regression to simpler and more primitive mode of responses, and (6) increased stress leading to random behavior and rate of error. If the decision protocols are committee-based, they may be time consuming and ineffective. In this chapter, we limit our discussion to three of these: (1) information, (2) technology, and (3) coordination.

Information Quality, Transparency, and Distortion

A common denominator of all the activities in connection with a crisis prevention and response is information. Information exchange needs to be interoperable, standardized, and secure. During a complex emergency situation, whether by natural or technological disaster, an accurate, timely description of the event, its consequences, the needs, the response requirements, and the gaps in national capacity to handle the crisis are required. A major problem can arise if various involved agencies participating in the decision have conflicting information about the crisis, according to Bui and Sankaran, of PRIISM.[17]

During an emergency, information is likely to get distorted. If too much information flows into a few decision makers, the information overload may lead decision

TABLE 13-1 Mapping Path Modeling to ERS Requirements

	Phases of assistance and relief operation		
Support type	***Pre-crisis***	***Crisis response***	***Post-crisis***
Information	–Needs assessment (local and global) –*Information collection, compilation, filtering, analysis, and storage (Global remote sensing & warning, document management)* –*Integration of infrastructure system databases (Data standardization and interoperability)* –*Translation and certification* –*Adaptation to national information management policies*	–Real-time Interactive Information center (access, share, exchange) –Real-time GPS-supported location information –*Global authentication of data* –Data security and standardization –Push-approach to information dissemination using voice communications (VoiP and multimedia)	–Dissemination of activity results –Dissemination of lessons learned
Communication	–Electronic discussion group –Satellite network –Dissemination of help request to expert group worldwide	–Knowledge-based information filtering –Teleconferencing	–Evaluation of communication bottlenecks –Search for alternate technologies
Collaboration/ coordination	–Group/event scheduling –*Coordination with regional/national network* –*Transnational scenario development (planned emergency responses)* –*Trust building among international agencies/teams*	–Computer-assisted logistics (tracking, monitoring) –Just-in-time support –Group/event scheduling and coordination of planning –Security (VPN) –*Language translation* –*Special assistance to international rescue staff*	–*International briefing of coordination* –Exchanging of lessons learned
Medical support	–Public health education –Information about major diseases –*Planning, training, stockpiling, and transportation of medical supplies*	–*Remote diagnosis/patient monitoring* –*Information network to support health care teams*	–*Review of international coordination procedures* –Follow up on ongoing medical situations
Decision focus	–Intelligence gathering, interpretation –Continuous update of directory of experts –*Universal visualization and multimedia*	–*Supply-chain management support (sequencing of responses)* –*Global response tracking support* –*Distributed group decision support system* –Computer-assisted project management (modularity and scalability)	–Review of effectiveness of decision outcomes –Update organization memory –*Assessment and improvement of global emergency management processes*

makers to focus only on selected sources. Another cause of distortion is loss of information over long distance.

Media usually provide breaking news. Local media tend to be nation-centric, focusing on national priorities and community interests. They can be short on analysis and tend to fail to provide all the data required for executive decision. A disaster assessment team should try to provide analysis based on a sound understanding of the facts so as to influence the strategic decision and the use of resources.

Emergency response operations should be transparent to everyone, including the local populace. Authorities involved in a disaster are reluctant to release information they deem critical to national security. The lack of sharing security information can threaten the lives of those who work among the local populace. As an example, in a recent rescue operation in Rwanda and Chechnya, emergency workers have been targeted and killed by rebel troops without proper protection or even awareness of the threat. These events have led to more efforts for better coordination on security issues.

Technology and Infrastructure for Organization Readiness

In a crisis, a crisis management support system is expected to help its users prepare, analyze, and resolve conflict. IT can help all involved parties access and filter data from large online databases to cope with information overload and data reliability. As discussed earlier, IT can provide expert system technology such as case-based reasoning to learn lessons from past crises, and use DSS and NSS to alleviate problems related to group pathologies, improve decision quality, and enhance the organizations' readiness to deal with catastrophes.

Information technologies that work well during normal times may get overloaded and become incapacitated of meeting the high volume of information processing. Incompatible communication devices represent a particularly serious problem. The use of widely accepted commercial communication systems, such as cellular telephone, could ease these problems. But the need for securing up-to-date information still exists. Thus, the information age is a double-edged sword for an organization that is under siege.

Even if all the emergency response participants try to do their best in exchanging information among themselves, cultural and technical incompatibilities constitute considerable barriers for a free information flow. They may use different languages and incompatible communication equipment. At the inter-agency level, incompatibilities related to organizational structures also hinder the quality of information processing. When military organizations are called in for help, their rigid communication hierarchy may clash with their nonmilitary counterparts that are relatively free of rank. The movement of relief supplies depends on transport arrangement made by particular organization. Backlogs in port are common. If possible, just-in-time supply of equipment will reduce the needs for inventory and loss due to looting and spoilage.

In order to achieve total asset visibility, extensive monitoring and tracking capability is required. Although much of these capabilities can be brought through international assistance, raising the region's own permanent capability will improve the chances of the country joining the global network of transportation and communication in the long run.

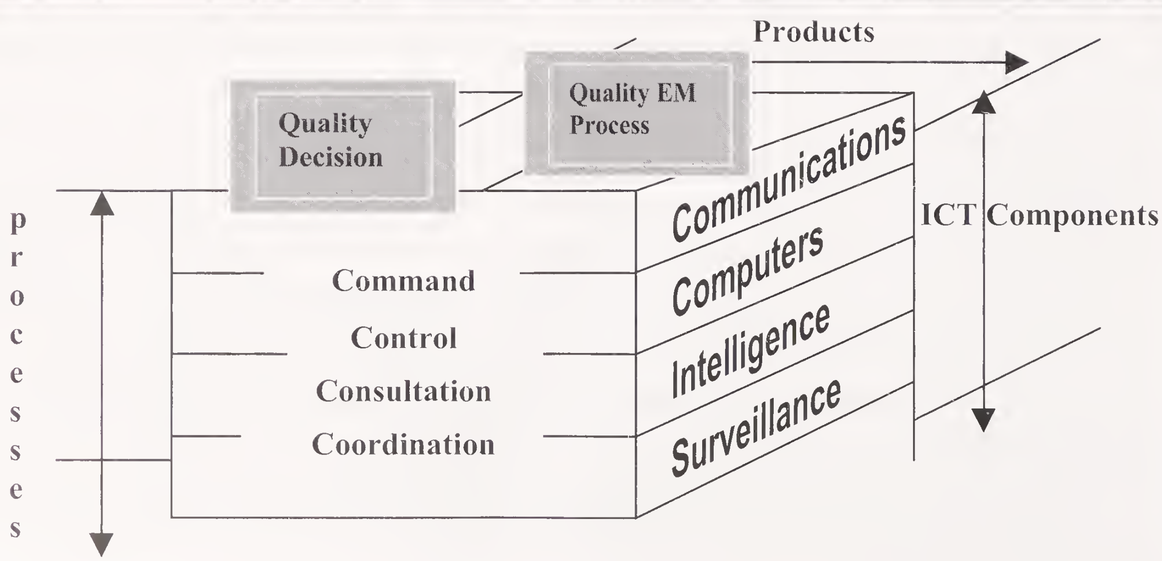
Another key issue is searching for a way to achieve unity of efforts and better coordination across the variety of organizations in emergency response operations. Coordination theory has proved to be useful in reducing time delay, from crisis planning, recognition, mobilization, and response.

There can be significant differences in perspectives between organizations involved in relief efforts during the emergency response process. For example, one organization may be more concerned about short-term rescue activities while another may be focused on long-term infra-structural development. It can lead to loss of coordination especially when short-term emergency response operations disrupt the long-term self-reliance of a specific region. Although minor disruptions are inevitable, if emergency response operations can be accomplished in a relatively short time before local situation is distorted, the disruptions can be minimized.

When quick and massive responses are required, no single organization has all the resources to alleviate the effects of a disaster. Supra-nationals, local government, and military units all must find some way to cooperate or at least not to disrupt others' activity. Because of the high number of participating agencies, command structure is often hard to achieve. The ad hoc mixture of participants is likely to lead to a situation where no one is in charge. Coordination should be planned prior to the occurrence of a crisis.

Putting all things together, we suggest that to improve the quality of decision outcome and processes, an ERS should be designed to enhance information, cognition, collaboration, and decision making. A high-level architecture should have three constituents: (1) system components, (2) products, and (3) processes to make these products. The ERS should be enabled by information and communications technologies for information, communications, and surveillance, and should be able to support the Command, Control, Consultation, and Coordination processes (see Figure 13-5). CIOs should have a emergency response plan that integrates well with this framework.

FIGURE 13-5 Structure of an IT-Supported Emergency Response Systerm (ERS)



MANAGING COLLABORATION IN VIRTUAL ORGANIZATIONS

This chapter on collaboration has presented some intriguing glimpses into the dramatic changes occurring in organizational structures. Frances Cairncross, Peter Drucker, Etienne Wenger, and others believe that the organization of the future will be much more like networks of communities and teams than the hierarchical bureaucracies of the past. The question is: With CoPs, network armies, and global virtual teams becoming more predominant, how are such nontraditional collaborative structures to be managed?

Lynne Markus, Brook Manville of Saba Software, and Carole Agres[18] explored this question by looking to the open source movement. Here is their thinking, which appeared in a *Sloan Management Review* article.

They, too, cite Drucker,[19] who stated that the job of executives in managing knowledge workers is not to tell them what to do (manage them), but rather to tell them where the organization is going (lead them). It is akin to leading volunteers who, though unpaid, labor for a cause out of commitment and the expectation of having a voice in the operation. Markus et al. note that CoPs, self-employed freelancers, and industries experiencing the emergence of networked organizational forms all point to a workforce with a more volunteer-like mind-set—in spirit if not in fact. The authors researched the open source movement to help the managers of one knowledge-based organization that was having governance troubles. The traditional forms of governance were causing employees to feel distant and leave. The authors' research led them to two conclusions:

1. Executives of increasingly virtual organizations should think about expanding the kinds of motivators they use. The open source movement demonstrates that while money is a motivator for volunteers, gaining a high reputation among peers, taking pride in contributions, and being able to improve and use high-quality software are strong motivators as well.
2. Executives of increasingly virtual organizations should consider adopting a governance structure that fosters self-governance by employees. Although the open source movement appears to have all the trappings of chaos waiting to happen, it is actually very well disciplined because its governance mechanisms foster self-governance.

MOTIVATING A VIRTUAL WORKFORCE

Markus, Manville, and Agres[18] suggest that managers in virtual organizations put in place motivators that reinforce each other. Open source contributors volunteer for many often-interlocking reasons. They love to build software. That is pure joy for them, states Eric Raymond,[20] who wrote "The Cathedral and the Bazaar," an online paper that has been influential in touting the benefits of open source development of software. They take pride in helping others and giving something back to society. They often believe that software should be given away, as it is in university computer science labs where open source flourishes. In addition, they receive the personal benefit of having better software for their own use. One obligation in this culture is to send software enhancements to the author to be checked. Another is to make the enhancements widely available.

Like academia, open source is a "reputation culture," note Markus et al. Reputation is the measure of success. Gaining a reputation for uncovering bugs and making good fixes spreads because open source contributions are highly visible. Every project includes a credit list of the people who have contributed. This culture is also a gift type of culture. Reputation is gained by what the contributors give away, rather than what they control (as in the exchange culture found in traditional business). In a gift culture, there is abundance. In open source, there is plenty of computing power, network bandwidth, storage space, and such. A good reputation can lead to a job or venture capital. Although money cannot be earned from the software, it can be earned by selling support or education.

Markus, Manville, and Agres thus recommend that reputation may be the symbol of success in other kinds of knowledge work. Managers should use this "coin of the realm" to motivate employees in their virtual organization.

Governing Virtual Organizations

Managing open source appears to be an impossible task because there are at least 750,000 developers, all of whom signed up on their own volition and can stop volunteering at any time. Yet, note Markus et al., many open source projects work well because they employ three governance principles: managed membership, rules and institutions, and social pressures.

Managed Membership

Open source work has a well-defined leadership, with the originator often maintaining a lead role in development and distribution. Or a lead team might rule, dividing the work, refereeing coordination across teams, and so on. Leaders are rarely elected. Although anyone can be involved in searching for bugs and fixes (in most open source work), project authority only comes from being given it by, say, the project's core team based on the quality of one's work on the project. In some cases, even working on a project may require being voted in. Thus, membership is limited, making it manageable.

Rules and Institutions

One rule is the open source license—how the software can be used. The license may, for instance, permit any form of commercial use or not allow commercial versions at all. Other rules relate to how members and leaders are chosen or how voting and discussions are conducted. All communications are generally done over the Internet and occur in phases for a specific length of time. For instance, there can be a request-for-discussion phase, a call-for-votes phase, and a results phase, note Markus et al. Each phase has its own rules. Most voting is democratic, but some is not.

Social Pressures

To have teeth, rules need means to enforce compliance and resolve disputes. To bring continual noncompliers into line, open source groups generally use social pressures. For example, a group may flame someone, which means sending the disobeyer angry e-mail. Or members may spam the person, that is, overwhelm the person with e-mail. Or members may simply shun the person by not responding to that person's e-mail.

Generally, after such treatment, the disobeyer learns the rules of the community and falls into line. Such pressures can even be turned on leaders who act inappropriately.

Conflicts that end badly can cause volunteers to simply leave an open source group because it kills their motivation to contribute. Generally, open source groups use escalated sanctions to resolve conflict and bring noncompliers into line. They also monitor work, which represents another type of social pressure.

These social pressures work because reputation is so important, and because the work is so visible to everyone. Also underlying all the governance mechanisms are the shared values of the culture, which place emphasis on self-control (to maintain one's reputation) and social control (monitoring each other's behavior). IT is a key enabler for all these governing mechanisms, permitting the distributed software development, coordination among the participants, and groupwide enforcement of the rules via the various social controls.

Markus, Manville, and Agres recommend that managers in virtual organizations consider adopting these practices from the open source movement because intrinsic motivation and self-management are as important in virtual organizations as they are in open source. Furthermore, managers should consider rewarding collective results (as happens when an open source product gains commercial success) along with individual benefits. They should also foster development of reputation through the assignment of project lead roles and other mechanisms.

However, adopting the tenets of open source to managing in a virtual organization needs to take into account that a strong shared culture is a precondition for the governance mechanisms to work. A virtual organization without such a culture may not have the same results. Furthermore, Markus et al. question whether the mechanisms for governing programmers performing challenging work can apply equally well to employees performing routine activities. In short, self-governance is at the heart of managing virtual organizations. Without self-governance and strong reinforcing conditions, such social governance mechanisms might not work.

CONCLUSION

IT-based tools for supporting collaboration have been around for at least 30 years, becoming increasingly sophisticated over that time: The interaction between IT and the users is getting more flexible and more user-friendly. Modeling tools are more advanced. And data availability has become unprecedented. New IT platforms also make it more conducive to use technology to support collaboration. It is worth repeating the emerging role of wireless computing that brings data and processing power to the users, whenever and wherever they need them.

As reviewed in this chapter, some technologies are meant to support people attending a planning meeting. These tools permit more discussion, more evenly spread participation, more high-level company-wide discussion, and involvement by more people than a traditional planning meeting would allow. Other tools allow real-time collaboration among distributed team members who not only need to hear each other's voices, but also need to simultaneously see their hand-drawn changes to an engineering drawing in real time. Still other collaboration tools help team members located around the globe "converse," not in real time, but at different times of the day.

Technologies to support collaboration can be deployed to enhance the effectiveness of workflow management, negotiation, and crisis management. For each type of application, there is a different set of design considerations regarding data requirements, modeling, and communication support.

In all cases, the use of IT-based collaboration tools changes the collaboration process, who can participate, how they participate, and even the kinds of work they do. Collaboration is at the heart of the business world. No single organization can hope to be successful going it alone. The business world is moving too fast to stay abreast on all fronts at once. Partnering with others has become the standard style of work. For this reason, this area of IT-based collaboration support is likely to grow and mature quickly in the years ahead.

QUESTIONS AND EXERCISES

Review Questions

1. According to Drucker, why are team-based organizations like hospitals or orchestras?
2. Explain five characteristics of groups.
3. Name several types of groups and briefly describe each.
4. Explain the three ways Communities of Practice can be nurtured.
5. What are the characteristics of the open source movement?
6. Describe the four cells of the time/place matrix. Give an example of a technology used in each.
7. What are some of the ways IT can help improve meetings?
8. What benefits did Burr-Brown get from its use of a group decision room?
9. List some of the ways Group Support Systems (GSSs) can improve the traditional presentation-discussion session? What are some potential disadvantages?
10. What were the four success factors for the SLICE team at Boeing-Rocketdyne?
11. What sorts of motivators should managers of virtual organizations adapt from the open source movement, according to Markus et al.?
12. What sorts of governance practices might managers of virtual organizations find useful, according to Markus et al.?

Discussion Questions

1. Support for communication and coordination is quite different from support for group decision making. The technologies also should be different. Do you agree or disagree? Explain your reasoning.
2. The lessons from the open source movement cannot be applied to virtual teams because the open source developers are truly volunteers and they have passion for their work. The same is not true of virtual teams getting paid to work. Do you agree or disagree? Explain your reasoning.
3. Network armies hold valuable lessons for the way some organizations should think about reorganizing themselves. Do you agree or disagree? If you agree, describe some organizations you are familiar with and what they could learn from

network armies. If you disagree, describe several organizations you are familiar with and why they have nothing to learn from network armies.

Exercises

1. Find an article that describes an IT-based collaborative tool. What is its major purpose? What technology is used?
2. Conduct a survey of products available in the marketplace for supporting collaboration. What kinds of support do the systems provide? How do they compare with the systems described in this chapter?
3. Visit a local company that is using technology to support group work. Map its activities onto the time/place matrix. What infrastructures has the company developed?

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CHAPTER

14

SUPPORTING KNOWLEDGE WORK

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INTRODUCTION

In this chapter, we deal with two of the most important and most talked about, yet still evolving, topics that relate to supporting knowledge work. One is the subject of managing knowledge. That means not only encouraging people to share knowledge personally, but also putting their knowledge in a form that others can easily access. Because knowledge can come from inside as well as outside the firm, the final sections on knowledge management deal with customer knowledge and researchers' knowledge and how to embed this outside knowledge in a real-time system. Under this topic are the intellectual capital issues of valuing intellectual property, usage, and sharing knowledge.

The second topic is the vast arena of computer ethics, which deals with such areas as information privacy, intellectual property rights, and other legal and ethical issues relating to information and knowledge. Many laws and regulations written before the computer age and the Internet explosion are being applied to today's software, databases that house personally identifiable information, and networks that connect different cultures. The entire realm of intellectual capital challenges the applicability of these laws and norms.

Consistent with the framework laid out in this text, we address the problem of supporting knowledge work along three dimensions: technology, organization, and environment.

Companies Want to Manage Knowledge

One of the enduring subjects in the IT field since the mid-1990s has been knowledge management. Top corporate executives realize that their greatest corporate assets walk out the door every evening, taking with them another crucial asset, knowledge. Attempts to capture knowledge in computer systems continue. But for some experts and researchers in the field, knowledge is not something that can be captured in a machine; it only exists inside a person's head. Information can be captured in computers; knowledge cannot. Many feel that the term "knowledge management" creates the wrong impression. The term "management" often brings forth the "we can control it" mind-set. Knowledge cannot be controlled or engineered, so the mechanical metaphor is wrong. It can only be leveraged through processes and culture. The biological or ecological metaphor is much better. The more people are connected, and the more they exchange ideas, the more their knowledge spreads and can thus be leveraged. This view, of course, is still being debated, and raises the question, "If we cannot disembody knowledge, how do we better manage the knowledge within people to leverage this asset?"

Tony Brewer,[1a] a researcher at Gartner, researched this topic and notes that as we move from a service economy to a knowledge economy, companies move toward managing their intellectual capital in a more formal and deliberate way. In essence, knowledge exists in two states, tacit and explicit. Tacit knowledge exists within a person's mind and is private and unique to each person. Explicit knowledge has been articulated, codified, and made public. Western management practices have concentrated on managing explicit knowledge; but cultivating and leveraging tacit knowledge is just as important. Effective knowledge management requires transferring knowledge between these two states.

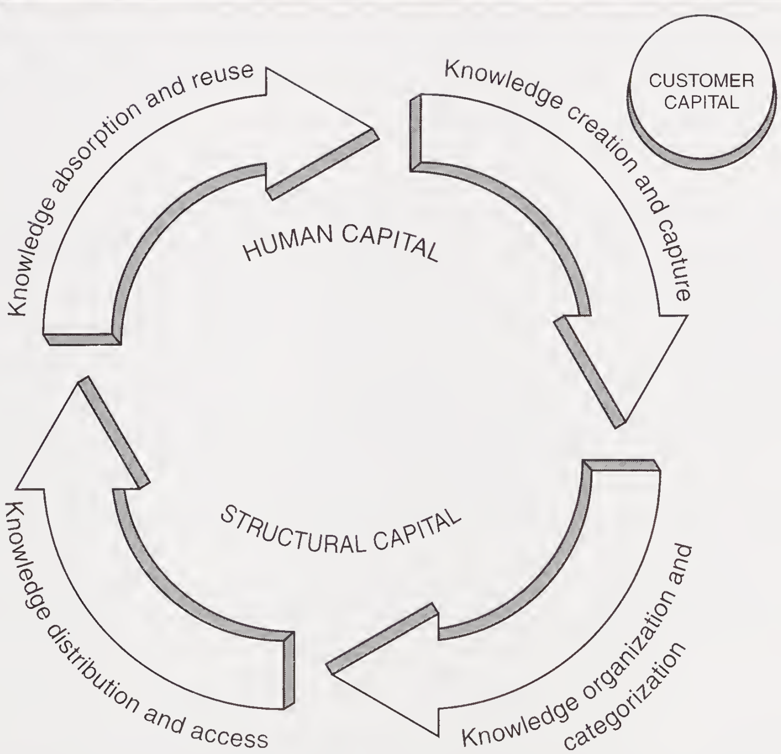
How is that done? Well, says Brewer, because knowledge is not a physical asset, it is not effectively described in terms of manufacturing analogies, such as storing it in inventory. Rather, it needs to be thought of in ecological terms, such as nurturing it, cultivating it, and harvesting it. Furthermore, ways to transfer knowledge back and forth between its tacit and explicit states are crucial and are generally a result of encouraging the free flow of ideas and information, something that organizational norms, departmental boundaries, and national differences can inhibit.

The process of transferring tacit knowledge to others is a key part of managing knowledge. To emphasize this idea, some companies have stopped talking about knowledge management and use only the term "knowledge sharing." In this regard, IT is seen as one enabler, but not the main one. The key to knowledge sharing seems to be getting people together face-to-face to explain how they do things. Once people sit down and talk about what they do and why, barriers fall, knowledge flows, and sharing increases. Unfortunately, people are not given the time or the space these days for this kind of interaction; free time for sharing is not seen as important.

A MODEL FOR MANAGING KNOWLEDGE

Due to the increasing emphasis on knowledge, some now call it intellectual capital to distinguish it from the other kinds of capital that firms possess. Giga Information Group,[2] a research firm, has published a model for managing intellectual capital. As shown in Figure 14-1, the model is circular and has four stages, which

FIGURE 14-1 A Knowledge Management Framework



Source: Reprinted with permission from *Best Practices in Knowledge Management*, Giga Information Group, 1997, www.gigaweb.com.

represent what people generally do with knowledge. First, they create it or capture it from a source. Next, they organize it and put it into categories for easy retrieval. Then they distribute it (push) or access it (pull). Finally, they absorb another's knowledge for their own use or to create more new knowledge. Thus, the cycle begins again.

The four stages create three types of capital: human, structural, and customer.

- ***Human capital.*** This form of intellectual capital consists of knowledge, skills, and innovativeness of employees as well as company values, culture, and philosophy. It is created during the knowledge-creation-capture and knowledge-absorption-reuse stages because these two stages focus on getting people together to share knowledge. They deal with the people aspects of knowledge management. Their main question is, "How do we get people to have more knowledge in their heads?"
- ***Structural capital.*** This is the capabilities embedded in hardware, software, databases, organizational structure, patents, and trademarks that support employees as well as relationships with customers. Structural capital is formed in the knowledge-organization-categorization and knowledge-distribution-access stages because these stages focus on moving knowledge from people's heads to a tangible company asset. These stages deal with the technology issues surrounding knowledge management and sharing. Their main question is, "How do we get knowledge out of people's heads and into a computer, a process, a document, or another organizational asset?"
- ***Customer capital.*** This form of intellectual capital is the strength of a company's franchise with its customers and is concerned with its relationships and networks of associates. Furthermore, when customers are familiar with a company's products or services, the company can call that familiarity customer capital. This form of capital may be either human (relationships with the company) or structural (products used from the company).

Based on a series of case studies, Giga discovered that the human capital stages and the structural capital stages require different mind-sets. Hence, companies have had to use different approaches to grow each one; and the techniques for one do not work for the other. The companies that focused on human capital used touchy-feely, people-centric approaches. In some cases, no technology was used at all. The companies that focused on structural capital took a typical IS approach: using technology to solve a problem. Little talk addressed individuals, communities, and work practices; talk mainly centered on yellow pages of experts, knowledge bases, and such. However, to succeed in leveraging intellectual capital, companies need to do both.

Now we turn to specifics of what companies have done to build human capital, structural capital, and customer capital.

Building Human Capital

The emphasis in building human capital, notes Giga, is to answer the question, "How do we get people to have more knowledge in their heads?" Giga sees four ways: create it, capture it, absorb it, and reuse it.

Knowledge Creation and Capture

This phase deals with generating knowledge, either by nurturing employees to create it or by acquiring it from outside. Hence, it deals with both human capital and customer capital. As noted earlier, the Giga cases that emphasized this phase of managing knowledge have used high-touch approaches, such as creating a sharing culture, urging people to meet either in person or electronically, and encouraging innovation.

As another example of what a company can do to promote knowledge sharing globally, consider the approach that Buckman Laboratories has taken. This description is based on Brewer's[1a] work.

CASE EXAMPLE

BUCKMAN LABORATORIES

www.buckman.com

Buckman Laboratories, an industrial chemical company based in Memphis, Tennessee, has some 1,300 employees across 70 countries around the world. The concept of sharing knowledge and best practices has been around in Buckman for more than 15 years. In fact, the company's code of ethics reinforces the sharing culture. The company believes that successfully transferring knowledge depends 90 percent on having the right culture and 10 percent on technology.

To bring the knowledge of all Buckman's employees to bear on a customer problem anywhere in the world—whether in Europe, South Africa, Australia/New Zealand, or Japan—Buckman established a knowledge transfer system called K'Netix, the Buckman Knowledge Network. The goal of K'Netix was to get people who had not met each other, but belonged to the same business, to communicate with each other and develop trust in each other: trust that one person was interested in the other's success, trust that what one person received from others was valid and sincere, and enough trust in the culture to help someone else.

Ten years ago, sharing was accomplished mainly by people traveling all over the world to see each other, with lots of face-to-face conversations and meetings. Today, such meetings still occur, but the technology helps people stay in touch between these meetings, making communications more continuous.

When employees need information or help, they ask via forums, which are Buckman-only online forums over the Internet. In all, seven forums in TechForum are organized by industry and are open to all employees.

One particularly influential conversation, which set the tone for companywide sharing, took place over TechForum and concerned Buckman's global sales awards. A large cash award was split among the top three salespeople worldwide; the top 20 got plaques. It was based on a formula that took many factors into account. The salespeople, however, were unhappy with the formula. When this discussion appeared on the companywide forum, then-CEO Bob Buckman jumped into the fray and decided that the entire company should iron out the problems in

(Case Continued)

front of all employees. Hundreds of messages were recorded, and the entire award structure was restructured online in front of everyone. It was a rare opportunity to allow everyone to share in an important, yet sensitive, company subject. Moreover, top management did not dictate the results. This conversation reinforced the sharing culture.

The conversations are the basis for transferring knowledge around the company. So the important ones are captured. Volunteer experts identify conversations that contain valuable information and, more importantly, valuable streams of reasoning. This information is then edited to remove extraneous material, given keywords, and stored in the forum library. In essence, Buckman is capturing the artifacts of its virtual teams in action. In so doing, it is creating a self-building knowledge base, which can be used for what-if analyses and can be mined to create new knowledge.

The prime benefit is timely, high-quality responses to customer needs. For example, a new employee in Brazil was scheduled to visit a customer who had a particular problem. The salesperson posted both the problem and a suggested solution in a forum and sought advice from anyone with more experience. A response came quickly: "I've faced this problem and your pH is too high; it will cause odors and ruin the paper. Bring the pH down by two points. That won't hurt the process, and it will clear up the problem." As a result, this new employee, who had only modest experience, was able to present a proposal with the experience of a 25-year veteran, and make the sale. ■

Knowledge Absorption and Reuse

This phase of building human capital addresses the notion of getting knowledge into people's heads where it can be enhanced and reused. Irrespective of whether people believe that knowledge only exists in minds or can exist in computers, the Giga cases that emphasized this phase of managing knowledge used high-touch approaches. They too focused on nurturing interactions among people, recognizing the knowledge brokers who exist in companies, and supporting communities of practice.

Recognizing knowledge brokers: "The Rudy problem." Simply discovering who has what knowledge is a step in the right direction to fostering knowledge sharing. Yet, when possessing knowledge is not rewarded by management, neither is sharing, as the following story illustrates.

At a knowledge management conference, Dr. Patricia Seemann,[3] who headed up a knowledge management project at a pharmaceutical company, told the story of Serge and Rudy (fictitious names but real people). Serge, she said, was a "real" manager. He had a three-window office, a big desk, and a title. If you asked him what he did the past year, he would say, "I registered 600 products in 30 countries." Rudy, on the other hand, is a headache, his manager says, because he does not work. He just stands around and talks all day. Whenever you see him, he is talking to someone. When you ask him what he did the past year, he says, "I sort of helped out."

The company downsized, and guess who got laid off? Rudy. And then what happened? His department fell apart because there was no one to help, to provide guidance. When they fired Rudy, they fired their organizational memory, said Seemann. He was a crucial, yet unrecognized asset, because he was willing to share his knowledge.

While at this company, Seemann and her team created a yellow pages guide of company knowledge brokers. Guess who was in the book and who was not? Rudy, of course, was in the book. Serge was not, and neither was top management. How can companies fix what she calls "the Rudy problem"? One way is to create a technical career track and promote knowledge brokers. Giving Rudy a title would have made an enormous difference, Seemann said, because it would have sent a signal that knowledge sharing was recognized in the company. Companies cannot appoint knowledge brokers. They just emerge. And when they do emerge, they need support.

One approach to fostering knowledge sharing: T-shaped managers. If not understanding Rudy's role in the organization is how not to foster knowledge sharing, what is a way to nurture it? Morton Hansen, of Harvard Business School and Bolko von Oetinger, of Boston Consulting Group[4] propose what they call T-shaped managers. These are executives who have both a vertical role (such as running a business unit) and a horizontal role (such as sharing knowledge with their peers in other business units).

The goal of this structure is to circumvent the limitations of knowledge management systems: They can only house explicit knowledge (not implicit know-how); they cannot foster collaboration by just making documents available, and their directories of experts can get out of date quickly. T-shaped management is especially important in organizations with autonomous business units because it helps counterbalance their tendency to compete with each other and hoard expertise.

Whereas the value of T-managers' vertical work is measured by traditional bottom-line financial performance, the value of their horizontal work is measured in five ways, note Hansen and von Oetinger:

1. Increased company efficiency from transferring best practices among business units
2. Better decisions by soliciting peer advice
3. Increased revenue by sharing expertise, again, among peers who are experts in areas in question
4. Development of new business ventures by cross-pollinating ideas
5. Moving strategically through well-coordinated efforts among peers

However, success in these five areas does not just happen. Knowledge sharing requires clear incentives. The company needs reward sharing. Furthermore, sharing needs to go both ways—give and take. Benchmarking across business units can encourage underperformers to ask for help. Success also requires formalizing cross-unit interactions. It does not mean creating bureaucracy, but rather creating peer-level collegial support (and confrontation). It also means picking and choosing which cross-unit requests to fulfill based on expected business results and how much someone can really contribute.

BP is exemplary in its use of the T-manager concept, state Hansen and von Oetinger. The insight Hansen and von Oetinger learned from studying BP is that mechanisms must be put in place to both foster and guide managers' knowledge-sharing activities; otherwise, they start to take up too much time and produce few results.

CASE EXAMPLE

BP

www.bp.com

BP is in the energy business. It merged with Amoco in 1998, with ARCO in 2000, and Castrol and Veba Aral in Germany in 2002; it now has 100,000 employees in 110 countries. BP's approach to T-shaped management began in the early 1990s in BPX, its oil and gas exploration division. To cut layers and increase accountability, John Browne, then head of BPX and now head of BP, divided the division into 50 autonomous business units. Unfortunately, each business unit head focused only on his or her unit, not on BPX.

To get the business unit heads working together, Browne instituted peer groups in 1993, each with about 12 business unit leaders in similar businesses. No bosses were allowed in these peer groups, so the discussions would be candid and not consist of political posturing. Sharing did increase, but it was not until 1994, when these groups were made responsible for allocating capital within their group and for setting their performance levels, that their sharing started to truly impact BPX's performance. The peer group members finally saw the financial value of sharing expertise. When Browne became CEO in 1995, he instituted peer groups BP-wide.

BP has also created cross-unit networks around areas of shared interest. However, BP found, unfortunately, that these several hundred networks cost a lot of time and money (with people flying all over the globe) without resulting in better results. Thus, the number and use have been limited.

BP has also instituted the practice of identifying a limited number of "human portals" who connect people, so that everyone is not trying to network with everyone else. Typically these people are not the top executives, note Hansen and von Oetinger, and typically they have been at BP a long time and in many jobs and locations.

IT plays a role in these various knowledge-sharing activities. An electronic yellow pages identifies experts, and multimedia e-mail and desktop video conferencing permit easier virtual team meetings, report Hansen and von Oetinger.

Since the mergers, BP has reorganized its business units into new peer groups that are more strategically focused. As Hansen and von Oetinger note, the evolution continues.

One T-Shaped Manager's Experiences

One BP T-shaped executive, who heads BP's gas business unit in Egypt, illustrates this new mode of operation. Formerly, whenever his business unit needed help, he would call headquarters. Now, he looks to his peers in other gas units.

His job essentially has two roles, one vertical and one horizontal. He is CEO of the business unit, so he is responsible for its profit-and-loss statement, capital

(*Case Continued*)

investment decisions, and such. He is also expected to participate in cross-unit activities, which take up some 20 percent of his time. These activities can undermine his vertical role, so he and the seven gas-production peers in the Mediterranean and Atlantic regions in his peer group limit their meetings to business purposes. Knowledge sharing is not enough of a reason to meet. Instead, they meet to decide how to allocate capital among themselves and how to meet production targets set by their division's executive committee.

In his knowledge-sharing role, in addition to collaborating, he also connects people, acting in some ways like a "human portal," suggesting who might help solve a problem, for example. He also gives advice to peer business units when asked and when he feels he can contribute. He was personally involved in 3 out of 20 of his business unit's "peer assists" one year, report Hansen and von Oetinger. In addition, he also requests peer assists, receiving 10 assists one year from BP business units around the world.

Due to all BP's networking, people know where expertise lies, so they go directly to the expertise rather than through headquarters. And because sharing is rewarded, bosses know who is sharing (and requesting assistance) and who is not. In its knowledge-sharing efforts, BP has aimed to change management activities, not corporate structure, to gain the benefits of knowledge sharing while preserving the autonomy of its business units so that they can more quickly and effectively serve their local markets. As John Browne stepped down in 2007 as the Group Chief Executive, he claimed that the success of his tenure was the improvement of BP's ability to learn from mistakes and to create a knowledge-driven and sustainable institution. ■

Building Structural Capital

The Rudy story also fits with this second subject, building structural capital, because that is what Seemann and her team aimed to do in creating the online yellow pages of knowledge brokers. Her goal was to increase their value. Those yellow pages are a form of structural capital. As noted earlier, companies that emphasize building structural capital generally use high-tech approaches.

Knowledge Organization and Categorization

This phase is often handled by creating best practices knowledge bases or metadata indexes for documents. A few have even tried to measure intellectual capital. Following are two examples, one that focused on improving a knowledge-support process and one that looked into valuing intellectual capital.

CASE EXAMPLE

A PHARMACEUTICAL COMPANY

A project at a major pharmaceutical company was aimed at improving the process of developing new drugs and getting them approved by the U.S. Food and Drug Administration (FDA), a process that takes 5 to 10 years, costs $250 million, and can yield revenues of $1 million a day per drug once it reaches the market.

This project, described at the Knowledge Imperative Conference,[3] revolved around creating a "knowledge infrastructure," one that manages information, enables understanding, and supports learning. The crux of the matter was to understand the customer's needs. In this case, the FDA is the primary customer; however, insurance companies, doctors, and consumers are also customers. The company sells all of them knowledge about disease, treatment, and how a drug will work in particular scenarios. When employees understand the type of knowledge they need to create for these customers and their role in its creation, they will identify better ways to work.

The project began by studying and codifying 60,000 pages of documents filed with the FDA to discern how the teams developing drugs and filing their results were sharing knowledge. These regulatory files explain to the FDA what the company knows about a drug, how it learned those things, and what conclusions it has reached.

The knowledge-infrastructure project team found the files lacking. Each file should have four parts: purpose, content, logic, and context. Only one of the files had a statement of purpose, which stated the problem to be solved. A file without a statement of purpose shows that the author does not know the reason for the document. Many files had contradictions, which told the team that the authors had not talked to each other. For instance, they disagreed on whether the drug should be taken once or twice a day.

To rectify the situation, the study team created a generic knowledge tree of the questions the FDA asks when deciding whether to approve a drug. The top of the tree has their three main questions: Is it safe? Does it work? Does it have sufficient quality? The tree lays out the supporting questions for these three main questions, in layers, which shows the teams which questions they need to answer to the FDA's satisfaction. It also shows people why others need specific information, thus giving them a context (beyond trust) for sharing.

In a pilot project, the knowledge-infrastructure team used a different process with one team: writing as a tool for thinking. They got the team to write up their 10-year drug study before they did it, so that the team members were clear about the data they needed to gather and present to the FDA. Furthermore, they wrote the report template publicly as a team. To create the template, they wrote critical points that had to be in the report on Post-It notes. Next, they prioritized the points on huge sheets of paper on the meeting-room wall. Then they designed studies to prove the points that had to be proven. In creating this virtual prototype of the

(*Case Continued*)

knowledge to be presented to the FDA, publicly, on the wall, they could physically see what knowledge was needed. They created a common mental model of the results. It was a powerful technique.

They have seen tangible progress in filling in the report sections on content, logic, context, and purpose. In another case, where an existing drug was to be registered for use with a new disease, the team had not made much progress in two years' time. After they were shown the knowledge tree over a two-day period, they were able to submit the file to the FDA in three months (they had previously estimated 18 months), and the FDA approved it in 18 months (the team had estimated three years). ■

Skandia Future Centers,[1b] discussed in Chapter 4, provides an example of delving into the world of valuing knowledge. Few firms have ventured into this realm, but because Skandia deals in knowledge and wants to experiment with the future, this is one area it has explored.

CASE EXAMPLE

SKANDIA FUTURE CENTERS

www.skandia.com

The charter for Skandia Future Centers is organizational prototyping. One project, the knowledge exchange, has addressed the question of putting a value on intangibles, such as knowledge.

Today, some 70 percent of investments in the United States are for intangibles; in Sweden it is 90 percent. However, no common mechanism for establishing their value or trading that value is yet available. A knowledge exchange increases the accessibility of hidden knowledge and will act as a multiplier for wealth creators, both people and organizations.

Skandia's knowledge exchange began as a network for exchanging knowledge using software akin to Lotus Notes. Over time, it has evolved into a Web-based trading arena where people can buy and sell knowledge assets. It is now based on Nonet, a Lotus Notes–like product from Metaphor, a Spanish company.

It has two test sites called ICuniverse.com (IC stands for intellectual capital) and Futurizing.com. On ICuniverse.com, for example, before responding to an e-mail message, the recipient and the sender first agree on a price to be paid to the responder, perhaps via an auction. Thus, people are paid for the knowledge they provide. Ideas and writings can be housed on ICuniverse.com and resold, which gives high yield to currently unvalued intellectual assets.

The two sites run on an infrastructure (IQport) owned by NatWest in

(*Case Continued*)

the United Kingdom and were built over several years' time. IQport includes software and a financial clearing mechanism so that information that is generally thrown away can be wrapped into a package and given a price tag. The sites are linked to two accounts at NatWest; one is in financial currency (traditional money), the other is in digital currency, which can be used to purchase other knowledge. Skandia is testing this concept because it could become a new global currency. It is part of the new digital economy.

The knowledge-exchange project has been self-organizing from the start. The center simply provides the arena for "knowledge entrepreneurs" or "knowledge nomads"—people who go from arena to arena working on their latest ideas. Thus, the center supports a nontraditional working model.

To illustrate its migration, the project began with IT people from the United Kingdom who were then joined by IT people from Sweden and the United States. Later, students and the professor from Venezuela who developed Nonet for oil companies was the mainstay. The students collaborated with the professor at the center and with Metaphor, the Spanish company that bought Nonet. Today, the knowledge-exchange team has people from Sweden and Denmark.

The question that Skandia Future Centers is now asking itself is: How can we reward knowledge nomads? They do not want a career; they want a journey and freedom. Their lifestyle does not fit into traditional organizational models, yet working with them helps speed up accounting and organizational remodeling because they act like bees, moving among research centers pollinating companies with ideas. ■

Knowledge Distribution and Access

This phase emphasizes both pushing knowledge out to users (distribution) and accommodating users who pull information to themselves (access). The Giga cases that emphasized this phase also used high-tech approaches. They focused on implementing networks and networking tools to access human and structural capital. Intranets and groupware were important IT-based tools. To illustrate one enterprise's approach, we turn to a U.S. energy company discussed in the Giga report.[2]

CASE EXAMPLE

A U.S. ENERGY COMPANY

In this highly autonomous energy company, the 15 business units each focused on their own performance. To instill sharing in this culture, these units would have to see the benefits themselves. In addition, many of the employees

(*Case Continued*)

were concerned they would not get credit for their good ideas. To overcome both issues, management decided to focus on promulgating best practices across the business units. A best practice was defined as a practice, know-how, or experience that had proven effective or valuable in one organization and might be applicable to another, notes Giga.

With management encouragement, a number of programs to collect best practices arose. For example, groups in the refining division documented best practices using Lotus Notes.[13] They documented "hard" practices (such as distilling techniques) and "soft" practices (such as training) and recorded metrics, where possible. The division estimated it saved $130 million a year utilizing each other's best practices, notes Giga. Similar programs appeared in other divisions.

Yet, these efforts were disparate, so an enterprising manager within IS gathered all the statistics together and presented them to top management to demonstrate how the company could be nurtured to become a learning company. With top management support, an important booklet was created to align the various divisions. It explained the company's mission, vision, values, total quality management (TQM), and environmental policies. It became the guide for sharing best practices.

In fact, the TQM principles of focusing on processes, measuring processes, and continuously improving them, which the company's employees understood and used, played an important role in espousing knowledge distribution and reuse.

One example was in its capital projects management process. This process is used to manage some $4 billion worth of projects a year. In benchmarking this process, management discovered it had some gaps. Therefore, the process was redesigned, and management of capital projects improved. Seeing the benefits of this process orientation, the corporate office funded other cross-business-unit initiatives that fostered sharing.

However, there was still no central responsibility for knowledge distribution and reuse, and such centralization would not fit the culture well. To solve this problem, certain people were designated "technical knowledge experts" because they knew about best practices across the company. Their job was to disseminate tacit knowledge. To do that, they looked for technical ways to turn tacit knowledge into explicit knowledge. Lotus Notes, as noted earlier, was commonly used to house best practices. It links best practice databases across the 15 operating companies. Employees are encouraged to use Notes to describe best practices, search for a mentor on a subject they need to know about, and find best practices. Notes has also been used to support processes. For example, it is used to coordinate the around-the-clock work of 100 employees in the refining company. In creating this workflow system, the employees reengineered the work so coordination worked more smoothly.

The company has also created online discussion databases, some 50 of them, to encourage sharing and reduce travel. Some of the networks have attracted hundreds of employees, leading to a more networked culture. In turn, some of these networks have led to face-to-face get-togethers, which have further spurred sharing on common topics, such as how to reduce energy costs, improve quality, and hone public relations in different cultures.

(*Case Continued*)

In short, this company has spurred best practice sharing wherever it makes sense, mainly guided by the interests of the employees. The results have not only been cost savings, but also a change in employee perception, based on the results of employee satisfaction surveys. Employees responded that there was increased emphasis on processes and more sharing of best practices across the company. ■

Building Customer Capital

As noted earlier, customer capital is the strength of a company's franchise with its customers, the percentage of customer "mindshare" in its industry. Brand recognition is part of customer capital. Familiarity with one's products is another. One of the most fascinating case studies in the Giga knowledge management report,[2] all of which are anonymous, is the one about the vice president who derived the notion of customer capital. Here is that story, based on that report.

CASE EXAMPLE

A NORTH AMERICAN BANK

After the U.S. savings and loan debacle and the devaluation of real estate in the 1980s, the vice president of organizational learning and leadership development at a North American bank asked, "Why have banks become so exposed to risk in their lending practices?" The answer he arrived at was, "Because they do not understand the new information age and its underpinning collateral." At the time, and still today, banks lent money against hard assets, such as a shopping mall. However, the value of such assets can dissipate almost overnight, making them risky collateral. "Perhaps there is less risk in lending against soft assets, such as a group's knowledge of a programming language or a patented process," he reasoned. Knowledge in a person's head does not disappear overnight. However, the vice president had no way of valuing such intangibles. He continued to work on the problem of knowledge valuation. Over time, his thinking changed the way the bank evaluated new hires and reshaped some of its operations.

To begin his quest on how to value knowledge, or intellectual capital, he drew on the ideas of human capital and structural capital, and then added his own: customer capital.

Human capital was the know-how to meet customer needs; he asked bank managers to measure it by assessing how fast their teams learned. To increase

(*Case Continued*)

human capital, he shifted emphasis at the bank from training (pushing instruction to people) to learning (getting people to pull the instruction they needed to them), because he believed the crux of increasing human capital was increasing the pace at which an organization learns. He believed people learned when they "owned" their learning and took responsibility for applying it to improve their performance. He developed a list of skills needed to serve customers and gave employees numerous ways to learn these skills, from reading specific books to choosing a mentor.

Structural capital was the organizational capabilities needed by the marketplace. The vice president measured structural capital by uncovering the percentage of bank revenue that came from new services and similar metrics. He believed that although it takes human capital to build structural capital, the better the bank's structural capital, the higher its human capital; one feeds the other. Thus, he generated structural capital from human capital by creating a competitive intelligence "library" about the industry that the bank considers a valuable "intellectual capital repository." Rather than being a library of documents, however, it was a map that showed the kinds of knowledge the bank held and where it existed, whether in an employee's head or a database.

Customer capital was the intellectual assets in the minds of customers related to the bank. The vice president's team measured three aspects: depth of knowledge about the bank in a customer organization, breadth of knowledge by a customer, and loyalty to the bank. To strengthen these aspects, the vice president believed the bank needed to assist its customers' employees in learning. Some of that learning pertained to learning more about the bank, which required making the bank's values and strategies congruent with those of its customers. The vice president therefore helped senior bank officials determine customer needs; establish a common language for communicating with customers; develop a sense of purpose for the relationship; and, most importantly, make learning within the customer organization an important part of the bank's services. He believes that assisting customers will increase his bank's customer capital: depth, breadth, and loyalty. Thus, his knowledge management efforts focused outwardly as well as inwardly. ■

To recap, Figure 14-2 shows the key activities in each of the four stages, the form of capital each supports, the skills required of people, and the tools and techniques that are proving valuable for that stage.

The Cultural Side of Knowledge Management

Success in managing knowledge comes as much from changing organizational behavior as it does from implementing new technology, notes Cyril Brooks.[5] His company, Grapevine, offers a product for managing information and knowledge. He notes that besides the platitude of "create a culture that rewards sharing," few people recommend specifics on how to reduce the cultural roadblocks that can hinder knowledge management projects. He describes some cultural barriers, which he calls "red flags."

Phase	*Emphasis*	*Skills/People*	*Tools/Techniques*
Creation and Capture Generate new knowledge Make tacit knowledge explicit Hire people with the right knowledge Create culture of sharing Encourage innovation Incentives for sharing	Human capital Customer capital	Knowledge harvesters Knowledge owners Mentoring/coaching Partner with universities Teamwork Business intelligence Top management	Easy-to-use capture tools E-mail Face-to-face meetings Knowledge tree Write-to-think Feedback
Organization and Categorization Package knowledge Add context to information Create categories of knowledge Create knowledge vocabulary Create metadata tags for documents Measure intellectual capital	Structural capital	Academics Knowledge editors Librarians Knowledge architects Authors Subject matter experts IS	Frameworks Cull knowledge from sources Best practices databases Knowledge bases Knowledge thesaurus Knowledge indexes Measurement tools
Distribution and Access Create links to knowledge Create networks of people Create electronic push and pull distribution mechanisms Knowledge sharing	Structural capital	Publishers Top management IS	HTML Groupware, Lotus Notes Networks, intranets Navigation aids Search tools
Absorption and Reuse Stimulate interaction among people The learning organization Informal networks	Human capital	Group facilitators Organizational developers Matchmakers Knowledge brokers	Team processes Electronic bulletin boards Communities of practice Yellow pages

FIGURE 14-2 Knowledge Management Stages

Source: Reprinted with permission from *Best Practices in Knowledge Management*, Giga Information Group, 1997, www.gigaweb.com.

Watch Out for Cultural Red Flags

Cultural barriers can shut down knowledge management efforts because knowledge management is really about cooperation and sharing. To reach these lofty goals, efforts need to turn the tacit knowledge in people's heads into explicit knowledge in a process, product, or other organizational artifact. Thus, knowledge management work must tap people's motivations to share and cooperate. Without the motivation, knowledge databases, for example, are not updated or errors are ignored. Or people avoid contributing to a knowledge-sharing network for fear they will give away their best ideas and lose their "competitive advantage" against their peers in the company. Such red flags are not obvious; they are often subtle, yet harmful, says Brooks.

Here are a few of his behavioral red flags that can derail a knowledge management effort:

- Being seen as a whistle-blower or messenger of bad news. Few people want to betray their boss, so they avoid presenting early warnings or disagreeing with internal documents. In organizations where "messengers get shot," sharing good news is fine, but sharing bad news is not, which defeats the full value of sharing.
- Losing one's place as a knowledge gatekeeper. Although knowledge brokers are important in organizations, their self-value comes from their controlling the knowledge they house and sharing it only with whom and when they choose. They may see a knowledge management system that encourages the free flow of ideas as decreasing their value, and therefore fight it.
- Knowledge sharing really does take time. Because sharing takes time, experts may hide so that they are not bothered by requests from others. Others may not participate in, say, presenting their ideas, which may benefit the organization as a whole but has no personal reward, so they think.

These reactions are human; therefore, knowledge management efforts often need to build "cultural workarounds" so that these kinds of reactions do not block the work. Brooks offers some suggestions. For example, to reduce concerns about being a messenger, the system might allow only limited dissemination of some ideas or give people the ability to rank feedback comments based on their significance. To counter concerns about losing personal advantage, contributions could require authorship or comments might always be linked to the original items. To reduce time consumption, the reward structure could reward contributions based on their value.

In addition to cultural red flags, management red flags are also a concern. Three management red flags are:

1. Saying the project is not cost-justifiable because the benefits are intangible
2. Concern that too much participation will reduce employee productivity
3. Concern that creating the taxonomy of knowledge categories will be just too expensive to undertake

Reducing these concerns is an important aspect of knowledge management. Some examples for mitigating these management roadblocks, says Brooks, include illustrating the value of serendipity that has occurred due to sharing, as illustrated in vendor case studies; ensuring that the new system promotes feedback to contributors, which can increase productivity; and drawing on vendor expertise to create knowledge taxonomies rather than start from scratch.

As Brooks points out, organizational culture is an important aspect of knowledge management efforts and a key determinant of success.

Design the System to Match What the Users Value

Thomas Stewart,[6] a well-known writer in the knowledge management field, agrees and makes the important point that knowledge needs to be managed within the context where value is created. In short, the system needs to be designed to fit the people who will use it and gain value from it. He notes that many official knowledge management efforts have come to naught because they did not create the place where people first look for knowledge. On the other hand, a number of grassroots, unofficial efforts have succeeded.

Stewart gives the example of three consultants who created an informal, unofficial Notes-based e-mail list in their company to have a place to collaborate online. Anyone could join the list; to date, it has attracted over 500 company employees. It has actually become the premier knowledge-sharing mechanism in the company even though it is difficult to search and generates a lot of messages, which fill up e-mail boxes. It works for four reasons:

1. It is demand driven. Some 80 percent of the traffic is members asking each other, "Does anyone know anything about. . . . ?"
2. It roots out tacit knowledge. People contribute what they know, which might not be recorded anywhere in the company.
3. It is right in front of the members in their e-mail boxes every day.
4. It is full of intriguing and strongly held opinions, which the members find most interesting.

The system is like a conversation rather than a library; thus, it is about learning rather than teaching. That is a major difference. It was designed to manage knowledge in the context where value is created. Given the high number of failed knowledge management projects, Stewart suggests answering the following three questions before launching off:

1. Which group will use this knowledge space? Once determined, make them responsible for the content.
2. What kind of knowledge does the group need? Once known, that knowledge needs to be managed within that group's context because that is where the value arises. A knowledge management system or resource should only deal with a single group that creates value in the same way.
3. What is the company culture; is it composed of reusers or originators? The difference matters. A repository of things promotes a reuse culture; an online chat room helps originators, but not vice versa.

Beware of creating a system that supports the wrong culture. There is really no such thing as a generic knowledge management system. Each one needs to fit a knowledge-sharing group. Answering these questions will help uncover the structure and content of a knowledge management resource that will add value and actually be used.

As an example of a knowledge management project that has worked and has followed many of the tenets espoused by Stewart, consider the work at Partners HealthCare System in Boston. Notice how it takes into account the health care culture.

CASE EXAMPLE

PARTNERS HEALTHCARE SYSTEM

www.partners.org

Not too long ago, Tom Davenport of Accenture's Institute for Strategic Change and John Glaser, CIO of Partners HealthCare System in Boston,[7] described how Partners HealthCare System is delivering just-in-time knowledge.

The problem the physicians at Partners HealthCare hospitals and physician groups face is the deluge of new knowledge they need to know but cannot possibly keep up with on their own. The solution has been to present physicians with the new knowledge they need when they need it through the information technology they already use in their work. In essence, this approach makes knowledge management part of their job, not a separate activity, and it can deliver knowledge just when a patient really needs it.

The work at Partners HealthCare began on a small, doable scale: using the doctors' online order entry system to notify doctors of drug interactions when they enter a prescription order. The system checks the patient's medical record, looks for allergic reactions to the drug (or a similar drug), and alerts the physician. The doctor can inquire about the reaction, and, if it was mild, override the computer's recommendation to switch to another medication.

The system can also tell the doctor about a newer, more effective drug or inform him or her of another drug the patient is taking that can lead to a bad interaction. Or, if the doctor is ordering a test, the system can describe a newer, more effective test for the noted symptom. Or the system can warn the doctor that the prescribed medication could worsen a patient's disease.

This integrated system is built on knowledge bases (databases of knowledge about the patient, drugs, tests, medical research, and such) and a logic engine (which, as its name implies, performs the logical interconnections between the various kinds of knowledge in the knowledge bases).

The system also has an event-detection mechanism, which alerts a physician when it learns of an event that can endanger the health of a patient. For example, when the patient's health indicators deviate from the norm while the patient is in the hospital, the doctor or a nurse is notified via pager. This capability brings knowledge management into real time, note Davenport and Glaser.

However, this system could not be bought. It had to be built by Partners HealthCare. It was a large investment, but it was made because too many patients at Partners were experiencing drug interactions. Management had to fix that problem. One of the steps it took was to form committees of top clinicians to identify the knowledge that needed to be in the knowledge bases and keep it up to date. The drug therapy committee makes the medication recommendations, whereas the radiology committee develops the logic to guide radiology testing.

(*Case Continued*)

Participation in each committee is seen as prestigious, which is crucial to the success of the system, so that busy physicians give time to the committee work.

Another step Partners took was to only address the most critical processes. Furthermore, the system is simply seen as a recommendation system. It does not make final decisions. Those are left up to the physicians. The combined human–computer system seems to be working. Some 380 orders (out of 13,000 a day) are changed due to a computer suggestion. Some one-third to one-half of orders with drug interactions are cancelled, and some 72 percent of treatments are changed when the event-detection system sounds an alert. Partner's strong measurement culture helps it gather such statistics and see the benefits of the system.

In summary, embedding knowledge in the systems and work processes that professionals use is an effective way to achieve just-in-time knowledge management and dramatically improve an organization's performance. ■

INTELLECTUAL CAPITAL ISSUES

Data, information, content, and intellectual capital all raise some thorny issues. These issues have prompted legislation in some countries, but not all, which causes even more problems in today's intertwined, global society. Their resolution is important for global e-commerce, and such resolution could be a long way off. We begin by looking at information value, usage, and sharing issues. Then we move on to the large, but rarely discussed, subject of computer ethics.

If information is to be viewed as an asset, as many companies now do, it must be treated differently from the traditional assets of labor and capital, notes Thomas Davenport.[8] For one thing, information is not divisible. Nor is it scarce. In addition, ownership cannot be clearly defined. We discuss here four categories of issues in managing information:

1. Value issues
2. Usage issues
3. Sharing issues
4. Social and ecological issues

Value Issues

Information's value depends on the recipient and the context. In fact, most people cannot put a value on a piece of information until they have seen it. However, people do, indeed, place values on information. Look at all the information services that people buy. Information marketplaces exist, both inside and outside of companies. The only practical way to establish the value of information is to establish a price for it and see whether anyone buys it. Pricing possibilities include charging for the information itself rather than for the technology or the provider, charging by the document rather than a smaller unit, charging by length or time or number of users, or charging by value rather than cost.

A number of tools are being used within companies to increase the value of information.

- ***Information maps.*** These maps can be text-based charts or even diagrammatic maps that point to the location of information, whether in written material, experts' minds, and so forth. IBM, for example, created a guide to market information so that managers can find out where to get quick answers to their ad hoc questions. The result has been less money spent on duplicate information and increased understanding of the kinds of questions people typically ask.
- ***Information guides.*** Guides are people who know where desired information can be found. Librarians have traditionally played this role. Hallmark Cards, for instance, created a job guide in its business units to help employees find computer-based information on available jobs. These guides have substantially reduced the time needed to find information.
- ***Business documents.*** Business documents are yet another tool for sharing information. They provide organization and context. One fruitful way to embark on information management is to uncover what documents an organization needs. This process can be easier, and more useful, than defining common terms. One brokerage firm discovered that its brokers all used the same documents, over and over. Some 90 percent of these documents could be put on one CD-ROM, kept on local servers, and updated monthly, greatly facilitating information use.
- ***Groupware.*** Groupware is a tool for getting greater value out of less structured information. It allows people to share information across distances in a more structured manner than e-mail. Lotus Notes is such a product. Groupware can ease discussions and aid distribution of information, but its success depends upon the culture. For one, better access to information increases (not decreases) people's appetite for even more information. However, employees using sophisticated groupware products need to learn how the technology can be used to improve work habits and profits, neither of which flows naturally from the technology.

To create value, the databases need to be managed, even pruned and restructured. Knowledgeable people are needed to manage the information resource and its use. This need is true for intranets and Web sites as well.

Usage Issues

Information management is a management issue because it deals with how people use information, not how they use machines, says Davenport. Three points illustrate the importance and difficulty of managing information use.

One, information's complexity needs to be preserved. Information should not be simplified to be made to fit into a computer, because doing so truncates sharing and conversations. Information does not conform to common definitions. It is messy. It naturally has different perspectives, which are important and need to be preserved. A certain amount of tension between the desire for one common global meaning and numerous familiar local meanings is inevitable. Companies that want to settle on common corporate terms must do so with line people, not technical people, because line people will use the end results. The IS organization can facilitate these discussions, but the businesspeople should determine the meanings.

Two, people do not easily share information, even though its value grows as it is shared. Culture often blocks sharing, especially in highly competitive organizational cultures.

Three, technology does not change culture. Just building an information system does not mean that people will use it. It is a false assumption that too many IS people make. To change the information culture of a company requires changing basic behaviors, values, attitudes, and management expectations.

Sharing Issues

If information sharing is the goal, a number of contentious challenges must first be resolved. Davenport explains that a sharing culture must be in place or the existing disincentives will thwart use of a sharing system.

Technical solutions do not address the sharing issue. For example, much talk has touted information architectures, where the definitions of stable types of corporate data, such as customers, products, and business transactions, can be specified ahead of time and used consistently across the firm. This approach may work for data, but it is problematic for information, because information architectures generally fail to take into account how people use the information. Managers get two-thirds of their information from conversations, one-third from documents, and almost none directly from computer systems. Therefore, a common computer-based information architecture is not likely to solve the information-management problem.

An issue in sharing is: Who determines who has legitimate need for the information? The "owning" department? Top management? And who identifies the owner? The process of developing the principles for managing information—how it is defined and distributed—is actually more important than the resulting principles because the touchy subject of information sharing is brought out into the open during the process. In short, working out information issues requires addressing entrenched attitudes about organizational control. That is where consensus needs to be built: in discussions, not through edicts.

Is sharing good? asks Davenport. Not in all cases. Forcing employees to share information with those above them can lead to intrusive management. Some executive support systems limit "drill down" for just this reason. Managers must think about these types of issues in information management.

Unlimited information sharing does not work. Limits are necessary. On the one hand, the sharing of corporate performance figures is beneficial, especially when corporate performance is poor, because it usually increases morale; uninformed employees usually guess the worst. On the other hand, the sharing of rumors (noninformation) generally demoralizes people. Separating information from noninformation is an information-management issue. Allowing employees to send messages to large distribution lists exacerbates the information-management problem. Managements have awakened to the fact that they need to address this issue. Vendors have developed filters and agents for e-mail systems. Such responses can help resolve corporate information-management issues, but only when the correct underlying policies are put in place.

Even hiring practices play a role in information management. If promotions are based on circulation and publication of new ideas, a sharing environment exists. If these activities are not rewarded, sharing may be anathema to the culture.

In all, getting value out of information requires more than technology. Information is inherently hard to control. It is ever expanding and unpredictable. Only when executives view information in this light will they manage it for most effective use.

Social and Ecological Issues

It is worth repeating here that the leading theme of this chapter is how to use knowledge management to sustain individual and business performance. This is achieved through technology-supported learning, unlearning, and adaptation. Despite the advances of more intelligent systems, and the willingness of large corporations to invest billions of dollars in these technologies, it is also important to recognize the limitations of technologies. Data mining and other data-driven analytics have shown useful results, but they could also lead to inconsequential or dumb results. Human users of knowledge management technologies should remain as the key part of knowledge quality assurance, or at least, as educated knowledge consumers. Today's "intelligent" systems are certainly smarter than their predecessors. But it would be a stretch to argue that IT can store and distribute human intelligence and experience. The ability to deliver the right information to the right person at the right time in a dynamic, context-dependent concept still requires human intelligence.

An organization can be viewed as a knowledge ecology with evolving interactions between knowledge workers capable of learning and adapting to changing situations. Therefore, nurturing and protecting intellectual capital continue to be central concerns for knowledge-based organizations.

The social and ecological issue here is at least twofold. First, as knowledge, defined in its broadest sense, is widely fragmented across networks of servers, the power that can be derived from this knowledge is shifted to a large number of independent stakeholders. It is difficult to predict how these people work together or against each other in the creation and use of intellectual capital. Furthermore, with the ease of access to massively distributed knowledge, how do organizations bond human talents together to create and sustain a shared vision or common sense of purpose?

WIKIS

A Simple Open Source for Online Knowledge Repository

In 1994, Howard G. Cunningham started the development of a piece of software known as the WikiWikiWeb or simply WikiWiki, or simply Wiki for the Portland Pattern Repository. The idea was to build an electronic forum allowing computer programmers to exchange ideas about software development. The technology was based on Apple's hypercard concept developed in the 1980s to cross-link texts and documents. One of Cunningham's concerns was to design a platform that users can quickly log in and edit the text. Wiki in Hawaiian language means "fast." This very first Wiki now hosts tens of thousands of pages. When knowledge is not intended to be shared, a desktop-based Personal Wiki can be used to organize content.

The Wiki engine is a simple collaborative software installed on a Web server or more that allows Web pages to be created and edited using a Web browser. As information is entered in the text by users (affectionately called wikizens), the system stores information in a database-management system, or a content management system. To date, there exists a rather extensive list of Wikis systems using net-centric and open source technologies with Java, JavaScript, PHP, Perl, VPScript, Python, and others.

The concept was quickly adopted by many communities, and turned the Wiki concept into a platform for online communities to build collective knowledge. Wikis are growing in number. They serve as knowledge repositories, with the Wikipedia as one of the success stories of collective and global knowledge creation. Today, many large organizations are creating their own context-specific Wikis for internal knowledge management.

The knowledge creation is based on trust and a strong code of ethics to give all participants the motivation to engage the building of the Wikis, with no malicious intent. Users can freely add or delete content, but here are roll-back procedures to revert to previous versions which are available Wikis as histories. In many Wikis, contributors are requested to register so that Wikis administrator can hold trace contact them or hold them accountable.

From a knowledge-management perspective, the creation of Wiki pages by the community of practice illustrates well the concept of conversational knowledge management. In distributed or virtual environments, individuals use a common Internet platform to create knowledge. Unlike other forms of information exchange or conversational knowledge such as e-mail, instant messaging, discussion forums, or decision support technologies, Wikis has the potential for organization to facilitate group work—such as writing an annual report or a business plan—without the need for meeting face-to-face. Wikis allow some off-line conversation. However, they excel in collaboration.

Wikis for Business Use

Wiki technology has evolved to meet business needs. Commercial Wiki software has features that require different levels of authorization for people to access, add, or modify existing contents. For example, the HR department posts some policies on a corporate Wiki and does not allow anyone to alter the document. New Wikis also have better versioning features, allowing the users to organize information.

Generally speaking, thanks to the low cost of acquisition and use, a Wiki would be a good technology for a business that needs to establish an intranet quickly with a reasonable level of functionality, security, and durability. Another reason for installing a Wiki is to allow corporate documents to be stored and accessible through the Internet, and let employees self-manage these documents with a minimum of effort, while avoiding redundancy. Many businesses have successfully used Wikis for project management and to manage and organize meeting agenda and minutes.

Like any business application, a business-oriented Wiki requires adequate computing resources and proper project management. The system that hosts a Wiki should have security and data-management tools. The organization should also appoint a staff member to be responsible for maintaining the Wiki.

As we discuss the issue of computer ethics in the next session, it is fitting to address a possible downside of knowledge creation using Wikis. As documented in the literature about group pathologies, the information, views, and opinions stored in the Wikis might de facto—for the better or worse—the collective wisdom. In many instances, and by its very nature, a Wiki's knowledge repository is built in an anarchic manner. The issue here is that this wisdom might be incomplete and biased, and Wiki users should be aware of how knowledge is being created, and the context of how knowledge is being built and rebuilt. The *Economist*, in its April 2006[9] issue, raised the possibility of vandalism in Wikis. Despite the code of ethics mentioned earlier and the effort of Wikis' administrators to enforce some quality control, there is a risk of people telling lies. The *Economist* reports the incident of a person telling lies on wikipedia.org. For 132 days, the lies went unnoticed and remained on the site, until some volunteers did detective work to trace the creator of vandalism.

Nevertheless, Wiki technologies have proved to be a flexible tool for collaboration. The issue here for CIO or top management leadership is to view Wiki technology as another enabler for knowledge acquisition and dissemination.

THE VAST ARENA OF COMPUTER ETHICS

To conclude this book, before looking to the future in the last chapter, we need to address an issue that is coming more to the fore: computer ethics. We can only touch on this vast subject, but this brief discussion will give a flavor of the issues involved. New technologies pose ethical issues when they open up new possibilities for human action—individual action as well as collective action—points out Deborah Johnson[10] of Georgia Institute of Technology, in her book *Computer Ethics*. Nuclear power, the atom bomb, genetic engineering, and other technologies raise ethical questions, as do computers; hence, the realm of computer ethics.

A Little History

In the first era of computing, when companies and governments used mainframes to collect personal information and store it in huge databases, the perceived threat was invasion of personal privacy. In the United States, that concern led to a major privacy study in 1976. At the time, no formal rules limited access to personal data in computers.

The second era of computing, mini- and micro-computers, turned attention to the democratizing aspects of computers and software and the ethical issues of property rights. Should software be owned? What sorts of intellectual property laws were needed to protect software owners? Such questions raised the ire of people who did not like the idea of property rights in software, those who believed software should be free. Issues of property rights also raised liability issues: Who is responsible for errors in code?

The third and latest era, the Internet, has brought "an endless set of ethical issues," notes Johnson, because it can be used in so many aspects of life. Thus, all the concerns of the past have resurfaced: privacy, the democratizing nature of the Internet, property rights on Web sites, the concept of free speech (is information on the Internet a form of speech or expression?), and now even global property rights.

What Is Computer Ethics?

In 1985, James Moor wrote the seminal piece "What Is Computer Ethics?"[11] Moor stated that new technologies raise ethical issues because they create policy vacuums. The ethical issues are these vacuums. The role of computer ethics is to fill the vacuums. Thus, areas of ethical concern include privacy, property rights, liabilities, free speech, and professional ethics. This notion implies that the technology appears first and the ethics follow. It might be better for IT to follow ethics, says Johnson, but that rarely happens in any technology. Two possible examples are freeware and the privacy-enhancing technology of anonymous remailers.

New technologies bring benefits and problems, which raise the ethical issues of how to shape a technology's use for good and minimize its use for harm. We need to make moral choices about how we are going to use IT, personally, organizationally, nationally, and even globally. The central task of computer ethics is to determine what our personal and social policies should be, states Moor.

Johnson provides a whole host of examples of IT ethical issues. Here are abbreviated samplings of a few of her examples to show the breadth of this subject.

- John buys a software package to help him invest in penny stocks. At a party, he mentions the software to Mary and she asks to borrow it. She likes it, so she copies it and then returns the original software to John. What did Mary do wrong, if anything? Why is it wrong? (Intellectual property rights)
- Inga has a small business and collects customer data from her customers directly and from their purchases. She wants to use data-mining tools on these data to uncover patterns and correlations among her customers. The customers gave her the data to make a purchase; she wants to use those data for another purpose, even though individuals will not be uniquely identified in this use. Would she be doing anything wrong? (Privacy)
- Carl is a systems designer who is designing a system to monitor radar signals and launch missiles in response to those signals. He has become concerned that the system has not been made secure, for one thing, and that it cannot adequately distinguish between a missile and a small airplane, for another. His manager dismisses his concerns. What should he do? (Professional ethics)
- Grundner sent a message on an unmoderated listserv that contained the phrase "wives . . . and other informationally challenged individuals." Mabel sent him a private message reprimanding him for his sexist language. Grundner thought Mabel's message was sent to the entire listserv, so he broadcast a message that stated that online communications transcend barriers as long as "professional victim-mongers" do not "screw it up." Many members of the listserv felt Grundner's response was a personal attack on Mabel, and said so. Others sent messages on gender issues. Insults spread around the listserv. What's wrong with this? (Flaming)
- Kimiko is a successful pension fund manager who uses an expert system to help her make investment decisions. Her experience tells her the market is going to turn down, so she wants to sell stock. However, the expert system recommends buying stock, even when Kimiko double-checks the economic indicator data she has entered. She does not understand the reasoning in the expert system, so she cannot check its logic. For all she knows, it could be malfunctioning. What should she do, buy or sell? (Accountability)
- Milo is an independent journalist and an expert on South American politics. He subscribes to an Internet-based service that sends him articles and news on areas of interest to him. Upon returning from a trip, he discovers a posting that says he is involved in illegal drug dealing and his articles protect drug cohorts. Milo is enraged by the lie. He wants to sue for defamation of character, but the bulletin board owner will not give him the address of the message poster, who used a pseudonym. So he sues the bulletin board owner instead. Are bulletin board owners liable for the contents posted on their board? (Accountability)

To address such issues, says Johnson, some people look to traditional moral norms and apply them to the new situations. They extend property law (copyrights, patent, and trade secret laws) to software. Similarly, certain kinds of spoken and written communications have traditionally been considered impolite or confidential. The same should hold for computer-mediated communications, some contend.

However, to apply past norms, we must first define, say, the Internet or software, which is difficult to do when both are still evolving. Is the Internet a highway? A shopping mall? A fantasy world? Each would have different laws, contends Johnson, which is one reason why computer ethics is so difficult. She questions whether we should be treating new opportunities like old situations. Although it is true that new uses of, say, computers, touch familiar ethical notions, we need to ask whether they pose new ethical issues. That is the main purview of computer ethics. IT creates a new species of traditional moral issues, with new variations and new twists, says Johnson.

So the question becomes, should we fill the vacuums with laws or something else? The answer should not begin or end with laws. Rather, we need a shared sense of what is good and just. We need personal and institutional policies and social mores.

The ethical questions surround what people do to one another. Therefore, they involve such concepts as harm, responsibility, privacy, and property. In essence, says Johnson, IT creates a new instrumentation for human action, making new actions possible. As such, it can change the character of actions. For example, launching a computer virus on the Internet can wreak havoc for thousands, even tens of thousands of people and institutions. We need to account for this change in ethics, she contends.

Some actions are unethical only because they are illegal. Others are unethical whether or not they are legal. Much of the unethical behavior on the Internet is not controversial or complicated. It is just criminal behavior in a new medium. It is doing bad things in new ways. Computer ethics can thus be thought of as a new species of general moral issues that may not fit familiar categories. It has a global scope, which makes it unusual, and the actions have reproducibility in that they can be easily shared.

With this brief introduction to the realm of computer ethics, we now look at four areas that raise ethical and legal questions.

1. Information privacy
2. Intellectual property rights
3. Legal jurisdiction
4. Online contracting

Information Privacy

Privacy includes freedom from intrusion, the right to be left alone, the right to control information about oneself, and freedom from surveillance. It is a major issue in today's world because of the widespread availability of personal data and the ease of tracking a person's activities on the Internet.

The United States and many other countries have enacted laws to control certain types of personal information, such as medical, credit, and other financial information. These laws carry over to the online business environment. As companies have built large databases on their online customers, the value of these data makes selling them an attractive business option. That is one reason the United States now has a privacy law that requires companies to publish a description of how they treat the personally identifiable information they handle.

Internet technologies, cookies in particular, make tracking the browsing activities of individuals possible. Consumer concerns about this perceived invasion of privacy now require companies in some countries to post and adhere to privacy statements on their Web sites.

Some companies use third-party cookies (i.e., cookies set by a firm other than the owner of the site being visited) to do online profiling. It is also known as profile-based advertising, and it is a technique that marketers use to collect information about the online behavior of Internet users and to facilitate targeted advertising. Profile-based advertising could easily be considered a form of online surveillance. What is worse, some third-party cookies are often placed on Web browsers' computers without their knowledge when banner advertisements appear. It is not necessary to click on the banner ad to generate a cookie.

Companies with cookies on their Web sites obviously want information about their customers to make better decisions about the types of products and services they should develop, says Johnson. On the other side of the coin is people's desire for privacy; their fear of who has information about them; and their mistrust of large, faceless organizations and governments.

Another technology that has privacy advocates concerned is RFID. They contend that these radio-frequency sensors on products will allow industry, governments, and thieves to monitor personal belongings after they have been purchased. As CNET's News.com reports, Debra Bowen, a California state senator, held a hearing on RFID technology and privacy to study what sorts of regulation might be needed to protect consumer privacy.[12] One example of privacy invasion mentioned at the hearing was, "How would you like it if you discovered that your clothes were reporting on your whereabouts?" Others presented other potential invasions of privacy from RFID tags on individual consumer items.

Still others suggested protection possibilities. One was to create a set of "fair use" guidelines for industry. One guideline might be that companies must label products that have RFID tags. Another might be to let consumers disable the sensors. A third could be to allow consumers to request and see the information collected about them from the sensors. Another suggestion was to require legal guidelines to be in place before deploying RFID.

Bowen has already introduced bills to regulate the use of other technologies that might invade privacy, including face recognition, data collected by cable and television companies on consumers' viewing habits, and shopper loyalty cards issued by supermarkets and other chains. Bowen is not alone in her concerns. Britain also is delving into RFID privacy issues.

However, the argument for personal information privacy has not "won the day," says Johnson. The following has not proven to be a strong argument: "We control relationships by controlling the information we give to another party. When we lose control of our information, we lose control over how others perceive and treat us. The loss reduces our ability to establish and influence relationships." The reason that this argument is not strong is because when people must make a choice between a social good (such as police protection) and loss of control of information, they give up control.

A much stronger argument for the right to privacy can be made if privacy is seen as a social good, rather than as an individual good. This argument goes as follows, notes Johnson: "Democracy is the freedom to exercise one's autonomy. If the consequences are too negative, few people will take the risk, and democracy will diminish. For example, people act differently when they know they are being watched. Thus, privacy is a social good in its own right. The less privacy, the more difficult it is to make social change. How information is gathered, exchanged, and used affects us all, not just those who have something to hide."

Johnson recommends five ways to increase information privacy protection:

1. ***At the national level.*** Treat privacy as a social good that lies at the heart of democracy, giving its protection more weight. Deal with privacy policy nationwide rather than on an industry-by-industry basis, as it has been in the past. Citizens need protection from private institutions just as much as public ones, so include both public and private information gathering, with an eye toward global exchange. Treat personal information as part of the infrastructure of our society. It is better to manage this information outside the marketplace.
2. ***Computer professionals.*** Point out privacy matters to clients when they build databases that contain personal information.
3. ***Technology.*** Use privacy protection technologies, such as Web anonymity and tools for detecting the privacy level of a Web site.
4. ***Institutions.*** Adopt internal policies that protect privacy, such as restricting who can see personal information.
5. ***Individuals.*** Take personal actions to increase the privacy of information about you.

Intellectual Property Rights

The protection of intellectual property is critical in an Internet-based world because many products and services contain intellectual property, copies of such items are easy to make, and the copy is as good as the original. Examples of online activities in which intellectual property rights are critical include electronic publishing, software distribution, virtual art galleries, music distribution over the Internet, and online education.

Following are four types of legal protection of intellectual property: copyrights, patents, trademarks, and trade secrets.

Copyrights

Copyright law aims to protect an author's or artist's expression once it is in a tangible form. The work must be expressive rather than functional; a copyright protects the expression, not the idea. For example, a cartoon duck is an idea and cannot be copyrighted, but Donald Duck and Daffy Duck are expressions of that idea and are copyrighted. Registering a copyright is not a requirement; putting the expression into tangible form is sufficient. A copyright is valid for the life of the author plus 75 years.

Just about all original content on a Web site can be copyrighted by the creator of the site, from buttons to video, from text to a site layout. If a company hires someone to develop a site, by default the copyright belongs to the developer, not the company. The developer can then demand royalties from the company if it uses the Web site; therefore, it behooves companies to clearly define the ownership of the copyright in the contract.

The Internet raises many nontrivial issues for copyright law, which was developed for physical media. Placing copyrighted material, such as a photograph, on a Web site without permission of the copyright holder is a clear violation of the law. Less obvious is whether having a link to someone else's copyrighted material, say, a photograph, is a violation of copyright law. In this case, the answer is probably yes. However, if one includes a link to the homepage of the site rather than a direct link to the content, then probably no violation has occurred. Internet copyright issues are now being worked out in courts and legislatures.

Patents

Patent law aims to protect inventions—things or processes for producing things, where "things" are anything under the sun made by man but not abstract ideas or natural laws, according to U.S. copyright law. Valid for 20 years, patent protection is quite strong. In the United States, patents are granted by the U.S. Patent and Trademark Office after stringent thresholds on inventiveness have been met.

The United States recognizes patents for business processes. Although software, in general, cannot be patented—it must be copyrighted—certain business practices implemented in software can be patented. In the e-business area, Amazon.com has received a patent for "one-click purchasing." The company has enforced its patent rights against its main competitor, Barnes and Noble. Barnes and Noble cannot use one-click purchasing on its Web site. British Telecom has claimed to have invented the hyperlink. To obtain the patent, the company will have to show that no prior use of hyperlinks occurred before its use. Any prior use would invalidate the patent.

Trademarks

Trademarks protect names, symbols, and other icons used to identify a company or product. Trademarks can be registered with the U.S. Patent and Trademark Office. A trademark is valid indefinitely, as long as it is used and does not become a generic name for the goods or services. The aim of trademark law is to prevent confusion among consumers in a market with similar identifying names or symbols. The standard for trademark infringement is whether the marks are confusingly similar.

The biggest area of trademark conflicts in e-business has to do with domain name registration. For a while, cybersquatters were registering domain names that clearly referred to known companies, realizing those companies would eventually want the domain name and would be willing to pay for it. Although this tactic worked for a while, anti-cybersquatting laws were passed and the practice is now illegal. To avoid potential problems, firms should obtain and register a trademark for its domain name. Note that most online services that register domain names do not check for trademark infringements. Firms are advised to do a search for possible trademark infringements before using a domain name, to avoid future litigation.

Trade Secrets

Trade secrets, as the name implies, protect company secrets, which can cover a wide range of processes, formulas, and techniques. A trade secret is not registered and is valid indefinitely, as long as it remains a secret. Although laws protect against the theft of trade secrets, it is not illegal to discover a trade secret through reverse engineering. Trade secrets are the area of intellectual property rights least applicable to e-business.

Legal Jurisdiction

Laws are written for particular jurisdictions with clear geographic boundaries, so how do those laws apply in cyberspace, which has no geographic boundaries? Take, for example, the case of trademark rights, which are limited to geographic areas. In the physical world, a sign over "Lee's Computer Services" in Singapore would not have a significant impact on "Lee's Computer Services" in Honolulu—neither in customers nor competition. However, in cyberspace the Web sites of the two companies would clearly overlap and, if the companies were to take advantage of the global reach of the Internet, competitive overlap could be an issue. The companies have little legal recourse for resolving their identical trademarks.

Gambling provides another example. Do Hawaiian laws against gambling apply to a Nevada company with a gambling site on its Web server located in Las Vegas? The Attorney General of Minnesota has asserted the right to regulate gambling that occurs on a foreign Web page that is accessed and "brought into" his state by a local resident.

Similar cases have involved sites dealing with pornography and securities trading. Alabama successfully prosecuted a California couple for bringing pornography into Alabama; their server was in California. Note that U.S. pornography laws are based on "community standards"; Los Angeles, California, standards are clearly different from those of Mobile, Alabama. The state of New Jersey is attempting to regulate securities trading over the Internet if anyone in the state has access to it, and many states are trying to revise their tax codes to gain revenues from e-commerce.

At best, this trend is disturbing. At worst, it could greatly disrupt e-business. Faced with the inability to control the flow of electrons across physical boundaries, some authorities strive to impose their boundaries on cyberspace. When technological mechanisms, such as filters, fail, the authorities assert the right to regulate online trade if their local citizens may be affected. In essence, under this approach, all Internet-based commerce would be subject simultaneously to the laws of all territorial governments. Imagine a Hawaiian company setting up a Web site for retailing over the Internet needing to consider the laws of Hawaii, California, New York, and the other 47 states, plus Singapore, Peru, Syria, and any other place you might name. This situation would clearly cripple e-business.

The concepts of "distinct physical location" and "place where an activity occurred" fall apart in cyberspace; no clear answer is available to the question: Where did this event take place? Of relevance are the locations of the business's offices, warehouses, and servers containing the Web sites. Some of the uncertainty can be resolved by placing online contracts on the site specifying the legal jurisdiction that will be used for disputes. Users who agree to the contract designate so by clicking a button that says "I agree." In most cases, the contract will hold.

In the United States, states have adopted the Uniform Commercial Code (UCC), a wide-ranging codification of significant areas of U.S. commercial laws. The National Conference of Commissioners of Uniform State Law and the American Law Institute, who sponsor the UCC, are working to adapt the UCC to cyberspace.

Internationally, the United Nations Commission on International Trade Law has developed a model law that supports the commercial use of international contracts in e-commerce. This model law establishes rules and norms that validate and recognize contracts formed through electronic means, sets standards governing electronic contract performance, defines what constitutes a valid electronic writing and original document, provides for the acceptability of electronic signatures for legal and commercial purposes, and supports the admission of computer evidence in courts and arbitration proceedings.

Online Contracting

A contract is a voluntary exchange between two parties. Contract law looks for evidence that the parties have mutually assented to the terms of a particular set of obligations before it will impose those obligations on them. Before the law will recognize the existence of a binding contract, there must be

- A definite offer by one party, called the offeror
- A timely acceptance by the offeree
- Some consideration must pass between the offeree and the offeror

A widespread misconception holds that contracts must be in writing and signed before they are enforceable in court. The general rule is that offerees can show their acceptance of a contract offer by any means that are "reasonable under the circumstances." Reasonable acceptance includes oral agreements. Some exceptions do apply, however. For example, sales of real property require signed writings and, in the United States under the UCC, any contract for the sale of goods for a price greater than $500 requires a signed agreement.

In e-business, evidence of acceptance of a contract can be a simple click on a button saying "I accept" or "I agree." The case becomes more complex when the transaction involves payment greater than $500. The relevant questions are: Is our purely electronic communication "in writing" and have we "signed" the agreement? The answers are as yet unresolved. No cases have been presented regarding whether a file that exists in a computer's memory is "written" for purposes of contract law. Most commentators think the answer is probably "yes," but the final answer will have to wait until courts have reviewed the issue more closely.

In June 2000, President Clinton signed the Electronic Signatures in Global and National Commerce Act (E-Sign). Basically, E-Sign grants electronic signatures and documents equivalent legal status with traditional handwritten signatures. It is technology-neutral so that the parties entering into electronic contracts can choose the system they want to use to validate an online agreement. Many browsers contain minimal authentication features, and companies are developing pen-based and other types of technologies to facilitate online contracting. In addition, a number of companies already provide digital signature products using public key encryption methods.

The full impact of E-Sign may not be as revolutionary as some would hope. The act specifies that no one is obligated to use or accept electronic records or signatures—all parties must consent to using the method. The act does not apply to a wide range of situations, such as the creation and execution of wills, adoptions, divorces, any notice of cancellation or termination of utility services, or foreclosure or eviction under a credit agreement. In addition, the marketplace has to sort out some serious problems with varying electronic signature standards. For example, a number of companies issue digital certificates, but none of them can operate with the others. It would require parties interested in adopting electronic signatures for their business to provide several technologies or risk losing access to some customers.

CASE EXAMPLE

CLICKWRAP AGREEMENTS

www.cli.org

On its Web site, the Cyberspace Law Institute[13] offers an interesting case. You subscribe to an electronic newsletter on a Web site with the following text:

You may obtain a 1-year subscription to our newsletter XYZ News for the special low price of $5.00 for each monthly issue, simply by filling in your name and e-mail address on the form below and then clicking the SUBSCRIBE button. By subscribing, you agree to the terms and conditions set forth in our Subscriber's Contract; to read the Subscriber's Contract, click on CONTRACT TERMS below.

Suppose you fill in your name and e-mail address and click SUBSCRIBE but, like most folks, you don't actually take the time to look at, let alone read, the Subscriber's Contract. Do you have a contract with XYZ?

Absolutely. You received an offer (to deliver the weekly newsletter to you); you took a specific action that the offeror deems to constitute acceptance of the offer (clicking on the SUBSCRIBE button); and you agreed to pay consideration for the contract (the offeror will deliver the newsletter to you for $5.00 per issue).

This clickwrap contract is an example of what the law calls a contract of adhesion—a contract that you did not really bargain over in any way, but which was presented as more of a take-it-or-leave-it offer. Generally speaking, adhesion contracts are legally enforceable.

The use of the term "clickwrap contract" is an extension to the shrinkwrap licenses used in purchased software. Mass-marketed software comes with the terms of the contract—the license agreement—packaged under clear wrapping, with the notice that by opening the package you are agreeing to the terms of that license. Clickwrap is the same idea: by clicking here, you similarly agree to the contract's terms. ■

CONCLUSION

In organizations, knowledge management is the process of identifying, acquiring, creating, representing, and disseminating knowledge for situation awareness and assessment, learning, and reuse. In Part IV of this text, we have surveyed a number of technologies such as expert systems, knowledge repositories, group systems with case bases, and the likes. To properly support knowledge work, companies need to understand the life cycle of knowledge because each phase of the cycle is best supported by specific approaches. Two of the four phases discussed in this chapter are better supported using high-touch approaches, and two are better supported using high-tech approaches. There have been many undisclosed knowledge management failures, so it behooves executives to understand where IT fits in the overall knowledge management and knowledge-sharing arena.

Likewise, it behooves management to understand the vast arena of computer ethics. IT adds new twists and, often, greater ramifications to long-standing ethical issues. New laws should not be the only recourse to address these ethical quandaries. Enterprises need to discuss these issues, make their own judgments, and make them clearly known to their stakeholders.

Companies in some countries are now required to state their privacy policies with respect to the personally identifiable information they handle. Many companies have also decided whether or not e-mail is company or private property and made their stance known to employees. It would be wise for CIOs to bring up other ethical issues and see that company policies are set, promulgated, and enforced, so that knowledge and other forms of intellectual property are properly used for good, not harm.

Many countries have also put into place stringent regulations with regard to intellectual property protection and consumer's privacy. It is thus a legal obligation for businesses to comply with regulations. However, for a forward-looking organization, the search for competitive knowledge assets and the need to cultivate a culture of knowledge sharing should be on the top agenda, not just a mere legal compliance.

QUESTIONS AND EXERCISES

Review Questions

1. What is tacit knowledge? What is explicit knowledge?
2. What are the four phases of Giga's knowledge management model?
3. How do human capital, structural capital, and customer capital differ?
4. How has Buckman Laboratories encouraged knowledge creation and capture worldwide?
5. What is "the Rudy problem" and how did Seemann attempt to deal with it?
6. What are the two roles of the BP T-shaped manager in Egypt?
7. What did the pharmaceutical company do to create a knowledge infrastructure?
8. What approach did the energy company take to encourage knowledge sharing among its 15 business units?
9. Give three cultural roadblocks to knowledge management projects, as noted by Brooks.
10. What three questions does Stewart recommend be asked before launching a knowledge management project?
11. According to Davenport, what are four management issues in managing information? Briefly describe each.
12. According to Moor, what is the role of computer ethics?
13. Give some examples of IT ethical issues.
14. How does Johnson recommend increasing information privacy protection?
15. What are the four methods of legal protection of intellectual property?

Discussion Questions

1. Should IS take the lead in the development of knowledge management and sharing? Why or why not?
2. Knowledge management is a misnomer because knowledge only exists in people's heads. Thus, knowledge management is really just people management. Do you agree or disagree? Discuss.
3. An ethical question regarding e-mail is whether the contents belong to the sender or the corporation. What is your opinion? Explain your reasoning.
4. How do you think the flaming example in the "Computer Ethics" section should have been handled by the listserv operator? By the listserv members?

Exercises

1. Find an article about a successful or failed knowledge management project. Why did it fail or succeed; that is, what were the "critical failure factors" or the "critical success factors"?
2. Visit a local organization that is developing a knowledge management system. Who is leading the development efforts? What benefits are being realized? What are their plans for the future?
3. Describe one or two computer ethics dilemmas either you or someone you know has faced. How was each handled? How could each have been handled better?
4. Describe your company's or school's policy on protecting information privacy. How easy was it to find this policy? Do you think it is being followed? If not, give examples of how it is being circumvented.

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PART V THINKING AHEAD

This part, which consists of just one chapter, is intended to focus our thinking on the future and the roles IT could play. It begins by refreshing the reader with some hot topics in IT management, and by recapping some recent inspiring thoughts that could inspire us to better manage IT resources in an Internet-based world. The rules of the road do not generally extrapolate from the rules of the physical world, so they are worth considering carefully, especially when they appear to be counterintuitive.

This concluding chapter also looks at the three main people issues of moving ahead: gauging users' enthusiasm or reticence to embrace new technologies, non-IT executives' roles in leading the use of IT, and educating IS staff about the business.

In essence, this part is about leadership in the Internet-based economy. As history reminds us, technology rarely evolves in the way most of us think it will. A leader is someone who is able to see what people do not see, think ahead, and take opportunistic actions. Thus, we end this book as we began it, highlighting the leadership box in our framework and thinking in the future tense.

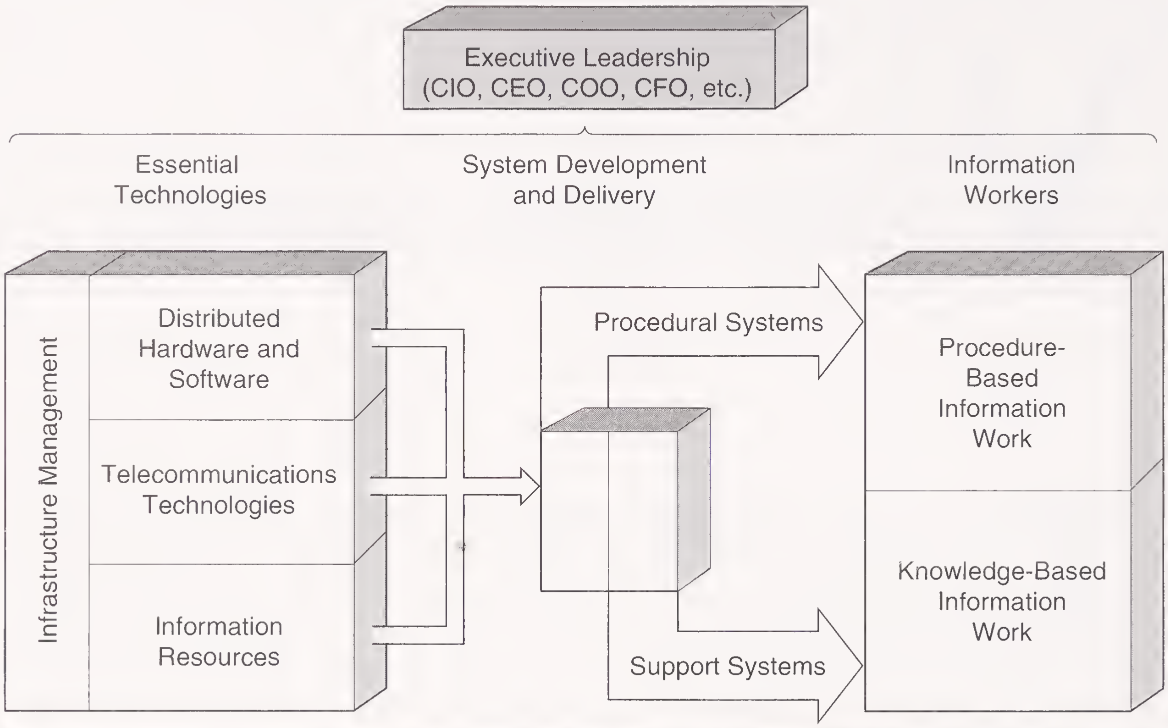

FIGURE P5-1 A Framework for IS Management

CHAPTER

15 THE OPPORTUNITIES AND CHALLENGES AHEAD

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INTRODUCTION

It has become strangely out of fashion, even behind the times, to talk about the new economy, e-business, the e-world, or anything to do with the letter "e"; yet, that is exactly the world we have moved into. The dot-com crash in 2000 still left a bad taste in the mouth of a lot of people, especially those who lost a lot of money in harebrained schemes. However, the end of that burst of frenzy does not mean that the e-world is going away. It has just gone underground, and by doing so, has become even more pervasive. It is at work everywhere. Enterprises around the world are quietly redefining their strategies, work environments, and skills. This chapter looks at the challenges facing IS organizations worldwide by assembling a collage of opinions about possible principles underlying the e-world.

The networked computer is an amazing machine because it leverages people's brain power, not just their muscle power. This capability is being used to process data, and more importantly, to communicate in new ways. This communication, in turn, allows companies to compete in new ways using cyberspace as an innovative platform for social networking and business partnership. Following are some hot IS issues and a brief discussion of some inspiring organizing principles to thrive in an Internet-based economy. The chapter ends by looking at ways to move forward.

HOT ISSUES—CHALLENGES OR OPPORTUNITIES?

We started in Chapter 1 with a number of emerging IT issues. Most of these issues are likely to remain for some time in the near to medium terms. In this final chapter, and with the desire not to repeat ourselves, we end here with three "hot" issues that should be on the radar screens of CEOs and CIOs—those that are politically sensitive within and outside the corporate boundaries. We present these issues as both challenges and opportunities for businesses that face them. The theme of this book is that the art of successfully managing IT resources is to skillfully apply proven management principles with a keen sense of technological and societal changes.

Navigating Information Overload

We discussed earlier the age of information abundance. We warned of the risk caused by cognitive overload and the costs related to distraction due to information abundance. We also suggested the use of search and filtering techniques to help find the right information for the right problem at the right time to the right people. IDC (www.idc.com) estimated that, in 2006, the amount of digital information that was created, captured, and duplicated was about 161 billion gigabytes—an equivalent to the contents printed in 12 stacks of books extending from planet earth to the sun. By 2010, IDC predicts the amount of information would reach 988 billion gigabytes. The hot issue here is how organizations deal with the growing threat caused by the overwhelming glut of information. Consumers have benefited greatly from popular search engines such as Google.com, MSN.com and Yahoo.com in their information needs (for retail shopping, for example). On the other hand, most businesses are still figuring out how to adjust their information resource management to the overflow of information. IT managers need to look at each of the elements of information management:

- ***Data.*** Databases, data warehouses, metadata repositories, networked storage systems
- ***Content.*** Records, documents, Web content, audios, images, and videos

They need to devise an appropriate business intelligence strategy (e.g., data extraction and mining, analysis, reporting, dashboards, performance management). With regard to information search, some corporate IT activities may include: keyword search, content classification, categorization, entity extraction, document search, e-mail search, and taxonomy creation. Tremendous opportunities lie in the ability to make use of relevant information. The challenges include, but are not limited to, the costs of managing information overload, the risk of looking at the wrong available data, and dealing with an organizational culture that is not used to dealing with information overload.

Green Computing

Setting aside the social consciousness of a few who join the save-the-planet-for-our-kids movements, green computing could help organizations that adopt it significantly reduce their power bills. According to *InformationWeek*, dollar amounts spent on data-center power have doubled in the past six years. Lehman Brothers, a major player in global finance, claimed that going green helped them save their energy bill by 25 percent in 2006. The firm's computer systems process millions of automated trading transactions each day and rely heavily on data centers. Data centers, in particular low-end servers, consume lots of energy to run and to stay cool. Some non-IT-related solutions are being used, such as use of hydroelectric power, to reduce energy costs. Server virtualization, grid computing, multicore processors, and use of blade servers are being hailed as promising cost-effective solutions. All together, these efforts help lower the number of servers, which diminishes space requirements and heat. Another trend is to utilize energy-efficient PCs and high-end workstations. However, this is just the beginning, and a clear-cut winning strategy has yet to emerge.

In the meantime, governments have started to take actions to save energy. The European Union introduced in 2006 the Restriction of Hazardous Substances (ROHS) directive to restrict the use of six toxic substances, to include lead and mercury. It also imposes two significant regulations on green technologies: the Waste Electrical and Electronic Equipment regulations that require vendors to recycle any product they sell, and the Registration, Evaluation and Authorization of Chemicals regulations that seek to better manage dangerous wastes. The United States has taken a similar move. The Electronic Product Environmental Assessment Tool (EPEAT) became law in January 2007, mandating that 95 percent of electronic products procured by federal agencies to meet EPEAT standards. The U.S. Environmental Protection Agency claims that a five-year purchase of EPEAT-registered computers could result in reductions of more than 13 million pounds of hazardous waste, more than 3 million pounds of nonhazardous waste, and more 600,000 MWh of energy (enough power for 6 million households). The opportunities here could be a "make or break" time for the IT department. Green IT is a socially welcomed strategy with non-negligible potential for energy savings. The challenges are no less significant: A green strategy is not a lean strategy. New investments must be made before future savings can be capitalized. Also, managing change in fast-evolving security and environmental legislation is, to say the least, not straightforward.

Virtualization and Parallelization

Virtualization can be simply described as techniques that simulate multiple self-contained application environments on a single physical server. By doing so, virtualization allows a business to run as many application-specific applications as required without the need of setting up a bundle of dedicated hardware platforms. Until recently, IT departments' most common practice was to install more computers to support more applications and data that are associated with them. As discussed in the previous paragraph, this less-than-ideal solution results in cramped space and energy-hungry devices. An improved generation of virtual machines has been recently released by major computer vendors to support software developments—typically, up to five virtual machines on each physical server. Some large companies such as United Technologies' Pratt & Whitney deploys more than 100 virtualized software applications on 16 physical servers. The concept of virtualization existed some 40 years ago with the creation of mainframe, and it has come of age. The benefits of virtualization include:

- ***Scalable resources with partitioning capability.*** Multiple applications and operating systems can be supported within a single physical system as virtual machines; these virtual machines can be scaled up or down based on business requirements.
- ***Simple encapsulation.*** A complete virtual machine environment can be saved as a single physical file, making it easier to run and maintain.
- ***Increased security with virtual isolation.*** When set up correctly, virtual machines are isolated from the host machine and other virtual machines. Processes and data are less subject to computer security frauds.

In addition to virtualization, parallelization technologies provide a new breed of hardware (for example, multiple core chips) and software that allow for potentially faster and more cost-effective parallel processing on the multiple cores. Although many small-scale and dedicated virtualization projects have been reported to be successful, large-scale transformation could prove to be difficult. IT departments that contemplate a virtualization of mission-critical, corporate-wide applications must manage the transformation carefully. They need to thoroughly identify their existing physical assets and establish business and technical constraints and workload, scheduling, and migration patterns, in order to take advantage of virtualization technologies and move their organization toward the real-time economy.

IT Talents and Globalization

IT personnel will continue to be one of the most critical issues. In addition to the prediction of a few analysts about severe talent shortage in the next 10 years, the impact of technological obsolescence and age discrimination have shown to be more severe in the IT industry than in others. To maintain and retain a pool of skilled labor, organizations should strive to develop HR strategies for continuing education and training of their IT staffs. Perhaps one of the most complex and unsettled issues is the global movement of IT labor. Experts are still divided between importation of workers versus outsourcing. Each strategy has pros and cons. CEOs should look at HR resources as a part of the overall strategy of the organization.

Dealing with these four hot issues, among others, requires the organizations to clearly identify challenges and opportunities that are linked to each of those critical areas. The essence of this chapter it to recap a number of influential concepts that organizations could use to navigate in a time of grand exploration—with information and communication technologies as a strategic component.

ORGANIZING PRINCIPLES

As "rules" are constantly being formulated, reformulated, and reformulated again, some principles will prove true; others will fall by the wayside. The following concepts offer possible organizing principles. They point out the areas enterprises may need to focus on to succeed in an e-economy.

The Learning Organization

Peter Senge wrote the influential book *The Fifth Discipline: The Art and Practice of the Learning Organization.*[1]

Senge begins his book by noting that most organizations live only 40 years, which is only one-half the life of a person. The reason is because they have learning disabilities. In children, learning disabilities are tragic; in organizations, they are fatal.

To Senge, organizational learning disabilities are obvious. Here are just three. One, enterprises move forward by looking backward in that they rely on learning from experience. This approach means that companies end up solving the same problems over and over. Second, organizations fixate on events, such as budget cuts, monthly sales, and competitors' new announcements. Yet the real threats come from gradual changes that occur so slowly that no one notices them. Third, teamwork is not optimal, which is contrary to current belief. Team-based organizations operate below the lowest IQ on the team, leading to skilled incompetence.

Organizations that can learn faster than their competitors will survive. In fact, it is the only sustainable advantage; that is, the organization and its people must master the following five basic learning disciplines:

1. Personal mastery
2. Mental models
3. Shared vision
4. Team learning
5. Systems thinking

Personal Mastery

People reach a special level of proficiency when they live creatively, striving for the results that matter most to them. Their lives turn into lifelong learning, in which they continually clarify and deepen their personal vision and focus their energies. This personal mastery forms the spiritual foundation for the learning organization. Unfortunately, many enterprises are not committed to the full development of their people. Therefore, they foster burnout rather than creativity.

Mental Models

People's mental models are the deeply ingrained assumptions, generalizations, and images that influence how they see the world and what actions they take. Senge notes that Royal Dutch/Shell was one of the first organizations to understand the importance of mental models; that is, how its managers viewed the world and the oil industry. Shell learned how to surface its managers' assumptions and challenge their inaccurate mental models. In so doing, Shell was able to accelerate its organizational learning and spur the managers to investigate alternative futures by using scenarios. When the 1974 oil crisis hit, its managers were able to react more appropriately than competitors because they had already explored the possibility of such a crisis and the best steps to take if one did occur. To change mental models, people must look inward, something few organizations encourage. However, those that do realize they have a powerful tool for fostering institutional learning.

Shared Vision

A shared vision is an organization's view of its purpose, its calling. It provides the common identity by which employees and others view it. Senge notes that Apple's shared vision has been to build computers for the rest of us. IBM's shared vision was exemplary service. A shared vision is vital to a learning organization because it provides the overarching goal as well as the rudder for the learning process. It becomes the force in people's hearts. It is the answer to: "What do we want to create?" Organizations with shared visions are powerful organizations.

Team Learning

When teams learn, they produce extraordinary results. One of the major tools for team learning is dialog, where people essentially think together. Senge distinguishes discussions from dialogs by saying that discussions occur when people try to convince others of their point of view. Dialogs, on the other hand, occur when people explore their own and others' ideas, without being defensive, to arrive at the best solution. Few teams dialog; most discuss, so they do not learn. Team learning, rather than individual learning, is essential in the learning organization because teams are the fundamental unit of the modern organization. If teams do not learn, neither does the organization.

Systems Thinking

We live in a world of systems. To understand systems, people need to understand their underlying patterns. For example, people can only understand the "system" of an enterprise by contemplating its whole, not its parts. Today's complex enterprises are best understood by looking for patterns and viewing them as a whole entity. Systems thinking is a conceptual framework for making complete patterns clearer. Using and understanding systems thinking can help people see how to change the patterns effectively.

Of these five disciplines, Senge believes that systems thinking is the cornerstone. It is the fifth discipline. Until organizations look inwardly at the basic kinds of thinking and interacting they foster, they will not be able to learn faster than their competitors.

Processes Rather Than Functions

In *Beyond Reengineering*, Michael Hammer[2] notes that the key point of the reengineering movement was not that changes needed to be dramatic (i.e., in terms of orders of magnitude), but that they needed to be made from a process-centered viewpoint rather than a task-centered one. The industrial revolution deconstructed processes into specialized tasks. As a result, the business world has focused on improving tasks. Tasks are about individuals; processes are about groups. We are now in a group economy, Hammer states.

Current organizational problems are process issues, he contends. They center around how specialized tasks fit together. Simple jobs require management and complex processes to get work done. When companies try to simplify these complex processes, they find simplification can only be done by creating complex jobs. A typical reengineering case in point is the move from a sequential workflow (where five people each perform just one or a few parts of a job) to a case-management approach (where one person performs the entire workflow). The result: simpler work process, more complex jobs. Employees manage themselves, eliminating the need for a supervisor.

Working and managing become part of everyone's job in a process-centered structure. Process-centered organizations can address today's organizational issues because the solutions require shifting perspective from tasks to processes. The shift to processes has a number of ramifications. One is the need for a new position, such as process owners. In every process, virtually every department is involved. So one person needs to have end-to-end responsibility. Rather than managing the people, process owners provide the knowledge of the process. They own the design of the process. Furthermore, processes need to be designed from a customer's perspective. Process design and process improvement become the essence of management in a process-centered organization.

The move to a process-centered structure also requires measures of processes, which are different from measures of tasks. Measuring a process (how long it takes to complete, its accuracy rate, its cost, etc.) means measuring its outcome from the customer's point of view. A task metric, on the other hand, would measure how many calls a customer service representative handles each hour. The process metric for the same job could be the percentage of problems (calls) handled completely on the first call, which is an outcome.

Process centering also turns people into professionals rather than workers, if you define a professional as someone who is responsible for achieving results rather than performing a task. The professional is responsible to customers, solving their problems by producing results. To do so means doing what it takes to complete a process. Workers, on the other hand, aim to please the boss, keeping busy with lots of activity, to perform what they are told to do. Workers are told not to be concerned with the totality of the work. The shift to professional from worker is profound. It makes factory employees concerned with customer satisfaction rather than number of parts produced per hour. It requires greater knowledge and a more holistic view by all the people involved.

Given this brief description of some of the principles underlying a process-centered organization, what would one look like? MeadWestvaco in Chapter 1 provides an in-progress example. Business process outsourcing provides another. For instance, order-to-cash is now a process being outsourced. It involves handling all the invoice-to-cash tasks. Thus, it turns an order for, say, a computer, into cash. Some outsourcers now specialize in performing this process for clients. These outsourcers are judged (and perhaps paid) based on how quickly they turn an invoice into cash.

Communities Rather Than Groups

Another organizing principle for the e-world is communities rather than groups. The distinction between the two is that communities form of their own volition. Groups are formed by design; their members are designated a priori, perhaps by a project manager, a select committee, or an executive.

As noted in Chapter 13, Communities of Practice (CoPs) are espoused by the Institute for Research on Learning in Menlo Park, California, a spin-off of Xerox PARC. As described by John Seely Brown, former director of Xerox PARC, and Estee Solomon Gray,[3] a founder of Congruity, a consulting firm, a CoP is a small group of people (rarely more than 50) that has worked together for a period of time, but not necessarily in an organized fashion. They may perform the same job or collaborate on a shared task or a product. They have complementary talents and expertise; they are held together by a common purpose and a need to know what the others know. Most people belong to several CoPs, and most important work in companies is done through them.

Communities are the building blocks of a knowledge-based company for three reasons. One, people, not processes, do the work. Big gaps separate official work processes and real-world practices (how things actually get done). The informal, perhaps impromptu, ways that people solve problems cannot be anticipated. When companies compete on knowledge, the name of the game is improvisation. The challenge is to keep processes elegantly minimal, so that they give room for local interpretation and improvisation; that is, for grassroots practices.

The second reason CoPs are important is that learning is about work, work is about learning, and both are social. The crucial, unappreciated ingredient in companies is tacit knowledge—intuition, judgment, and common sense—which cannot be explained. Within groups, tacit knowledge exists in practices and relationships that are based on people working together over time. When people recognize the importance of tacit and collective dimensions of work, they realize that learning has to do with being part of a community rather than absorbing information.

Third, CoPs are important because organizations are webs of participation. When a pattern of participation changes, the organization changes. Participation is the core of the twenty-first-century company. Only people who make a commitment to their colleagues can create a winning company. Companies that realize the power of communities and adopt processes that allow them to emerge are moving toward e-world companies. National Semiconductor fosters CoPs.

CASE EXAMPLE

NATIONAL SEMICONDUCTOR

www.national.com

National Semiconductor has gone far in promoting CoPs. The company began encouraging such communities after its business model that built low-margin commodity chips collapsed. The new CEO restructured and rationalized the company, then put it on a growth path and changed its business model. Part of the strategy was to build a core competence in mixed signal technology, where chips function as the electronic interface between the real world of voice-video and the digital world of computing-communications.

CoPs are central to this plan. They energize and mobilize the firm's engineers. They even shape strategy and then enact it. A CoP on signal processing, for example, grew slowly over 18 months. It now includes engineers from numerous product lines and has been influential in strategy decisions.

Another CoP has grown up around phase lock loops (PLL), a technology critical in some important company products. For 20 years, PLL designers swapped ideas, insights, and solutions to problems, even though they worked in different

(*Case Continued*)

business units that did not collaborate. Within this loose community, some PLL engineers began reviewing new chip designs as a group. When product teams around National Semiconductor heard about these reviews, they informally brought their designs to this group for advice. The more reviews the group did, the more effective it became; it earned a reputation for excellence.

These engineers cannot publish their design criteria, teach others how to do design reviews, or create a library of design, because their knowledge is embedded within their experience as a CoP. The only way someone can learn how to critique a design is to become part of that community and interact with it.

This PLL CoP has since been formally recognized and has a charter: to make its design know-how accessible, to make successes and failures known, and to continue to build the firm's PLL competence. This community does not report to anyone; it is "run" by its members. It provides a means of collaboration among National engineers concerning their PLL designs. It has even received funding to develop two advanced PLL prototypes outside any National product line. It also has created a "PLL place," a lab that houses the equipment it buys.

National is extending CoPs by formally recognizing them, offering funding for their projects, and handing out a toolkit to help people form their own CoP. National also encourages CoPs to create homepages on the Web to communicate. ■

Virtual Rather Than Physical

The virtual organization has come to be the popular description of a new organizational form. The underlying principle is that time and space are no longer main organizing foundations. A virtual organization does not exist in one place or one time. It exists whenever and wherever the participants happen to be. As organizations expand globally but need to adapt to local conditions, virtual organizations have emerged inside them, just as have CoPs. As an example of a virtual organization within an existing company, consider Sun Microsystems as reported by Richard Rapaport.[4]

CASE EXAMPLE

SUN MICROSYSTEMS

www.sun.com

John Gage, chief scientist and director of Sun Microsystems, gives an intriguing description of virtual organizations within an existing company. The network creates the company, "Your e-mail flow determines whether you're really part of

(*Case Continued*)

the organization; the mailing lists you're on say a lot about the power you have." For example, Gage had been part of the Java group at Sun for four or five years when his name mistakenly was taken off. His flow of information stopped; he stopped being part of that organization. He got back on the list in a hurry, he says.

Gage uses Sun's alias file (the master list of its e-mail lists) to know what is going on in Sun. No one needs to tell him when a new project has started; he can see a new e-mail list. When he sees a list balloon from, say, 35 to 200, he knows something important is happening.

People even create their own aliases, Gage observes. His own alias list is his personal view of the company's power structure on a project, no matter where the people work. The organization chart does not reflect the same list. These personal aliases have a secondary effect, too. They let others know whom you are keeping informed. In essence, each alias is a virtual organization. Web technology extends e-mail because it allows people to send "live" messages with embedded hyperlinks. So, rather than try to persuade people, you can just show them. ■

Self-Organizing Rather Than Designed

Some of the most stimulating discussions about the form of future organizations are those centered around chaos theory, ecology, and biology. Meg Wheatley's highly influential book, *Leadership and the New Science*,[5] is one example. Two others are Kevin Kelly's mind-opening *Out of Control* and *New Rules for the New Economy*.[6] The basic tenet of these works is that nature provides a good model for future organizations; that is, organizations that must deal with complexity, share information and knowledge, and cope with continuous and discontinuous change. In seeming chaos, we can get order for free, according to both Wheatley and Kelly. As with natural phenomena, enterprises will do much better if they are self-organizing or emergent, rather than designed.

Examples of Self-Organization

Wheatley, in both *Leadership* and her more recent book with Myron Kellner-Rogers, *A Simpler Way*,[7] describes the famous chaos experiment by Stuart Kauffman, a theoretical biologist. He attached each of 200 light bulbs to two others and programmed them so that each one turned on or off depending on the behavior of the two partners. He was interested to see whether a pattern would emerge from the 1,030 possible states. To his great surprise, a repeatable pattern emerged almost instantly, after 13 states. Even when he changed the connections, an organization (albeit a different one) emerged "instantly." His conclusion is that we get order for free, even without intelligence in the system.

Kevin Kelly, former executive editor of *Wired* magazine, gives many, many examples of order-from-chaos in both of his books. Here are just three. The first concerns the movie *Batman Returns*, in which computer-generated bats were to flock through Gotham City. One computer-generated bat was created and allowed to automatically flap its wings. Then it was replicated, by the dozens, until there was a mob. Each was instructed to move on its own following just three rules: do not bump into another bat, keep up with your neighbors, and do not stray too far away. When the computer simulation of the mob of bats was run, they flocked just like real bats! So even though the bats were seemingly out of anyone's control, they flocked. The same happened with the marching mob of penguins in the same movie, which also drew on a simple Reynolds algorithm. Kelly says this kind of behavior indicates that order can be achieved from chaos in any distributed "vivisystem," combined biological mechanical systems, organic or man-made.

In an equally striking example, Kelly describes how Loren Carpenter, a computer graphics guru, demonstrated a similar kind of order-from-chaos in an auditorium with 5,000 computer graphics conferees. Each one had a cardboard wand, red on one side, green on the other. At the back of the auditorium, a computer scanned the wands when they were held up high, picking up the color on each wand. At the front of the auditorium was a huge screen that displayed the sea of wands, which looked like a candlelight parade. Attendees could find themselves in the sea and change their color on the screen by flipping their wand.

Carpenter then projected the game Pong (a videogame similar to table tennis) on the screen, telling the audience that those on the left controlled the left paddle, those on the right the right paddle. Within moments, the 5,000 were playing a pretty good game of Pong, with the movement of the paddle being the average of the several thousand players' intentions. When Carpenter speeded up the game, the crowd adjusted, almost instantly.

When an airplane flight simulator was projected on the screen, Carpenter told the audience that the left side of the room controlled the roll and the right controlled pitch. In essence, the pilot became 5,000 novices. They became silent as they studied the controls in the cockpit, wrote Kelly. The plane was headed for a landing, yet it pitched left and right because the signal was latent and the crowd continually overcompensated. When it was obvious that they would arrive wing first on the landing strip, they somehow pulled the plane up and turned it around, even though no one gave a command. They acted as one mind, turned wide, and tried a second landing. But again, the plane was not straight, so in unison, and again without verbal communication, they pulled up. On the way up, the plane rolled a bit, then a bit more, and then, "at some magical moment" the same thought seemed to occur to everyone, "I wonder if we can do a 360?" In unison, without speaking, they rolled the jet, fairly gracefully, and then gave themselves a standing ovation. Kelly notes that the conferees did just what the birds did: they flocked.

Five years later, Carpenter tried the same experiment at the same conference, states Kelly in *New Rules for the New Economy*. This time, the game was more sophisticated (the controls had more choices), and the task more challenging (to steer a 3D submarine in search of sea monster eggs). However, unlike previously, when the audience took control, nothing happened. The submarine did not move. Even after lots of fiddling with controls and shouting, still no movement took place. Finally, in exasperation, Carpenter said, "Why don't you go right?" Immediately, the submarine went right. He had unlocked the paralysis. The group needed leadership. It might only be a few words, but it was enough to initiate cohesion. From then on, the 5,000 copilots maneuvered the submarine deftly.

The Self-Organizing Point of View

Wheatley and Kellner-Rogers believe that organizations, like the lightbulbs and many natural phenomena, can be self-organizing. They believe self-organization requires taking the perspective of "organizing-as-a-process" rather than "organization-as-an-object."

Processes can do their own work if supplied with what the processes need to begin: resources, information, and access to new people.

Self-organizing systems create their own structure, patterns of behavior, and processes to accomplish the work. People within a process "design" what is necessary to do the work and "agree on" the relationships that make sense to them. Systemwide stability depends on the ability of the members to change. As conditions change, the people change the process. As a result, the members do not need to plan things into existence; they only need to work with the unknowns, and an "organization" will emerge. Systems are relationships that are seen as structures, but those relationships cannot be structured; they can only emerge. Webs develop as the individuals explore their needs, if they are free to create the relationships they need. Freedom and trust are paramount for self-organizing systems to thrive. Such systems are healthiest when they are open to including diversity; it gives them strength and resiliency. (This discussion sounds like the open source movement discussed in Chapter 13, doesn't it?)

Kelly believes that the only way to create truly complex systems is to use biology's logic of self-governance, self-replication, partial learning, and some self-repair. He believes that the mechanical and biological worlds are merging, leading to bionic systems, which he calls "vivisystems." On the one hand, a nation's flight control system needs mechanical clockwork systems. However, when adaptability is needed, the best systems act as swarms, like a hive of bees. Kelly notes that when bees swarm, that is, move en masse to a new hive, the process is not command controlled. Instead, a few scouts check out possible new hive locations and report back to the swarm by dancing. The more theatrical a scout bee's dance, the better the bee liked the site. Deputy bees then check out one of the competing sites based on the dance that attracts them the most. If a scout concurs with the dancing bee's choice, the scout joins the dance. This activity induces others to check out the site and then join the dance if they concur. In this democracy, the favorite sites get more visitors, and, following the law of increasing returns, they get more dancing votes, and the others get fewer. In the end, one large snowballing dancing swarm dominates and flies off to the new site, taking the queen bee with it.

Can an example of an organization with such a self-organizing principle be found? Consider Semco of Brazil.

CASE EXAMPLE

SEMCO, S. A.

www.semcoinc.com

In his books *Maverick: The Success Story Behind the World's Most Unusual Workplace*, and *The Seven-Day Weekend*, Ricardo Semler,[8] CEO of Semco, describes how his company, a Brazilian manufacturer of industrial equipment, moved from fifty-sixth place to fourth place in its industry. To survive with Brazil's crippling

(*Case Continued*)

inflation rate, Semler felt he had to "break all the rules" to get costs down and productivity up.

As a result, factory workers at times set their own production quotas, help redesign products, formulate marketing plans, and even choose their own bosses. Bosses set their own salaries, yet everyone knows what they are, because workers have unlimited access to Semco's one set of books. All employees have been taught how to read balance sheets and cash flow statements. Finally, on the big decisions, such as relocating a factory, everyone decides. In one case, a factory was shut down for one day and buses took the employees to all three possible sites. Then the workers decided on a site that management would not have chosen.

At Semco, self-management goes a long way. Semler and the other top executives make few decisions. When there is a problem or issue—whether to have employee badges, if a group of employees unknowingly generates a high telecommunications bill one month, or what to do about a boss highly disliked by subordinates—the standard response from management is "to do nothing," notes Semler. It is the employees' job to handle their own problems in their own way, which may take longer and require a lot more discussion than a swift management decision, but it has a better lasting result. In fact, once a decision has been agreed on, its implementation is immediate—quite the opposite of top-down decisions that take time to be implemented by others (or not).

Semler believes the way to unleash innovation and have a motivated workforce is for top management to give up control—a heretical thought in just about all other enterprises. Yet, Semco's financial success and low employee attrition rate attest to these principles, which have worked for more than a decade.

Another self-organizing tenet at Semco is that all meetings are voluntary for all employees, including hiring meetings, budget meetings, team meetings, even board meetings (any employee can sign up to hold one of two open voting seats at the next board meeting). Meeting agendas are published ahead of time for everyone to see. If no one shows up at a meeting, then the company obviously should be doing nothing about that subject. Furthermore, people can leave a meeting when they are bored. This self-organizing discipline keeps the company focused on issues of importance to employees, notes Semler. Meetings that deal with issues of great concern draw many, many employees. People attend meetings they care about. Likewise, they work on what they care about. When they become unhappy, they are free to look for another job in the company.

Semco has no receptionists, secretaries, or perks, and Semler really does not know how many employees he has because some of his employees work part-time for him and part-time for competitors, others are contractors, and still others are vendor employees. When Semler took over the company after the death of his father, he threw out the rules because they discouraged flexibility and comforted complacency. For example, Semco sets no travel rules; employees are to spend whatever they think they should, as if it were their own money. The rationale: "If we're afraid to let people decide in which section of the plane to sit or how many stars their hotels should have, we shouldn't be sending them abroad to do business in our

(*Case Continued*)

name, should we?" writes Semler. Employees are considered partners; they are self-managing and self-governing. They even vote on how the profit-sharing pot will be split each year.

Things are rather messy around Semco. Machines are not in neat rows. They are set at odd angles, where the team that assembles a complete product puts them. Most workers do several jobs on a team, not just one, with the backing of the unions. Team members do not have to show up for work at the same time, but they do coordinate their schedules so as not to disrupt production. As the workers assumed more responsibility for their work, the number of supervisors decreased, as did corporate staff. Semco does not even have IS, training, or quality control departments. Three layers of management do the job that used to take, and those three are represented by three concentric circles.[9]

Furthermore, departments can buy from whomever they choose. This competition keeps departments on their toes. Management encourages employees to start their own companies, even to the point of leasing Semco machinery to these start-ups at favorable rates. These companies sell to Semco and competitors. This strategy keeps Semco lean and agile.

The changes have been rough and were not undertaken in an orderly or coherent fashion, as Semler recounts, but the radical changes to a far more democratic workplace allowed the company to grow 600 percent at the same time that the Brazilian economy was faltering. It is a dramatic story, and illustrative of the benefits of self-organization in a chaotic business environment. ■

Adaptable Rather Than Stable

In their provocative book *It's Alive: The Coming Convergence of Information, Biology, and Business*, Christopher Meyer and Stan Davis[9] speculate on future organizational structures. Actually, some of these structures exist today. The two authors contend that successful organizations will be structured to naturally support (perhaps even foster) volatility and continual surprises. Today, organizations are structured to maintain stability; change is minimized. Hence, change costs a lot. Firms built for stability are not adaptable.

IT is causing the world to become more connected, and connectivity increases volatility. The only way to achieve adaptability is through distributed intelligence and action. Thus, organizational models will be built around networks and will be designed to evolve.

The theories that drive biology will be used to model enterprises. Individuals will become the focus of organizations because individuals are the agents of adaptation. Organizations will aim to influence the decisions that individuals make. A major strategy will be "seed, select, amplify," state Meyer and Davis, which means testing as many "seeds" (possible goods or services) as possible, selecting the ones that the market responds to, and then amplifying those winners. Such testing will be handled by the bottom of the organization, causing it to be run bottom-up, rather than top-down. The leaders will govern the independent actions of the people in the organization by establishing the guidelines and constraints for their decisions and actions. Capital One is a prime example of this future organizational structure, note Meyer and Davis.

CASE EXAMPLE

CAPITAL ONE

www.capitalone.com

Established in 1995, Capital One has swiftly become a Fortune 500 company providing a wide spectrum of financial services. Initially, it issued credit cards and then it moved into consumer financing of automobiles, elective surgery, and dental work. IT enables Capital One's information-based strategy, which enables it to base decisions on the results of market tests. Capital One's core competency is its test design.

The company believes in "the law of large numbers"; that is, high volumes of tests will yield an accurate reading of the marketplace. It therefore conducts tens of thousands of tests a year.

The heart of the company's strategy is dreaming up credit programs that might have value to customers and then testing numerous variations of each program to see which yields the best results. Each new type of credit card or financing offer is tested on many factors. The results of the tests are analyzed using advanced statistical modeling. The winning variations are then modified and offered to more consumers (once funding is acquired from management). It is "seed, select, and amplify," to use Meyers' and Davis' terminology. This strategy, which is akin to scientific experimentation, is not at all the convention in the industry. And it is far more IT-based than competitors' strategies.

As one example, Capital One discovered from its first test that "balance transfer" was a winning offer. Consumers can use balance transfers to move credit card debt from another card to a Capital One credit card, which has a lower introductory interest rate. Capital One created this lucrative market and had it to itself for about 18 months. Once others jumped in, and profitability dropped, Capital One exited the market. But it has since reentered the market, once it became profitable again. Its continual testing has tracked that part of the market.

Capital One's strategy goes with its bottom-up culture, where decisions are made at the bottom based on the market tests. Management controls funds for rolling out new products but not for conducting the testing. In general, management uses its veto power to approve or disapprove funding requests based on test results. Managers spend a significant amount of their time making hiring decisions using the same test-and-learn strategy, which has taught them which behaviors correlate with success in their environment.

The results speak for themselves. According to *BusinessWeek* (2005), Capital One has become the fourth-largest U.S. firm in diversified financials. It has the lowest net charge-off rate and the highest risk-adjusted margin in the industry, and it grew 45 percent in one year. ■

Distributed Rather Than Centralized

Following are two views on how organizations could become more distributed.

Distributed Capitalism

Based on 10 years of research, Shoshana Zuboff, of Harvard Business School, and James Maxmin, former CEO and chairman of several companies, contend that the commercial purpose of organizations has changed. Hence, organizational structures will change accordingly. (*The Support Economy: How Corporations Are Failing Individuals and the Next Episode of Capitalism*.[10])

Firms have believed that they create value by their production of goods and services. That belief has been the foundation of managerial capitalism, which has led to the deep structure of most organizations today. That structure includes the hierarchical and corporate forms of ownership so common today, and the centralized production of goods and services. This form of capitalism has provided a world with material prosperity, giving people affordable products. With this wealth has come a shift in consumers' desires: to individuality, which is apparent in the growing number of products and services aimed at smaller and smaller niches of consumers.

But managerial capitalism will not really satisfy today's consumers because there is a huge gap between consumers' desires and the goods and services for sale. That gap is all the hassles consumers encounter and have to battle themselves. What consumers really want is deep support; that is, they want someone to help them when they have a problem, not give them a hassle. They want someone who will take responsibility for an entire consumption experience, such as all the things that go with medical treatment that they now must handle on their own—hassles with insurance companies, hospitals, doctors' visits, and so on. They want the "concierge care" of the old family doctor.

Consumers are full of disappointment and rage because the terms and conditions of consumption are set by the producers. They want to set their own terms and conditions, which is why there is road rage, air rage, hotel rage, and so on. Likewise, on the sellers' side, employees face huge stresses in trying to satisfy seemingly unsatisfiable customers. That is why so many employees have opted out of the standard enterprise environment to start their own business.

The only form of capitalism that can actually provide deep support is distributed capitalism because it takes a very different view of the world. Primarily, it recognizes that economic value comes not from producers of goods and services, but from a relationship with an individual. Consumers are recipients of pre-made goods. Individuals have needs to be met. The difference is akin to being treated as a subject versus being treated as a citizen, state the authors.

To tap the value in individuals' needs, commercial processes will need to align with three "quests":

1. The quest for sanctuary (gaining control over time and activities)
2. The quest for voice (such as extreme sports that have no rules, self-published books and music, Internet blogs, and grassroots activism, all of which give individuals a direct voice rather than a voice through an intermediary)
3. The quest for connection with trusted others

Individuals will pay for the support that allows them to live their unique lives.

One possible organizational structure for this distributed capitalism is federations, which offer a concierge service to each individual, as defined by that individual. Zuboff and Maxmin call this "the individuation of consumption." People will choose the level of support they want. Some may want self-service (via the Web); others may want the personal touch.

Providing deep support unique to each individual is highly complex, so federations would provide the support by collaborating with others and by coordinating the complexity using IT. IT allows them to create and keep track of highly complex relationships. The players in a federation get paid when the individual releases the money. In fact, individuals may actually own aspects of the means of production. Distributed production and ownership will be major tenets of this emerging distributed capitalism, state Zuboff and Maxmin.

Market-Based Organizations

Tom Malone, of MIT's Center for Coordination Science, also sees future organizational structures in his book *The Future of Work, How the New Order of Business Will Shape Your Organization, Your Management Style, and Your Life*.[11] But he sees markets as being a major organizing tenet—inside and outside of enterprises.

The cost of communications has influenced the structure of organizations. When costs are high, organizations have centralized to keep these costs to a minimum. Now that IT is reducing the costs of communication, dramatically more decentralized ways of organizing work are possible. The benefits of large organizations (economies of scale and knowledge) can be achieved along with the benefits of small organizations (freedom, creativity, motivation, and flexibility). The new world of work will not have one center; it will have many. Loose hierarchies will have dense communications, lack of central control, and offer freedom to participate.

Organizations will structure themselves to operate more like democracies or markets. Some already do. Markets can be used in surprising ways, notes Malone. Here are just two examples. BP set up an internal market to reduce the greenhouse gases it produced. Business unit managers made their own decisions on buying and selling permits via electronic trading. The result was that BP achieved its 10-year goal in just one year. Likewise, HP discovered that when it created an internal market of "idea futures," where any employee could guess, say, future printer sales, the futures market was more accurate than one produced by "the experts."

But companies need new infrastructures to bring in-house markets into being. For one thing, markets have incentive and trust problems, and they require lots of communication. Employees need new skills, and management needs new attitudes toward risk and control. Internal and external markets need legal frameworks to resolve disputes and regulatory systems to set and enforce the rules.

The job of management will shift from command and control to coordination and cultivation. Managers will define the rules of the game and manage the dependencies between activities. In fact, Malone goes so far as to say that some hierarchies may exist mainly to regulate internal markets—markets that allocate resources, schedule production, determine prices, and coordinate all kinds of work.

As can be seen, a number of these organizing principles seem to be moving in the same direction: toward organizations that are more self-organizing, demand driven, and distributed. This should not be too much of a surprise, because networking is such a major component to today's world—and it enables these new ways of organizing work. The next section explores aspects of a networked world.

CAPTURING THE WORLD OF CONNECTIONS

The world has become a networked world, and a networked world has different characteristics from the non-networked world many people are used to living in. This section presents three viewpoints of what these differences might be and why they are important.

The Internet Mind-set

Just as PCs turned the mainframe data-processing mind-set upside down, the Internet wreaks havoc with businesses that do not understand and embrace the min-set of the global online world. The four components of this mind-set are described by Elizabeth Ghaffari.[12]

1. Communication is personal, not mass market.
2. Customer contact is interactive, not broadcast.
3. The customer service time frame is theirs, not yours.
4. The culture is bottom-up, not top-down.

Communication Is Interest-driven, Not Mass Market

The World Wide Web makes a significant break with the past. Its communication is "up close and personal," not top-down mass marketing. Personalized homepages differ substantially from those of major corporations. Many are personal vanity plates, resembling family photo albums where individuals tell their life stories. These pages are alive, interesting, entertaining, humorous, personalized, and constantly changing. Their message to traditional marketing departments is, "Your ad copy is boring, dead."

Other Web sites are owned by frustrated writers who publish their own electronic magazines, called e-zines, or journals, called blogs. Their message to the publishing industry is, "Your editorial filters are too tight. If you won't pay us to publish our work, we will publish it ourselves." The Web demands that customers be viewed outside the traditional publishing frame of reference. Who is the customer of a magazine, really? Is it the reader? Or might it be the writer? What are people willing to pay for?

Some corporate Web sites are stuck in the traditional advertising model, merely duplicating the printed page but in the new graphical, dynamic, and global medium. Large brand-name companies have littered the online world with digital equivalents of paper-based coupons. They are using the wrong mind-set: mass market rather than personal.

Some companies have gotten the message and given people a way to create MySite personalized pages. Yahoo! was probably the first, allowing people to create a MyYahoo! homepage with whatever information they wanted to see: weather in a certain part of the country, sports, the stock market, and so on. Airlines, rental car companies, stock brokerages, and others now provide such personalized pages.

At the same time, the phenomenal success of myspace.com, facebook.com, and bebo.com has exemplified the growing interest in social networking. In the social networking sites, users choose to post the information they wish to share, and visitors can select what information they wish to view. The communication is driven by surfers' common interests. Online social networks provide a massive source of personal endorsements, making this an interesting case study of a new form of community-based communication.

Customer Contact Is Interactive, Not Broadcast

The single most important point of view to take toward the Internet is to view it as interactive, not broadcast: incoming, not outgoing. It is a get-the-message, listen-to-the-customer, capture-the-feedback milieu. In essence, the Internet is a customer's window to companies. It is substantially different from television because customers can initiate communications with a firm rather than merely react to their ads. They can express satisfaction or dissatisfaction with products. They can suggest improvements for products or co-design products with the company. Today's consumers are self-sufficient and intelligent. They want to define what custom-made means to them.

An illustrative example of online consumer-initiated communications is in the area of medical self-help information. Every major ISP now has forums or conference areas where individuals can peruse medical information, outside the parameters of established medical associations. Even though the medical establishment bemoans "snake oil salesmen," the Internet gives consumers a way to search for the information from alternate sources. Departments or groups that use the Internet for such interactions will succeed because they tap this huge, latent reservoir of customer needs, current thinking, and goodwill.

Customer-initiated dialog supported by the Internet significantly challenges marketing departments, customer support groups, and fulfillment folks. The eight-week turnaround from postcards in once-a-month magazines, for example, pales in comparison with just-in-time delivery of information via the Web.

The Customer Service Time Frame Is Theirs, Not Yours

Through the Internet, customers are closer to companies than most of them have ever experienced. In fact, they are closer than most companies can handle. For example, how can a company that serves its customers one at a time and answers its phones, "All our agents are busy...," ever hope to handle tens of thousands of site hits or customer inquiries from online requests for the latest product and pricing data?

Being put on hold will increasingly irk customers. Companies that stay with this level of disservice use the wrong mind-set. Today's consumers are busy and have little patience with waiting. In the Internet world, they can do two or more things at once using multiple windows and fast comparison shopping. As with TV remote controls, customers who do not get immediate satisfaction, or instant gratification, will switch to the competition with a point and a click.

This more intimate customer environment means that companies can hear directly, "I couldn't find your product in three stores today. Where do I get it?" without the protective layers of intermediaries or other buffers. Firms that have the organization in place to listen and respond to these closer voices of customers will hold on to those customers. If not, they could lose them. Thus, before an IS department can assist other departments in exploiting the Internet world, it needs to assess its proposed Internet business solutions using a new metric: "Will our firm's Internet strategy truly help all our customers communicate with us?"

The Culture Is Bottom-up, Not Top-down

The Internet is not the expert's world, where the few impart their knowledge to the many. In this information-intense world, "netizens" know that "together, we know more than any one of us alone."

This lesson even holds true for government officials who think they know what is best for their constituents. In Spokane, for example, local officials tried to levy a 6 percent tax on Internet providers. Citizens revolted and inundated city leaders with e-mail and phone calls. A Web site was established to gather their thoughts on the proposal.

The message is also clear for IS departments. IS cannot work in the top-down, broadcast mode, "I'm IS and I'm the expert, so here's your solution, customer." More than ever, IS must get input from its customers to determine the services they want, when they want them, and where they want them.

The traditional hierarchical expert model, where IS designed solutions followed by tests, migration, acceptance, and maintenance, no longer works as well. The customers of IS, too, can go elsewhere to find the expertise they need. They can browse the Internet to review lower-cost and lower-maintenance servers, view recommended best-business practices posted online, or download modeling software to compare alternative network costs in their market.

Furthermore, IS departments that are studying the feasibility of putting up an online parts catalog or are talking to marketing about designing online ads are using the outdated broadcast, top-down, mass-market mind-set. Departmental customers are one step ahead. They are sending e-mails asking when the latest releases of Java and XML will be available because they want to develop Web Services applications so that suppliers can perform their own searches on the parts inventory.

Rather than merely dump traditional corporate copy onto the Internet, the IS department needs to create channels for its departmental customers to continually communicate with other parts of the firm and its partners. Furthermore, it needs to help its company view customers through a finer, more timely mesh.

To hear from customers directly, without intermediaries, is both a gold mine and a massive challenge to those with a broadcast mind-set. To truly take advantage of this gold mine requires viewing the Internet as an interactive medium and redesigning the corporate listening mechanisms to hear and understand customer feedback.

Where's the Value in a Network?

To know how to leverage the Internet (or any network), it helps to understand where value is created. Mohanbir Sawhney and Deval Parikh,[13] offer some thought-provoking insights into how networks change sources of value. They note that when computers (or items containing computers) are not networked, each one needs to provide both front-end and back-end intelligence. Thus, stand-alone PCs have to bundle processing power, storage, and memory (the back end) with the display and interactive capabilities (the front end). This "coupled intelligence," to use Sawhney and Parikh's terminology, leads to compromises in both areas.

Introduce a network and these two forms of intelligence can be decoupled and better optimized. The back-end intelligence (to store and process data), which is best when centralized and made robust, stable, and standardized, can be housed in a core shared infrastructure, where it provides the most value. An example is Yahoo! and all the facilities it provides to online users, such as storage for their photos, e-mail, address books, and so on.

The front-end intelligence (for interacting with the user), which is most useful when it is decentralized, flexible, personalized, and sensitive to context (such as the type of display device), can be dispersed to a myriad of devices that can be small, mobile, customized, and specialized. These forms of front-end intelligence provide the most value. Examples are the handhelds and phones that permit Internet access as well as voice communication.

Value follows intelligence. Thus, in a networked world where everything is connected to everything else, value resides in four places: at the core and periphery, in common infrastructures, in modules, and from orchestration.

There Is Value at the Core and Periphery

Value moves to the ends, the shared infrastructure and the specialized devices. The middle, the network, becomes an unintelligent conduit, as the Internet is. That is not at all like the voice networks. They presumed dumb telephones, so they had to embed intelligence in the network. As we now see, those old-line telephone companies are having a hard time adapting to the new IP-based (Internet Protocol-based) world of dumb networks.

With intelligence and value diverging to the ends of networks, so, too, do companies, some to specialize on providing core infrastructure and others to focus on customer relationships (and controlling the user interface). The two require very different capabilities and strategies. Being decoupled, they can be optimized.

Another effect of value moving to the ends is the disappearance of middle management, because value is in the core (leadership and strategy handled by top management) and the periphery (customer-facing employees making decisions and taking actions). Middle managers were the information transporters between these two ends in the past. Digital highways now connect the two directly.

There Is Value in Common Infrastructures

Elements of any infrastructure—an organization, a system, a business process—that were distributed now are being pulled together and operated as a utility. That is why we see companies centralizing their staff functions (such as HR, finance, accounting, and IT) in shared services groups. Companies are also outsourcing these functions and some business processes (such as order-to-pay, payroll and benefits, and others), believing that there is even more value in common infrastructures among companies. That is also why we see companies rationalizing their IT purchases, down to one or two desktop operating systems, a single network protocol, and a standard set of applications.

Avon is an example of a company that understands the value dynamics of networks (specifically the Internet) and is exploiting them. At first, Avon's Internet strategy was aimed at customers, allowing them to buy the company's cosmetics and other products online. However, this strategy undercut its independent sales representatives who sell friend-to-friend. Avon's second strategy was to give each sales rep a personal portal to submit orders, learn about new products, and even analyze their customers' buying patterns. This strategy gives the representatives a shared infrastructure that they can customize to better perform their customer-facing job. It also gives Avon headquarters valuable customer data that formerly was lost when a sales representative stopped selling Avon products. That data can now be consolidated to see buying patterns and can even be transferred to new sales representatives in open areas. Therefore, this strategy strengthened both the core (corporate) and the periphery (the sales representatives).

There Is Value in Modularity

Software, devices, organizational capabilities, and business processes are being divided into self-standing modules, so they can be quickly and easily connected to form a value chain to respond to a circumstance. The more broadly a module can be used, the more value it has. This plug-and-play mentality is a chief tenet of Web Services.

There Is Value in Orchestration

When modules are abundant, there is value in being able to bring them together. Competition will revolve around being the orchestrator in one's value chain, ecosystem, or industry because orchestration is the most valuable business skill in a networked world, they surmise. Value shifts from those who own intelligence to those who orchestrate it. That is why companies such as Cisco, HP, and others are turning themselves into hubs that coordinate the information and interactions among their suppliers, customers, and channel partners. They garner more value from this coordination role than from performing the actions (such as building computers) themselves. This notion seems to defy our past beliefs of value creation. However, it is a notion that people in a networked world need to understand to tap this new form of network value.

Companies that understand these value dynamics are moving into four new kinds of businesses. The first is arbitrage, which means moving intelligence to areas where it is less costly to maintain. An example is providing online help to U.S. employees from Manila via the Internet to take advantage of the lower labor costs in the Philippines. Such offshore outsourcing is growing steadily. A second new business is aggregation, which means combining formerly separate pieces of infrastructure. Sawhney and Parikh point to Loudcloud, which provides companies with an e-business infrastructure on very short notice. The service is a new kind of utility. Like electricity, it is "turned on" when a surge of Web site hits occurs and "turned off" when the hit rate subsides. The third new business is rewiring, which involves coordinating processes in a new way. An example is an exchange that links police departments and towing companies so that requests for police towing are handled much faster. The fourth new business is reassembly, which involves coordinating disparate pieces of intelligence to form personalized offerings. An example is providing individuals with a personal one-stop Web site for accessing all their personal information—bank balances, stock portfolio, travel reservations, credit card charges, calendar, and such—that is accessible from any type of browser. In fact, such a service could even securely allow different facilities to pass information to one another.

In summary, companies that think about where intelligence resides in their network can extract the value of that intelligence by figuring out where it should reside and taking steps to migrate that intelligence to its most valuable locations.

The Rules of Networks

The Internet has turned the world into one giant network. Working in such a network means understanding the rules of networks. One of the best hypothesizers of the rules of networks is Kevin Kelly, in his book *New Rules for the New Economy: Ten Radical*

Strategies for a Connected World.[6] In it, he states that such a connected world has three distinguishing characteristics:

1. It is global.
2. It favors soft things—intangibles, such as software, information, ideas, and most importantly relationships—over hard things, such as trucks, steel, and cement.
3. It is intensely interlinked.

To Kelly, hard things will increasingly follow the rules of soft things, with the soft creating the context within which the hard operates. For example, a farmer will still plow a field, but he will have a portable office in his tractor cab linked to a GPS system. The soil will have sensors that talk to his system. He will electronically receive weather data, scientific findings, and pricing information and use all these kinds of information to increase his yields, use fewer resources, and get higher prices for his crops. In short, he will try to replace the hard with the soft.

To win in such a networked world, Kelly recommends 10 rules; here are three:

1. Aim for relationship tech.
2. Follow the free.
3. Feed the web first.

Aim for Relationship Tech

Networks embody an amazing phenomenon: Connecting more devices to a network exponentially increases the value of the network for everyone on it because so many new possible connections are created. Thus, a network of 4 people has 12 one-to-one directional connections. Increasing the network to 5 people leads to 20 connections. Whereas the industrial age was about increasing productivity, the network age is about amplifying relationships; that is, increasing the quantity and quality of economic relationships.

Technologies that enhance such relationships are the technologies companies should be investing in. One type is recommender systems, such as that used by Amazon.com. When you order a book from Amazon.com, it uses a recommender system to see what books other book buyers (who have bought that same book) have also bought, and then recommends those books to you. The power in this technology is that it can also be used to let people know of others who have similar interests, and thus spur new relationships.

It behooves companies to make their customers smarter because the enterprise with the smartest customers wins. It is also wise to encourage customers to talk to each other, to even form affinity groups, because that increases loyalty. The greatest expertise about a product does not reside in the company; it resides with its fanatical customers. Companies should encourage these groups and tap their knowledge. Instead, most sue the groups to take down their fan Web sites.

However, having informed customers requires more trust on both sides—the company trusting customers with information about product defects, for example, and customers trusting companies with information about themselves. At the heart of trust in the network economy is privacy. As a major issue, privacy should not be viewed by companies as an inconvenient obsession of customers that needs to be circumvented, but rather as a way to build a genuine relationship with customers. The concern is that customers do not know what a company knows about them or how this information is being used, which creates mistrust. Restoring trust means restoring symmetry so that customers know who knows what about them (in detail), how that information was obtained, and who else has been given that information.

This "shop for relationship tech" rule has obvious implications for CIOs. The main one is to take the point of view that IT is for processing, not communications, which may be quite a switch from the prevalent mind-set. Even if CIOs share this network economy belief, they might have to convince their peers of its value.

Follow the Free

One of the most fascinating aspects of the network economy can be seen today: The best get better and cheaper at the same time. It was not too many years ago when to get something better you had to pay more. Today, if you just wait a few months, you will either get the same quality for a lower price or better quality at today's price. The industrial age brought automation and cheap energy, initiating this phenomenon. Computers have accelerated it. In fact, Kelly notes that a transportation specialist told him that almost nothing in the information industry is moved by ships; everything is flown, so that the price will not drop during shipment.

The network economy is founded on this principle of decreasing price for increasing quality. The more that is manufactured, the cheaper each unit. Smart companies anticipate this cheapness and offer products for free. Paradoxically, those that do can make a fortune. In the 1960s, Robert Noyce and Jerry Sanders, the founders of Fairchild Semiconductor, were selling a transistor to the military that cost $100 to make. They wanted to sell the transistor to RCA for use in UHF tuners to replace the vacuum tubes RCA was using, which only cost them $1.05. Noyce and Sanders believed that learning and volume would decrease their production costs for transistors, so they boldly set their price at $1.05 from the start, even though they had not yet built the factory or the manufacturing processes they would use. They anticipated the cheap and got 90 percent of the UHF market and prospered. Within two years, they cut the price to 50 cents and still made a profit. Any item, soft or hard, that can be copied adheres to this inverted pricing principle, so follow the free. Technology creates an opportunity for demand and then fulfills it.

In the network economy, the most valuable goods and services are those that are most abundant because they increase the value of every other one. If they become cheaper as they become more plentiful, then the most valuable items are ubiquitous and free, he reasons. The fastest way to make something ubiquitous is to make it free. This strategy of the network economy is well tested, and it is the anathema of the strategy of the industrial age where scarcity was of the highest value. Netscape gave the browser away free and sold the servers. The strategy worked until Microsoft, with a larger network, did the same and took away market share.

So how can business make money in such a market? Kelly offers three answers. One, aim for free but only achieve cheap. It will have the same effect. Two, give away the core product and sell the service. This strategy has happened with cell phones and satellite dishes. They give the phones and dishes away free and sell the service. Three, structure the business so that you will be profitable when your product is free.

The reverse tenet of following the free is to see what is free today that could have value, and thus a price, tomorrow. One early example on the Web was the indexes.

which were free and became ubiquitous. Their value came from helping people find sites that might interest them via their categories. They drew people's attention, which is the scarce good in the network economy. Thus, they became valuable. Other free items that could have value in the future, surmises Kelly, are bots, remote cameras, catalogs, guides, distillations, and so forth. Thus, offering a good free and sharing with others can lead to ubiquity, which, in turn, can lead to having a valuable item.

The founding norm of the Internet was its gift economy mentality. Lots of information and knowledge were exchanged without money changing hands. In fact, software developers often asked for help by releasing their software as a beta version to be tested and improved by others. The most popular operating system for Internet servers—Apache—was developed this way; it is free. Linux, the freeware operating system, was, too. It makes you wonder whether CIOs could tap this gift economy. Of course, they would need to allow their developers to assist others in exchange. It is an interesting thought.

Feed the Web First

In the industrial age, loyalty to one's enterprise was important. In the network age, it is more important to be on the right network or network platform. Kelly thus sees loyalty moving from enterprises to platforms. As an example, he asks: "Are you a Mac or a Windows person?" Both are examples of competing platforms. Being on one usually means being out of the other. Thus, Mac users originally could not use the software written for the PC, and vice versa. Similarly, in the network world, choosing the right platform makes an enterprise "in" or "out," so choice becomes important. Once the choice is made, it is important for the company to "feed" that choice to ensure that it grows so that they are on the right network; that is, the one that prospers. People who joined the Mac (closed, proprietary platform) network did not prosper; those who chose the PC (open, nonproprietary) did. Apple releases its new computers equipped with Intel processors to deal with users' needs of open source computing.

In the network economy, a company's success depends more than in the past on the standards it chooses. For example, many companies have chosen an ERP package. If they chose one selected by many other enterprises, third-party providers saw a larger market for their work, so more of them wrote "bolt-ons" to add new functions. This tendency, in turn, expanded the options for everyone using this ERP platform. Companies choosing a less favored ERP package ended up having fewer bolt-ons to choose from, fewer peers to learn from, fewer consultants with expertise in the package, and so on.

The destiny of firms and their "web" (the platforms they choose) are so intertwined that a company's first duty is to "feed the web," because the firm's prosperity is linked to the prosperity of the network. A company cannot prosper unless its network prospers.

Here is an example in the software industry. Software companies, such as Microsoft, pay as much attention to their web as they do to their software. Thus, they hold conferences for developers who use their products to write applications. They provide tools to these developers and co-promote their applications. They provide education to consultants to learn about their software. They give away software to schools to promote their name to future generations. In short, they feed the web (the ecosystem) that surrounds their products. The same is true in the video game industry, the music industry, and the movie industry. All three currently face challenges relating to providing their products over the Internet.

In the network economy, enterprises will shift their focus from maximizing their own value to maximizing the value of their network. Some networks will, of course, be more important than others. For example, choosing to support the laser disk rather than the DVD platform was obviously crucial to movie companies. It is too early to tell how important one wireless Internet access platform will be over another and to whom the choice will have the greatest value.

A corollary is that standards thus become ever more important in the network economy. The prize is so large that many contend to become "the standard." That contest is now being waged in the wireless world. Which wireless protocol will win? It is still an open question. Companies that plan to offer services wirelessly must therefore decide before a clear winner is apparent. Then, they need to back it, promote it, and do all they can to ensure they have chosen the winner. The standard-making process becomes far more important in the network economy, so companies will devote much more time to it than in the past. Webs of relationships will be regulated by the technical standards they are built upon. The important lesson for CIOs in this operating principle is that they need to inform their peers in top management of the importance of the IT platforms they choose, not just to run operations, but also to serve customers and enhance their products and services. These choices are not IT decisions; they are business decisions.

Cut the Cord and Go Mobile

The wireless revolution continues its quiet but forceful march. New wireless technologies are more reliable, with longer-lasting batteries and faster data transfer rates, and are cheaper to operate. All of this increases the business value of networks. But, the revolution is still in the making. Emerging techniques to transfer energy—such as inductive coupling or magnetic resonance—have the potential to further reduce power consumption on mobile appliances, making wireless devices the most ubiquitous accessory in today's business. The uses of wireless are just the beginning. Wireless devices could help the organizations extend their sense making—that is the ability or attempt to make sense of ambiguous situations, expand and update organization memory, and add real-time value services to existing processes. IT managers should work closely with their colleagues to create innovative applications.

Given these potential operating principles for today's e-world, we present a few ideas on how to move forward.

MOVING FORWARD

The discussions in this chapter have been about processes, structures, and technologies; moving forward, though, is about people. It is about the people who lead us into this new business world and the people who are led. We start first with the followers; that is, the people who need to make use of the technologies in this emerging network-based business world. Not all people have the same inclinations to use technology. We end the chapter by talking about what business leaders need to know to be comfortable leading the use of IT and what IT leaders need to know about their business.

Understanding Users

Individuals, work groups, departments, and even business units have different levels of eagerness concerning any new technology. Therefore, if the IS department and other business leaders are truly going to help these groups use a new technology, they need to understand user-comfort levels. Elizabeth Ghaffari,[12] an IT consultant in Los Angeles, cites the Yankee Group and Find/SVP, two market research firms who distinguish levels of comfort with technology by using five "clusters." The Yankee Group uses these clusters to describe the 100 million U.S. households and how they view contemporary technology:

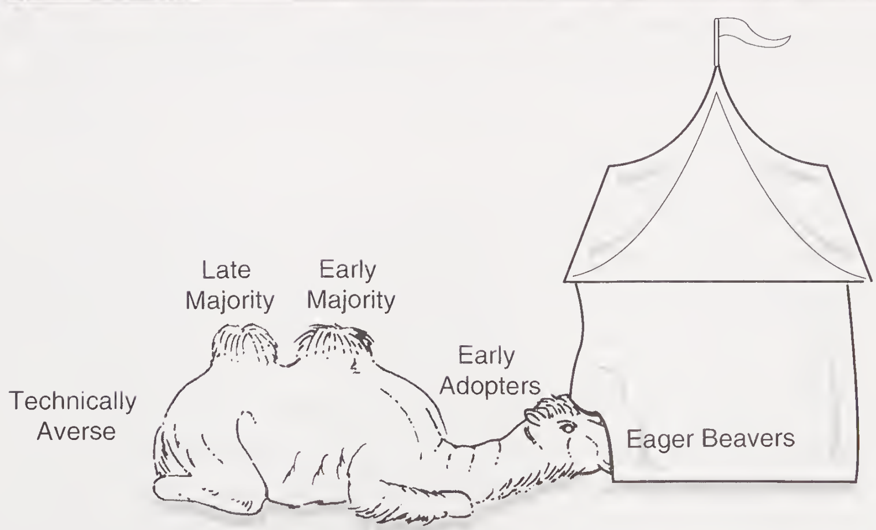
- 500,000 are innovators, constantly sniffing out new technologies.
- 5 million are early adopters of new technologies.
- 30 to 35 million are early majority households.
- 40 to 50 million are late majority households.
- 10 to 15 million are technically averse.

When graphed on a chart, these clusters look a lot like a two-humped camel, notes Ghaffari. It is lying on its stomach with its nose inside a tent, say, the Web Services technology tent. The first cluster is his nose as he nudges the flaps of the tent. The second is his slowly rising neck. The third and fourth are his two big humps; the fifth cluster is his rump. See Figure 15-1.

These five groups represent the spectrum from chomping-at-the-bit innovators (the camel's nose) to those who prefer to leave new technologies well enough alone (his rump). These concepts hold equally well for business users, departments, companies, and industries as well as for U.S. households.

For greatest success, IS departments would do well to benchmark their customers, partners, employees, and others in their business ecosystem against this camel, then introduce the new technology, such as wireless Internet access or Web Services, in a manner that reflects each cluster's willingness and ability to assimilate the new technology. Here are the different possible strategies for assisting each group at its comfort level.

FIGURE 15-1 The Technology Camel



Source: Elizabeth Ghaffari and Barbara McNurlin, "The Technology Camel," unpublished paper, 1998.

Eager Beavers: The Innovators and Pioneers

The smallest group is the noisiest: the zealots, proselytizers, salespeople, writers, and service providers. Today, for example, they are ecstatic about 3G wireless network services and Web Services. Everything about these two emerging technologies, by definition, is rather promising.

Most of these people are in software and hardware companies, where their enthusiasm and vision can be an asset. Some large IS departments have an advanced technology group charged with tracking new technologies and determining when and how to begin testing and implementation. In the average corporation, though, eager beavers can be a money drain if they are given the reins to lead the company into new technologies too early.

The recommended approach to eager beavers is to support them with some funding and to learn from them. Perhaps one to three percent of the IS budget is enough for R&D, provided some business objectives are being supported. Let the market shake out the hype before investing much more in their ideas. However, if being at the bleeding edge of technology is a company's business, these folks need to be supported with more money. In other cases, companies take a big risk following these zealots.

Early Adopters: The First Consumers

In the early Internet days, companies could barely constrain early adopters of Internet technology. They were the disciples, not too far behind the innovators. They were pushing to get corporate data on the Web. They probably even had their own homepages. They also bought a lot of BetaMaxs, eight-track tapes, CB radios, and new high-definition DVD players. Today, those excited about wireless doubtlessly have several generations of handheld devices and cell phones and subscribe to at least two wireless services—a 3G one if they can get it. Those into Web Services have already found ways to create some for their business group. They have a lot of discretionary income and tend to think their corporation does too.

Enterprises can miss a market by ignoring these people, but they do need to be managed. They need IS's help and encouragement, but they should not be allowed to overwhelm their department or the company. Use them to generate showpieces, a few early successes, but do not let them run the company's mobile Internet presence or Web Services group because they will exceed any budget. In addition, they may not want to listen to the customer feedback their success might generate. Monitor their performance like a hawk. Make sure they invest their own money in their experiments.

Early Majority: The First Big Wave

The first of the two big consumption waves includes the folks, departments, and companies that say they are willing to use new technologies but that they need some help. They are not the self-sufficient pioneers or the risk takers. They have just bought a Web access handheld or will do so in the near future. They use instant messaging. They are willing to consider doing a Web Services pilot. They may be confused by the terminology and the proliferation of products and services. It may look like chaos to them, so they ask, "Is it worth my time, money, and support costs to go this route?"

These early majority folks tend to be in relatively important positions in the organization, so they can make or break the introduction of a new technology, even more so than top management. The real business impact of a new technology depends on what these early majority folks do with that technology. IS management needs to understand how these users view the company, customers, and competition, and then help them choose a strategy to expand their familiarity with, say, wireless Internet or Web Services offerings at a self-paced rate that can be incorporated into the way their group does business. If a Web Services offering does not help them compete better, it is not worth IS's time or money.

Thus, IS management must become adept at creating options that can be tested for acceptance or rejection. At the same time, IS needs to provide some education and explanations to these folks on the options. What Web Services do their customers want from the company? What kinds of wireless access might customers want? Is instant messaging important? Investments with this group are well placed. Before approaching these folks, IS needs to understand the nontechnical products and services that consume these people's time and attention. Learn about their business.

Late Majority: The Technology Skeptics

Late majority people, departments, and companies are not afraid of a technology, but they do have serious concerns about risks and costs. They are concerned about wasting time and money searching for information on the technologies and the kinds of investments needed to make solid, informed decisions about what it will do for them. Technology skeptics also ask questions about whether the company's customers and suppliers really will benefit from the technology or whether early users are just a bunch of looky-loos out for a free ride.

Late majority companies do not have Web Services on their radar screen. The technology is too new for them to see any benefit from jumping in until it is tested. They are likely to still be deciding whether to implement an ERP system. Even though their employees may not be able to live without cell phones, the company is not thinking about how consumers might want to access their Web site via a phone or handheld. For this group, 3G wireless is not really here, and until it is and proving itself, the late majority will not show an interest.

For these late majority people, IS management needs to be as prepared to address risks and costs as they are to address technology opportunities. IS needs to show an appreciation of bottom-line concerns and answer security questions at the level that late majority people can appreciate. It is not necessary for corporations to allow their online presence to be accessed wirelessly via the Web. IS can point to examples, such as Lands' End and Eddie Bauer, where online information is an adjunct to traditional information delivery methods. Or they can cite Home Depot, which only shows the items stocked in the consumer's chosen nearby store. Web sites can be a sales sampling resource, isolated and independent of the private, internal corporate network. Or it can be a complementary source of advertising or education, providing a richer customer experience for customers, without sacrificing the reputation and the relationship nearby brick-and-mortar stores already have with customers.

Technically Averse: "Not on My Time You Don't."

The people, departments, and companies who resist technology are not currently considering doing anything about wireless access to their Web sites or implementing Web Services. In many cases, their concerns about loss of privacy, security, control, and possible exposure to competition override any perceivable benefits of these technologies.

Two industries that have traditionally been technology averse are real estate and publishing. Real estate has a sunk cost and protected monopoly position over multiple listing books. Publishing has a sunk cost and a protected monopoly position over media and advertising. It is rare, but the breakthrough cases in these two industries generally come from companies capturing niches by going outside the system. In real estate, for instance, a few have set up Web pages that permit wireless access by realtors as they are driving potential home buyers around looking at homes. Although traditional publishing media have begun to offer digitized content that can be downloaded from the Web, they are not thinking about wireless access from handhelds. In general, they do not know how to take advantage of it.

To guide the technically averse, IS first needs to understand their concerns. They have justifiable business fears that need to be identified and addressed before any thought of using a new technology for business purposes can be entertained. The challenge here is education, not applications. These people need the greatest amount of time to assimilate the changes taking place in their lives. Only then can IS help them explore potentials.

The message, then, is for the IS department and other leaders to recognize and acknowledge each cluster's concerns about new technology and then develop a multitiered approach to respond to those diverse concerns.

Increasing Executives' Understanding of IT

Finally, we end this chapter, and this book, as we began it, on the subject of leadership. As we have noted, business value comes from the use of IT, not from the technology itself, and IT use can only be guided by the users in the business. It follows that leadership of IT is no longer a technical challenge; it is a challenge for all business managers. An important action CIOs can take to move their enterprise forward in the e-world is to ensure that the business managers in their enterprise are staying abreast of the changes and new uses of IT; in short, that they understand and are comfortable with IT and its impact and potential value to the business.

Chuck Gibson,[14] a long-time top-level consultant, points out some current reasons why business managers, particularly senior executives, need to understand IT as it is today. For one, although the ranks of IT-literate and IT-savvy senior executives are growing, most still do not have the depth of background in IT that they have in functions such as marketing, finance, HR, or manufacturing. As a result, they may not understand the issues that drive effective use of IT, such as the need to invest in infrastructure ahead of the need.

In addition, most executives are well aware of IT because computers have become so woven into the fabric of business. Therefore, they understand IT's operational importance. However, seeing IT used day in and day out may lull them into seeing IT only as an operational resource. They might not think of IT as a competitive resource, one that can be used innovatively on new business initiatives. Likewise, if the IS organization is only seen as keeping the back office running, business executives may not see the CIO as a potential peer and resource for new business initiatives.

Behind this delayed realization lies an important lesson, itself worthy of executive learning: Although venture capitalists and many entrepreneurs jumped on the Web and its appendage businesses as soon as they became available, most of the rest of us did not. People undergo a gradual learning curve whether they are consumers or employees. Organizational and behavioral change takes time because acquiring new habits takes time. Only at a certain point in the curve does the network effect kick in: The more people who use a technology, the more necessary it becomes for others to use it due to the pressure they receive from the users and their need to be connected for their own benefit. Today, executives endanger their career when they ignore the growing, persistent, but somewhat underground e-commerce movement. During poor economic times, successful companies position themselves to thrive when the good times return. The time for executive learning on this manifestation of IT is now, or even yesterday.

For these reasons, CIOs need to be concerned with the potential gap between what their fellow business executives believe is important about IT versus what they really need to know to effectively guide the use of IT. Executive learning on new ways of doing business using IT and new ways of solving old problems are thus more important than ever in both companies and nonprofit agencies. The technology continues to evolve, and the new information economy is emerging, albeit slower than we thought.

Executives' Leadership Roles

Senior executives need to learn to carry out the following executive roles with respect to guiding the use of IT, notes Gibson.

Set the tone of the enterprise toward technology. One of the most important jobs of executives is to set the tone of the organization toward IT and the IS organization, mainly through their actions. The importance of IT and information must be modeled by executives through their personal use of technology, their e-world knowledge, and their decisions. They may need education in performing this role well.

Envision how IT can serve business strategy. Management must foresee how key business strategies can be enabled by IT. Business executives need to learn how to sense technology trends and discuss alternative scenarios of technological opportunities for their business. The goal is to achieve IT-business strategic thinking among all executives. However, some executives still believe that the IS function is a machine room, the CIO is a technician, and the IS function can stay a step behind business planning. Where these attitudes persist, organizations encounter problems aligning IS projects with business objectives. Understanding the role of the CIO and how to effectively integrate business and IT planning is part of the remedy.

Govern as well as lead. Top executives look at the huge investment in IT resources and systems and the complex array of pervasiveness of IT and often wonder how they should get involved in managing it all. Should the CEO head the IT investment committee or delegate that role? Should divisions set their own IT strategy or should it be centralized? These kinds of questions require executives to understand IT governance as well as IT management decisions. As research[15a,b] suggests, vital roles for top executives and board of directors are setting the right governance structure for IT as well as making particular situations part of IT decision making and planning.

Use IT to promote business change. The emergence of e-business has exacerbated this leadership need. For one, change is occurring faster. Executives need to understand that implementation of a powerful package, such as ERP or creation of a transactional Web site, cannot bring about major business change on its own. But it can be a powerful catalyst and tool for top management to foster business change.

The IS department cannot be the single driver of organizational change. Both top and line management must be the drivers. Line executives, in particular, are the real implementers of business change. This issue goes back many years yet it is still with us. Time after time it has been shown that when line management does not lead a change, it does not stick. They need to learn how to implement IT-enabled change.

Assess costs and benefits. This subject continues to be relevant because continuing tension characterizes the relationship between strategic objectives and the need to invest in IT infrastructure before people realize they need it. IS organizations must be ahead of requests for applications and have data available for unanticipated user needs. Business executives need to learn to use appropriate cost-benefit criteria to assess IT projects and understand the need to invest in IT infrastructure, even though it may have no easily measurable, near-term quantitative returns.

Current, Long-standing, and Upcoming IT Issues

Inspired by Gibson's work, we present below a number of IT issues that managers should focus on in the immediate future.

The impact of new regulations and market forces. This is a current issue with a potentially huge impact. For example, U.S. government agencies are being required to become paperless. The U.S. pharmaceutical industry faces deadlines for creating a paperless trail of test results and patient experiences with new drugs because the U.S. Food and Drug Administration is exercising its statutory mandate to be able to track experiments and batches of medicines the minute a serious adverse reaction is uncovered. Privacy legislation is also likely to affect companies and might even fly in the face of the database consolidations so many companies are undertaking. To properly invest in IT, top and line management need to understand the regulations and their ramifications for their business. Interestingly, market forces play a more dramatic role in driving businesses to adopt IT. Cross-border supply-chain management is an example of such a market trend forcing small and medium enterprises to move to EDI and Web-based computing.

Project management. Business executives in the class want to know how to identify, initiate, and get involved in IT projects. They want to understand what the IS organization is doing and particularly how they can manage their part of projects—the implementation that requires business changes. A trade-off needs to be made, though. Involving businesspeople in systems projects elongates the projects, and the two parties need to work out a common language for talking about systems, architecture, change management, and infrastructure. The benefit, of course, is that successful implementation is much more likely when business people are involved from the outset.

Measuring the value of IT. Executives want to use familiar metrics such as ROI to justify projects. However, some business executives need education in this area. They become so focused on garnering value for cost that they do not realize they should be using a portfolio approach, recognizing that some kinds of IT investments require different kinds of metrics.

Basically, not all IT investments have comparable returns. Whereas some can be justified on savings (displacing labor), others can only be justified based on judgment (such as an executive dashboard). Still others can only be justified on indirect and future, hard-to-foresee returns (such as infrastructure).

Change management. This is a second long-standing issue because a number of companies really did not manage the business change required of ERP correctly. They do not want to undergo a similar disaster in implementing CRM. So at the MIT class, they want to know how to manage IT-induced change properly.

Organization and control of the IS organization. This is a third long-standing issue. Currently, executives are grappling with balancing local needs with the need for standardization across the company. The other organizational issue over the past few years has been how to organize for e-commerce. Recent research on organizing for e-business by George Westerman,[15c] a research scientist at MIT, has shown that companies that wove in e-business organizationally have had greater long-term success that those that established and stuck to a separate e-business entity.

Cross-organizational e-processes. These processes, such as those that underlie e-business and supply-chain management, are an area where we are on the verge of breaking through, speculates Gibson. The curve is now taking off. Some leading-edge companies are now truly taking advantage of their consolidation of customer information (given privacy restrictions) to provide the same look and feel to their customers through their numerous channels.

Means for Executive Learning

There are numerous ways business executives can learn how to guide the use of IT:

Learn by doing. One of the cases presented in MIT's IT for the Non-IT Executive program is the case of Dow Corning. It illustrates learning by doing. When Dow Corning implemented ERP in 1995, the CIO was replaced with an experienced vice president who had spent his entire career in the company and was a well-respected business executive. He was given responsibility for IT and for the ERP project. He learned a lot about IT quickly; so did Dow Corning's executive team. They implemented SAP across the company in a few years' time and did so very successfully, even though it was hard on the people.

Learn by governing. An important learning forum for top business executives is steering committees and teams that include the CIO. Gibson notes that a CIO at Vanguard made his way to the executive suite in this way. Vanguard has huge investments in technology, and the Vanguard executive committee discussed major investment and technology issues as a regular part of its business. Being part of governance teams leads to executive learning.

Learn via educational programs. Despite the pressures of business today, executives are currently making time for formal training programs in IT. For example, CEOs, CIOs, heads of divisions, and other levels of managers are attending MIT's and other universities' executive education programs. "They come, in part, to get away from the pressures of their job and to engage in serious discussion. It's like a 2-day sabbatical to them. And because enrollment is open, they get to hear what's happening in other organizations—both profit and nonprofit," says Gibson.

CONCLUSION

What stands out in the discussions of organizing principles and the networked world at the beginning of this chapter is the repeated emphasis on naturally forming and evolving relationships. The focus is on people-to-people contact rather than technology; technology is the underpinning. The principles refer to natural phenomena rather than human-made structures. They dwell on how to develop relationships that help people work effectively.

We are, indeed, in a business revolution. With it, the use of IT is changing in kind. It has shifted from amplifying thinking and processing to amplifying communicating and connecting. It is now much more about relationships than transactions (which happen in the background and are, indeed, becoming increasingly sophisticated). Now that this shift has been made, IT becomes about business and needs to be the responsibility of the business folks, not the technology folks.

IT professionals have always been enamored with the technical aspects of computer technologies; the human side has been of less interest and far too complex for many. However, it is people who make or break a system through their use or disuse of it. So even though the Internet-based economy relies heavily on IT, relationships and such mechanisms as Communities of Practices (CoPs) play a major role. IT now allows such relationships to transcend time and space, and with the appearance of instant messaging, people can stay in on-demand contact. With cost-justifiable anywhere, any time video, people are able to communicate in richer ways across greater distances. In so doing, the foundations of past ways of working change. That is the exciting exploration that is going on right now as people grapple with creating the new work environment and the challenges it presents.

The aim of this book is to advocate for a proactive, forward-looking approach to managing information technology for business. Opportunities and challenges, such as the "hot issues" alluded to at the beginning of this chapter, may come and go, but the information economy is here to stay. And it is the responsibilities of managers to guide their organizations through the next wave of information revolution.

QUESTIONS AND EXERCISES

Review Questions

1. According to Hammer, how does a process-centered organization differ from a task-centered one?
2. According to Brown and Solomon Gray, why are communities the building blocks of knowledge-based companies?
3. What has National Semiconductor done to encourage CoPs?
4. According to Gage, how does he really know about the hot work being performed at Sun?

5. According to Kelly, what were the three rules given to the computer-generated bats in *Batman Returns*? What was the effect of these rules?
6. What is Capital One's core competency? Describe how it is used.
7. Give two examples of how a market has been used internally within a company, according to Malone.
8. What are the four mind-sets of the Internet?
9. Explain the four places where Sawhney and Parikh find value in a network.
10. What are the three distinguishing characteristics of the e-economy, according to Kelly?
11. Why should companies invest in making their customers smart, according to Kelly?
12. Briefly describe the five groups in the technology camel.
13. List the roles executives need to play in managing the use of IT.
14. List all the business opportunities or the business values that are created by the network economy.

Discussion Questions

1. Giving employees and small work groups the authority to make most of their own decisions seems to be of obvious benefit to companies. Why do you think this type of on-the-job self-management is not more prevalent? What are its drawbacks?
2. Kelly, Wheatley, and Kellner-Rogers talk about self-organizing systems. These ideas will not work in organizations because enterprises need defined structure, defined jobs, and limits. Do you agree or disagree? Describe your reasoning.
3. Executives over age 50 really do not "get it." They just do not understand or appreciate the Internet. They have the wrong mind-set, and they cannot be educated to have the right mind-set. Companies need younger executives to provide the Internet-savvy leadership to thrive in the e-world. Present arguments for and against these ideas.

Exercises

1. Read several articles or scan several books on how IT is changing organizations and work. What management issues do these articles/books present with respect to work redesign? What potential roadblocks do they discuss?
2. Visit a local company and talk to an IS executive about how the company combines use of the Web with physical locations and the effect this combination has had on their organization's work environment. Ask for one or two examples of new ways of working. Ask the CIO's opinions on self-organizing work groups.
3. Describe the work environment you would like to work in. Present it to the class. Describe how you might reach your goal.

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Glossary

3G Mobile Communications Third-generation wireless communication systems with high transmission capacity up to 2 Mbits/sec) allowing fast Internet browsing, video conferencing, and a host of new applications on mobile appliances.

3G Teams Teams of three generations (25+, 35+, 45+) that work together.

Action Labs An approach to planning where frontline employees identify and interactively refine local-level strategies by having to get them funded at action lab meetings with top management.

Advanced Technology Group A group within the IS department that is responsible for spotting and evaluating new technologies, often by conducting a pilot project.

Agent An electronic entity that performs tasks, either on its own or at the request of a person or a computer.

Aggregation Combining formerly separate pieces of infrastructure, providing companies with an e-business infrastructure on very short notice.

Analog Technology Signals sent as sine waves rather than ones and zeros (as in digital technology).

Applets Small, single-function applications, often written in Java, that are pulled from the Internet when needed.

Application Program Interface (API) An interface created for a software product that, like a standard, allows programmers to write to, link to, and utilize that software's interface in their applications.

Application Service Provider (ASP) A company that rents out software over the Internet.

Architecture A blueprint that shows how a system, house, vehicle, or product will look and how the parts interrelate.

Artificial Intelligence (AI) A group of technologies that attempts to mimic our senses and emulate certain aspects of human behavior, such as reasoning and communicating.

Authentication Assuring that the digital signature of the user is valid; biometric authentication is become increasing popular.

Authorization Assuring that the correct user is accessing a network, application, or stored files or documents.

BASIC (Beginners' All-Purpose Symbolic Instruction Code) An early programming language that makes micro-computers popular as an instructional device. Microsoft successfully prolonged BASIC with its Windows-based Visual BASIC.

Backbone Systems Mainline corporate transaction processing systems.

Back-end Systems Computer systems that handle an enterprise's operational processing, as opposed to front-end systems that interact with users.

Back-end Tools Tools, such as code generators, in computer-aided software engineering suites that automatically generate source code.

Best-of-Breed Outsourcing Outsourcing specific functions, each to the most appropriate provider, rather than outsourcing all functions to one provider who may not be the best for all the functions.

Blade Server A server chassis that houses multiple thin, modular electronic circuit boards known as server blades designed to deliver high processing power with little physical space, little cabling, and less power consumption; a blade server is dedicated to a single application.

Blogs Self-published journals posted electronically on the Web.

Bricks-and-Clicks Companies with a dual physical and Internet presence, becoming a hybrid of brick-and-mortar firms and dot-coms.

Broadband In telecommunications, refers to a wide band of frequencies to transmit information concurrently on many frequencies.

Bull-Whip Effect Where a small change by a customer results in a huge change upstream. For instance, a customer order triggers a company to generate an order to its supplier, who, in turn, generates its own larger order to its suppliers, and so on; moving upstream through the supply chain increases greater variance from the original order. If the customer then cancels the order, that cancellation ripples through the supply chain.

Business Continuity Involves not only disaster recovery (recovering data and programs from back-up and instituting communication links, for example) but also having back-up work procedures and office space for displaced employees to work with telephone lines and computers so that the business can continue operating.

Business Process Outsourcing (BPO) Outsourcing all or most of a reengineered process that has a large IT component.

Business Process Redesign/Reengineering (BPR) Significantly restructuring the operational business processes in a firm.

Business Intelligence An umbrella term used to describe a broad set of applications and technologies for gathering, storing, integrating, and analyzing data to help decision makers make decisions; typical applications include query and reporting, online analytical process (OLAP), Decision Support Systems (DSSs), and data mining.

Business Visionary One of the CIO's roles where the CIO will need to believe, and then convince others, that the Internet will lead to new business models. This makes the CIO's role a main driver of strategy.

Case-Based Reasoning (CBR) Expert systems that draw inferences by comparing a current problem (or case) to hundreds or thousands of similar past cases. CBR is best used when the situation involves too many nuances and variations to be generalized into rules.

CDMA (Code Division Multiple Access) A popular communication/network protocol that allows fast and parallel data transmission. CDMA has a number of variations; in particular, DS-CDMA (Direct Sequence CDMA) is an emerging technology for wireless communications systems that includes error-correction and error-detection, smart antenna management, and power control algorithms.

Champion A person inside or outside IS who has a vision and gets it implemented by obtaining the funding, pushing the project over hurdles, putting his or her reputation on the line, and taking on the risk of the project.

Change Management The process of assisting people to make major changes in their work and working environment.

Chaos Theory As applied to business, a theory that states that "order is free" when groups and organizations are allowed to be self-organizing because, as in scientific chaos theory, randomness (chaos) works within boundaries, which are called strange attractors. As a result, there is order in chaos.

Circuit Switching When a virtual (temporary) circuit is created between caller and receiver and that circuit is theirs alone to use; no other parties can share it during the duration of their telephone call. Most appropriate for voice calls.

Cleansed Data Data processed to make them usable for decision support; referred to in conjunction with data warehouses. Opposite is dirty data (data from different databases that do not match, have different names, use different time frames etc.).

Cleartext Nonencrypted versions of passwords and messages.

Clickwrap Contract A contract not really bargained over in any way, but presented as a take-it-or-leave-it offer. Generally speaking, these contracts are legally enforceable. The use of the term "clickwrap contract" is an extension to the "shrinkwrap licenses" used in purchased software.

Client-Server Splitting the computing workload between the "client," which is a computer used by the user and can sit on the desktop or be carried around, and the "server," which houses the sharable resources.

Closed Network A network that is offered by one supplier and to which only the products of that supplier can be attached.

Collaborative Outsourcing Where one service provider becomes the prime contractor for numerous facets of an operation, but some of the work is provided by other external service providers (ESPs).

Communities of Practice (CoPs) Networks of people who work together in an unofficial way to get work accomplished using unofficial procedures that may be outside the company's formal corporate culture.

Competitive Local Exchange Carriers (CLECs) Telecom carriers that compete with incumbent local exchange carriers (ILECS) and provide new kinds of connection options to businesses and homes, such as cable modems, optical fiber, wireless, and satellite.

Connectivity Allowing users to communicate up, down, across, and out of an organization via a network.

Content Refers to information presented electronically in a variety of media: charts, text, voice, sound, graphics, animation, photographs, diagrams, and video.

Cookie A file in a Web user's computer that identifies the user to Web sites.

Cooperative Processing Computer systems that cooperate with each other to perform a task. The systems may span internal business functions or even span enterprises.

Copyright A law that aims to protect an expression in a tangible form; a copyright protects the expression, not the idea.

Corporate Memory The knowledge or information accumulated by a business, which is often stored in its software, databases, patents, and business processes.

Corporate Portal An intranet where employees, customers, and suppliers gain access to a company's information, applications, and processes. This approach moves the software from being decentralized (on PCs) to being centralized (on a server).

Countermeasures Mechanisms used by people and enterprises to protect themselves from security breaches, such as stealing data or machines, destroying files, redirecting traffic, shutting down Web sites, and unleashing computer viruses.

Critical Success Factors (CSF) The few key areas of an executive's job where things must go right in order for the organization to flourish.

Customer Capital The strength of a company's franchise with its customers and its relationships and networks of associates. This form of capital may be either human (relationships with the company) or structural (products used from the company).

Customer Relationship Management (CRM) Computer systems used to know much more about customers (and perhaps noncustomers). They are used to manage a firm's relationships with its customers; hence the name.

Cyberspace A "space" on the Internet where people "exist" in a virtual world.

Cybersquatting The act of registering domain names that clearly referred to known companies, anticipating that those companies would eventually want the domain name and would be willing to pay for it.

Cycle Time The amount of time it takes to accomplish a complete cycle, such as the time from getting an idea to turning it into a product or service.

Data Electronic information that is comprised of facts (devoid of meaning or context).

Data Dictionary The main tool by which data administrators control a company's standard data definitions, to make sure that corporate policy is being followed.

Data Integrity Data that maintain their integrity because they cannot be modified in transit or in storage.

Data Mart A subset of a data warehouse created for a specific set of users, such as the marketing department.

Data Mining Having computers explore huge repositories of data to uncover unknown patterns, trends, or anomalies.

Data Model A generalized, user-defined view of how data represent the real world. Data modeling is the analysis of data objects that are used in a business applications and the identification of the relationships among these data.

Data Warehouse A huge repository of historical data used to answer queries and uncover trends; contains a snapshot of data at a point in time as opposed to operational databases that are updated with every new transaction.

Database Repository of data stored in a particular manner, such as a hierarchy or tables.

DDM Paradigm A part of the architecture of a DSS: the dialog (D) between the user and the system, the data (D) that support the system, and the models (M) that provide the analysis capabilities.

Decision Support Systems (DSSs) Computer applications used to support decision making.

Demand-Pull In this business model, companies offer customers the components of a service or product, and the customers create their own personalized versions, creating the demand that pulls the specific product or service they want through the supply chain; opposite is supply-push.

Denial-of-Service Attack Attack on a Web site from many coordinated computers that floods the site with so many empty messages that the site is overwhelmed and crashes and is therefore unable to process legitimate queries.

Digital Subscriber Line (DSL) A telephone subscription service that provides speed up to 1.2 Mbps (106 bits per second) over copper wire, as compared to modems' speed of 56 Kbps.

Disruptive Technology A new, low-cost, often simpler invention that displaces an existing product or service, and eventually transforms the entire market or industry.

Distributed System A computer system that has components physically distributed around a company or among companies.

Document A unit of recorded information structured for human consumption. This definition accommodates "documents" dating back to cuneiform inscriptions on clay tablets—what has changed are the ways information is represented and the ways documents are processed.

Dot-coms Businesses based primarily or exclusively on the Web, and hence merging IS and business. The dot-com crash refers to the stock market slump in 2000–2002 of many of these start-up companies. They failed to live up to expectations, the value of their stock fell to zero, and the companies folded. Internet-only dot-com competitors have now become more reality based, and the integration of the Internet into how companies work has proceeded.

Dribbling Data Obtaining data for a new application from data in an existing application.

Dumb Terminals Desktop machines without local processing or storage capabilities.

Eavesdropping Intercepting messages on a computer network.

E-Business Outsourcing Outsourcing e-commerce and e-business aspects of one's company, such as Web-site hosting, application hosting, telecom management, and so forth.

E-Commerce Buying and selling electronically, as in handling commerce transactions.

Ecosystem A web of relationships surrounding one or a few companies.

Edge Server Distributed databases on the edge of the Internet (close to a set of users), holding a copy of an organization's Web site.

E-Enablement Integrating use of the Internet into how companies work; building e-enabled relationships with consumers and other enterprises, not simply performing transactions electronically.

Electronic Channel An electronic link used to create, distribute, and present information and knowledge as part of a product or service or as an ancillary good.

Electronic Data Interchange (EDI) Business transactions, such as orders, that cross company boundaries via a network using carefully defined protocols and data formats.

Electronic Tender An electronic communication capability in a product or service that allows that product or service to be tended; that is, cared for, attended to, or kept track of by a remote computer.

Electronic Vaulting An off-site data storage facility used by organizations for backing up data against loss in case of a disaster.

Encapsulation Combining data and procedures in an object.

Encryption Coding and decoding documents for security.

End-User Computing Encompasses software development techniques that embrace the users in the design (Human Computer Interface, user-driven modeling.)

End Users Refers to a group of people who ultimately uses the systems; also known as target or expected users

Enterprise Nervous System The technical means to a real-time enterprise; a network that connects people, applications, and devices.

Enterprise Resource Planning Systems (ERPs) Systems that aim to provide companies with a single source of data about their operations. The systems have financial, manufacturing, HR, and other modules.

E-Procurement Buying items via the Web using company-tailored electronic catalogs of items for which the company has negotiated prices with the seller; e-procurement generally uses a third-party marketplace to handle the coordination between buyer and seller.

E-tailing Retailing over the Web.

Ethernet A network protocol used in many local area networks that broadcasts messages across the network and rebroadcasts if a collision of messages occurs.

Exchanges Business-to-business electronic marketplaces where many buyers purchase goods from many sellers. These are generally organized by industry or by specialties within an industry.

Executive Dashboard A type of executive information system that allows executives access to a company's data warehouse (via a display screen that resembles a car dashboard), allowing real-time analysis of how well a division, region, or other part of the business is progressing on meeting its forecasts.

Executive Information System (EIS) A computer system specially built for executives to assist them in making decisions.

Expert Systems An automated type of analysis or problem-solving model that deals with a problem the way an "expert" does. The process involves consulting a base of knowledge or expertise to reason out an answer based on the characteristics of the problem. A popular form of reasoning is to use "If... then" rules.

Explicit Knowledge Knowledge that has been articulated, codified, and made public.

Extended Enterprise All of one's own organization plus those organizations with which one interacts, such as suppliers, buyers, and government agencies; interconnected single-organization networks that are not limited by industry and provide a type of electronic information consortium.

External Document-Based Information Electronic information that is available outside an organization and is text based, rather than numeric.

External Operational Measures Measures of computer operational performance that users can see, such as system and network uptime (or downtime), response time, turnaround time, and program failures. These directly relate to customer satisfaction.

External Record-Based Information Electronic information that is available outside an organization and is numeric, rather than text based.

External Service Provider (ESP) A company that provides services to a firm, often acting as an outsourcer. There are numerous types of ESPs, such as those that provide Web-site hosting, backup and recovery, and application hosting.

Extract File A file extracted from a company's transaction database and placed in a decision support database or a data warehouse where it can be queried by end users.

Extranet A private network that uses Internet protocols and the public telecommunications system to securely share part of a business's information or operations with suppliers, vendors, partners, customers, or other businesses. An extranet is created by extending the company's intranet to users outside the company.

E-zines Web pages owned by frustrated writers who publish their own electronic magazines.

Federated Databases A way of organizing databases where each retains its autonomy, where its data are defined independently of the other databases, and where its database-management system takes care of itself while retaining rules for others to access its data.

Feeding the Web Promoting the platform on which a firm bases its offerings because the firm's prosperity is linked to the platform's prosperity.

Fiber Optics/Optics Glass fiber that transmits voice or data signals via light pulses.

Filtering Using a software program (a filter) to automatically route messages or documents according to their content.

Firewall Software on Internet servers (or entire servers) that keeps the public from accessing the company's intranet.

Fourth-Generation Language (4GLs) A computer programming language used by end users, as opposed to COBOL (a third-generation language), or Assembler (a second-generation language), or programming via plug boards (first-generation programming).

Freeware Software given away for free, generally via the Internet but also on CD-ROMs.

Front-end Intelligence An interface for interacting with the user, most useful when it is decentralized, flexible, personalized, and sensitive to context.

Front-end Tools Tools in a computer-aided software engineering suite that are used by analysts and designers to create the design of a computer system.

Gateway A data network connection that connects unlike networks.

Glocalizing Striking a balance between global and local needs.

Groupware Electronic tools that support teams of collaborators.

Hacking/Cracking The unauthorized access to a host computer. This access may be a direct intrusion or via a computer virus or Trojan horse.

Heuristics Rules that draw upon experience, common sense, ways of doing business, and even rules and regulations.

Homepage A person's or organization's base page on the World Wide Web.

Hubs One of three types of computers that route traffic, these forward packets of data from one machine to another. When a number of computers share a hub, data sent from one goes to all the others.

Human Capital Knowledge, skills, and innovativeness of employees as well as company values, culture, and philosophy.

Hypertext A style of presenting text in computer systems or networks where the reader can click on a highlighted word and jump to a related thought or site.

Hypertext Markup Language (HTML) The language multimedia Web pages are formatted in that uses the same technique to link graphical items on the World Wide Web.

Incumbent Local Exchange Carriers (ILECs) Formerly called Regional Bell Operating Companies (RBOCs), telecom companies spun off from AT&T in 1984.

Inference Engine A portion of an expert system's software that contains the reasoning methods used to search the knowledge base and solve the problem.

Information Data in context, which means the data have been given an explicit meaning in a specific context.

Information Age Though defined a multitude of ways, this book refers to the information age as when the number of U.S. information workers surpassed the number of U.S. workers in all other sectors combined (information workers exceeded 50 percent of the U.S. workforce).

Information Architecture A blueprint of definitions of corporate data—such as customers, products, and business transactions—that is used consistently across the firm's applications.

Information Repository The heart of a computer-aided software engineering (CASE) system that stores and organizes all information needed to create, modify, and develop a software system.

Information Resources The intangible information assets of a firm, including data, information, knowledge, processes, patents, and so on.

Infrastructure The implementation of an architecture, including in hardware, software, databases, electronic links, and data centers as well as the standards that ensure the components work together, the skills for managing the operation, and even some of the electronic processes themselves.

Insourcing Moving responsibility for specific services to a group within the company rather than to an external service provider. Commonly the insourcer is the shared services group.

Institutional DSS A decision support system built by DSS professionals using a DSS language that is intended to be used for the long term to support the organization's operations rather than to support an individual or small group for a short time.

Intellectual Capital A preferred term for knowledge, to distinguish it from the other kinds of capital that firms possess.

Inter-Exchange Carriers (IXCs) Long-distance telecom carriers.

Internal Document-Based Information Information that is available in-house and is text based, such as internal reports, memos, and so forth.

Internal Operational Measures Metrics of the performance of a firm's IT operations that are of interest to its computer operations staff, such as computer usage as a percentage of capacity, availability of mainline systems, disk storage utilized, job queue length, number of jobs run, number of jobs rerun due to problems, age of applications, and number of unresolved problems.

Internal Record-Based Information Information that is available in-house and is alphanumeric rather than textual.

Internet Service Providers (ISPs) Companies that offer Internet connectivity to homes and businesses; many bundle services such as e-mail, Web hosting, etc.

Interoperate Different products working together, driven by the open systems movement.

Inter-organizational Systems (IOS) Systems that require at least two parties with different objectives to collaborate on the development and operation of a joint computer-based system.

Intranet An internal company network that takes advantage of the Internet's infrastructure, telecommunications protocols, and browsers.

IT Alignment or Business-IT Alignment An effort to establish a correspondence between the organization's business mission and objectives to the IT architecture and infrastructure.

IT Governance The assignment of decision rights and the accountability framework to encourage desirable behavior in the use of IT. Governance differs from management in that governance is about deciding who makes decisions, while management is about making decisions once decision rights have been assigned.

Keiretsu Japanese term referring to the associations of independent and interdependent businesses working in concert.

Knowledge Information with direction or intent derived from strategies or objectives.

Knowledge-Based Economy An economy relies primarily on the production of values driven by the creation of knowledge.

Knowledge Brokers A way to promote knowledge sharing by giving titles to employees who excel at knowledge sharing.

Knowledge Infrastructure A support system that manages information, enables understanding, and supports learning.

Knowledge Management A set of methods and tools that can be used to discover, create, integrate, store, represent, and distribute knowledge for achieving a particular objective.

Knowware Advanced groupware information technology that helps people and organizations share knowledge.

Learning Organization Ability of an organization to remain flexible, aspiring, adaptive, creative, and productive in a fast-changing environment.

Legacy Systems Mainframe computer applications that handle the day-to-day transactions of the company in a centralized, rather than distributed, manner. Alternatively, any system that does not use current technology.

Line Executive A business executive who manages a profit-oriented business unit, such as manufacturing, rather than a supporting staff unit, such as finance.

Linkage Analysis Planning A planning approach that studies the links between an organization and its suppliers and customers.

Local Area Network (LAN) A network that traverses a floor of a building, a work group, or a department (as opposed to a wide area network that crosses countries).

Local Exchange Carrier (LEC) Telecom companies that only handle local, not long distance, telephone calls.

Loosely/Tightly Coupled Groups Loosely coupled groups are where the activity of each member is relatively independent of the other members (such as salespeople who have their own sales territories). Tightly coupled groups are where the work of each member is tied closely to the work of the other members.

Mainframe A huge, very fast computer capable of handling all the computing for a large organization.

Marketspace A nonphysical marketplace where information substitutes for physical products and physical location.

M-Commerce or Mobile Commerce Conducting commerce via small wireless devices, such as buying an item from a vending machine using a cell phone or personal digital assistant (PDA).

Mead's Law Says that N transistors on a sliver of silicon yield N^2 performance and value.

Metadata Information about a data entity, such as its definition, how it was calculated, its source, when it is updated, who is responsible for it, and so forth.

Middleware Software that eases connection between clients and servers in a client-server system.

Mid-Tier Servers A network topology that has several tiers of servers, such as local work group servers, departmental servers, and an enterprise server (the corporate mainframe).

Moore's Law Computer processing power will double every 18 months. This law, stated by Gordon Moore, a founder of Intel, has proven true since 1959.

Multidimensional Database (MDDBMS) Uses the concept of a data cube to represent multiple dimensions of data to users.

Multimedia The combination of text, graphics, sound, data, animation, and perhaps video in a message, a document, or at a Web site.

Network Army A set of individuals and communities aligned by a cause. They have moral and intellectual influencers as opposed to formal leadership, and are only as permanent as their common agenda. Their communications are open, in forums that anyone can join.

Network Effect When the value of a product or service offered on a platform (such as a gaming platform or an operating system) increases as the number of users increases, thereby creating a "virtuous" circle of upward spiraling product value and customers. The opposite is a downward spiraling "vicious" circle where a product continually loses its value and its customers.

Neural Networks A way to store knowledge and a type of decision-making system organized like the human brain, containing synapses and nodes that fire signals between each other. Neural networks are more intelligent than the other forms of knowledge representation discussed here because they can learn.

Nonrepudiation Not allowing a party in an electronic transaction to repudiate, which means claiming that the transaction never took place; nonrepudiation is an important cornerstone of electronic security.

Object In object-oriented programming, functions are packaged with data so that the two can be reused. These reusable components are called "classes," whereas at run time, each class can produce instances called "objects." Objects hold all the code and data in an object-oriented system.

Object-Oriented Programming A style of programming that encapsulates data and the operations that work on that data within an object, thus increasing the reusability of the code (as an object) and reducing the propagation of errors among objects.

Object-to-Object Communication The potential for objects such as smart tags to talk to one another.

OLAP (Online Analytical Processing) Computer applications that allow users to extract and view data from different points of view in real time.

Open Network or Open System Though the term "open" keeps expanding, this book refers to open networks/systems as those based on national or international standards so that the products of many manufacturers work with each other.

Open Source Software where the complete source code is distributed with any and all distributions, and where anyone can modify and redistribute the code.

Open/Closed Groups Open groups are where almost anyone can join. Closed groups are where membership is restricted. A "gray scale" between open and closed indicates the degree of difficulty to gain membership.

Outsourcing Contracting with another firm to perform work that had previously been performed in-house, generally requiring a multi-year contract and generally for "noncore" work.

Packet Switching Messages divided into packets, each with an address header, and each is sent separately—each packet may take a different path through the network.

Partnering Allying with another organization that has different core competencies, often on a strategic alliance basis, for mutual benefit.

Patent A law that aims to protect inventions (things or processes for producing things) but not abstract ideas or natural laws.

Peer-to-Peer (P2P) Computing distributing a task over a wide number of computers (peers) connected to the Internet.

Personal Area Network (PAN) A network that allows computers in a "personal area" to communicate wirelessly, much like Wi-Fi.

Personal Digital Assistants (PDAs) Handheld computers that sometimes allow wireless connection to the Internet and contain personal productivity tools (such as calendaring, address book, to-do lists, and games).

Personalization Coordinating disparate pieces of intelligence to form personalized offerings.

Phishing A type of fraudulent e-mail or instant messaging designed to trick someone into giving out confidential information.

Planning Developing a view of the future that guides decision making today.

Platform A major trend in inter-organizational systems that provides the infrastructure for the operation of a business ecosystem, a region, or an industry. Examples are American Airlines' SABRE computer reservation system, or the video game industry's PlayStation, Nintendo, and Xbox platforms.

Privacy Includes the freedom from intrusion, the right to be left alone, the right to control information about oneself, and freedom from surveillance.

Private Programs Computer programs created and used by only one person.

Process Owner A person in an organization responsible for an end-to-end process such as the ordering process or a research and development process.

Process-Centered Organization A company whose perspective has shifted from tasks to processes; an approach to designing an organization where the business processes are the driving structures.

Proprietary Software Software sold only in its compiled state, undecipherable by humans, and whose code is not allowed to be changed except by the developer.

Prototype A computer program that is used to test a new computing concept or application idea, such as distributed Java applets, for learning and experimentation purposes.

Public Key Encryption A methodology for encrypting and decrypting text to ensure identity of the parties. A message sender uses the assigned private key to encrypt the message and the recipient uses the sender's public key (known to anyone) to decrypt it, thus validating the sender's identity. The process also works in reverse; sending a message encrypted using a person's public key that can only be decrypted and read by that person using their private key.

Quality Assurance (QA) A systematic process to ensure that all activities of a project are carried out with quality.

Quality of Service Refers to the ability of a network to provide a range of assured levels of performance.

Quick Hit DSS A system that is quite limited in scope, is developed and put into use quickly, and helps a manager come to a decision. The term "ad hoc" has also been used to distinguish from institutional DSS, although some quick hit systems become regularly used.

Radio Frequency Identification (RFID) A short distance automatic identification method, commonly used for inventory tracking and management.

Rationalized Data Using the same data name for all uses of the same data.

Real-Time Enterprise Where organizations can know how they are doing at the moment, rather than have to wait days, weeks, or months for analyzable data.

Reengineering Not to be confused with the term "business process reengineering," this term, "system or application reengineering," is much narrower and refers to rebuilding software for a new platform or new programming language.

Regional Bell Operating Company A regional telephone company formed by the 1984 deregulation of AT&T. Formerly, these companies were part of AT&T.

Relational Databases Databases that store data in a set of formally designed tables in such a way that allow data be accessed or reassembled in many different ways, using a query language known as Structured Query Language (SQL).

Relationship Tech New peer-to-peer relationships that are forming—between customer and firm, between customer and customer—which question past ways of working (such as recommender systems).

Repudiation Refusing a computer-based transaction, such as when one party reneges on an agreement after the fact, the other party may be left paying for the transaction processing unless it is repudiated.

Routers One of three types of computers that route network traffic, these use a routing table to pass along a packet to the next appropriate router on a network, directing packets via the most efficient route and relaying packets around a failed network component. Routers also link network segments that use different protocols, and can connect to wide area networks (WANs).

Rules-Based Systems A common way to store knowledge in an expert system knowledge base, where rules are obtained from experts drawing on their own expertise. Rules generally present this knowledge in the form of if-then statements, and are appropriate when knowledge can be generalized into such specific statements.

Rummler-Brache Approach An approach for deciding how to reengineer an organization using "swim lane diagrams" to plot, trace, and assess an organization's processes and their interactions; the idea is to enhance communications and collaboration across departments and teams.

Scan-Based Trading (SBT) An arrangement between a retail store and product supplier whereby the scan data from point-of-sale checkout systems for products sold determines the amount the retailer pays the supplier.

Scenario A way to manage planning assumptions by creating a speculation of what the future might be like by drawing on trends, events, environmental factors, and the relationships among them.

Scope Creep Users asking for additional functions in applications as development proceeded.

Secure Sockets Layer (SSL) A protocol for providing security over the Internet.

Security Accountability Ability to trace to the cause of the security breach and deploy appropriate actions to include nonrepudiation, deterrence, fault isolation, intrusion detection and prevention, and after-action recovery and legal action.

Security Assurance Security goals are adequately met.

Security Confidentiality Security goal that seeks to protect from intentional or accidental attempts to perform unauthorized data reads during processing, transport, and storage.

Security Integrity Security goal that seeks to ensure data integrity (i.e., data are not altered in an unauthorized manner) or system integrity (i.e., the system functions as designed in an unimpaired manner and protected from unauthorized manipulation).

Self-Managed Work Groups Groups or teams that handle most supervisory tasks on their own, without a supervisor.

Self-Organizing Systems Entities, such as ecosystems, organisms, or organizations, that deal with their environment by responding to each stimulus in an appropriate manner, rather than in a predetermined manner, so they self-organize when needed.

Sense-and-Respond Strategy Making An approach to strategy making that endorses keeping in close contact with the business world, continually sensing for important changes, and then responding quickly to changes by conducting experiments that test different possible futures—as opposed to betting on one strategy for the future.

Service-Oriented Architecture (SOA) A generic software architecture aiming to achieve loose coupling among interacting and autonomous software agents.

Shared Services A department or division formed by consolidating and centralizing services formerly operated by business units. These services can include legal, travel, finance, IT, food service, fleet management, accounting, telecom, and others. It is a form of insourcing; business units draw on the expertise in shared services when needed.

Short Message Service An "always on" telecom service for communicating quickly and wirelessly using a small, handheld device; the messages are typed using a shorthand, code words, abbreviations, or short phrases.

Smart Tags Communicating objects with a small chip that contains information and a radio frequency identification device (RFID). They can carry far more information than bar codes because they carry the history of an item.

Sniffing The interception and reading of electronic messages as they travel over the communication networks. Usually for attempting to unveil passwords to gain access to a system.

Social Network A self-organized social structure made of nodes or actors (e.g., people, organizations, communities) and tied by one or more well-identified social needs (e.g., values, visions, friendships, trade).

Software Agent A self-contained, autonomous, and typically interactive program that acts with some (limited) intelligence. For example, a software agent could be created to deal with real-time auctioning.

Simple Object Access Protocol (SOAP) A simple XML-based protocol to let application exchange information across different computer platforms, operating systems, or programming languages.

Spaghetti Code The way code in many legacy systems appears to a programmer because it has been patched so many times that the logic of the application weaves in and out like a plate of spaghetti, making it difficult to understand and maintain.

Spam A technique that sends unsolicited messages, typically of promotional nature, to large e-mailing lists. To fight spam, dedicated software attempts to quarantine suspicious e-mails (through content analysis techniques).

Spiral Diagram A way of viewing the application development process as a spiral, as opposed to a waterfall, allowing many iterations or versions.

Spoofing Masquerading as another party, such as a storefront, to collect thousands (or millions) of credit card numbers and other information from naive consumers.

Stages of Growth The four stages that many organizations go through in the introduction and assimilation of new technologies. These are early successes (leading to increased interest and experimentation), contagion (the learning period for the field), control (integration of systems is attempted but proves difficult), and integration (use of the particular new technology is mature). An organization can be in several stages simultaneously for different technologies.

Status Access System A system for monitoring what is going on in the company and in the outside world.

Straight-Through Processing A system where transaction data are entered just once in a process or a supply chain.

Strategic Having a significant, long-term impact on the growth rate, industry, and revenue of an organization.

Strategic Alliances Systematic, long-term, and formal cooperation between two or more partners to pursue a set of agreed goals to gain competitive advantage.

Strategy Stating the direction in which you want to go and how you intend to get there.

Structural Capital The capabilities embedded in hardware, software, databases, organizational structure, patents, and trademarks that support employees as well as relationships with customers.

Structured Query Language (SQL) A database language for making queries of a database that has become the standard.

Supply-Chain Management Systems Systems that integrate supply chains that compete against one another on their ability to reduce costs and time across their entire chains. Development of these inter-organizational systems requires teams from the different organizations to work together.

Supply-Push In this business model, companies are organized to build a supply of products or services and then "push" them out to end customers, on store shelves, in catalogs, and such; the opposite is demand-pull.

Support Systems Systems that can help knowledge workers perform knowledge-based work.

Switches One of three types of computers that route traffic, these forward packets to the port of the intended computer, using the addressing information in each packet's header.

System Development The process of building a system, originally by writing code to create an application and then linking together applications to form a system; a newer process is system integration.

System Development Life Cycle (SDLC) Overall step-by-step process of developing an information system from identification of business information needs to maintenance.

System Integration The current process of building systems by piecing together hardware components, software packages, database engines, and network products from numerous vendors into a single, cohesive system.

Systemwide Rules An operating discipline for distributed systems that is enforced at all times and governs security, communication between nodes, data accessibility, program and file transfers, and common operating procedures.

Tacit Knowledge Knowledge "known" but not easily explained to others.

Tech Clubs Cross-organizational groups that meet informally, but are supported and sanctioned by top management.

Technology Camel A way to distinguish levels of comfort with any technology using five clusters, which, when graphed on a chart, look a lot like a two-humped camel.

Telecommunications The sending of information in any form from one place to another, electronically.

The Long Tail A statistical distribution characterized by a high-frequency population followed by a low-frequency population; the latter can make up the majority of the distribution area. In business, Anderson refers to the long tail as a market phenomenon by which many small, highly specialized businesses can survive the big businesses.

Thin Clients Network computers that are used much like telephones; they have no hard disk or house applications, but rather just a browser, memory, keyboard, and a modem.

Third-Generation Language A programming language used by a professional programmer, such as COBOL.

Timebox A methodology for building a system in which the developers promise to deliver specific portions of the system within a specific time frame (a timebox); the intent is to better control project delivery schedules.

Total Quality Management (TQM) A management technique that focuses on managing the quality of a service or product, often through statistical quality control techniques, in order to achieve higher customer satisfaction and reduce costs as well.

Trademarks A law to protect names, symbols, and other icons used to identify a company or product.

Transitional Outsourcing The outsourcing of legacy systems for maintenance so that the in-house staff can focus on developing replacement client-server systems.

Trojan Virus A computer program that appears to perform a legitimate task, but in fact is a hidden virus or a malware.

T-Shaped Managers Executives who have both a vertical role (such as running a business unit) and a horizontal role (such as sharing knowledge with their peers in other business units).

Value Assessment Framework A systematic way to separate potential benefits of IT investments by organizational levels.

Value Chain A technique for describing a chain of business processes from product/service conception through cessation of the product/service, where each of the processes adds some kind of value.

Value Network Technology-supported partnerships that allow internal and external specialized units to collaborate on a project, and collectively contribute to the value of the project.

Virtual Circuit A temporary circuit created between caller and receiver where that circuit is theirs alone to use; no other parties can share it during the duration of their telephone call.

Virtualization In computer application, a single physical resource (e.g., a server, an operating system, and a storage device) appears to the users to function as multiple virtual resources; vice versa, multiple distributed physical resources can be set up to serve as a single resource.

Vision A statement of how someone wants the future to be or believes it will be; it is used to set direction for an organization.

Visual Programming A technique for programming, such as creating a graphical user interface, by pointing and clicking on generic items—menus, dialog boxes, radio buttons, and other components of graphical displays—and then arranging them to create a screen.

Waterfall Approach A way to view the system development process as a series of steps that, when diagrammed, appear as a waterfall.

Waves of Innovation Primozic, Primozic, and Leben's presentation on how IT is used by industries and by enterprises, one view of the evolution of IT, and the escalating benefits it provides firms. They identify five waves of innovation, with time on the horizontal axis and benefit on the vertical access.

Web 2.0 An ongoing transition of the World Wide Web from a collection of independent Web sites to an interconnected computing platform with constantly new (even beta-version) services such as search engines, blogs, Wikis, and Web Services to meet individual users.

Web Cast Broadcast of a live event over the World Wide Web.

Web Services This second-generation Internet-based system environment gives software modules URLs (Internet addresses) so they can be called upon to perform their function as a service via the Internet.

Web Site A personal or organizational site on the World Wide Web. In just a few years, company Web sites have become standard business practice in most companies, large and small.

Web Surfing (Surfing the Web) Slang term for continuously following hyperlinks hidden behind highlighted words on Web pages that, when clicked, jump to another Web page.

Wi-Fi The 802.11 family of wireless Ethernet standards. For instance, 802.11b transmits up to 11 Mbps per second and behaves a lot like its wired cousin 10BaseT. Other members of this standard family exist and new ones are being developed.

Wide Area Network (WAN) A geographical, high-speed, high-bandwidth telecommunications network.

Wiki A collection of Web pages created collaboratively by its community users; anyone can freely contribute or modify content in the Wiki using a simplified markup language. Many organizations uses Wikis as a means of communication and knowledge management for their employees.

Worknets Informal groups of people whose collective knowledge is used to accomplish a specific task.

Workscape The virtual workplace, which includes the Internet.

Zero Latency Reacting quickly to new information (with no wait time).

ACRONYMS AND ABBREVIATIONS

1G/2G/3G/4G First, Second, Third, and Fourth Generation (of wireless systems)

3i Investors in Industry

4GLs Fourth-Generation Languages

ACM Association for Computing Machinery

AI Artificial Intelligence

AIS Association for Information Systems

AM Amplitude Modulation

AmEx American Express

AMS/3 Third-Generation Automatic Order Matching and Execution System

ANSI American National Standards Institute

AOL America Online

AOP Advanced Optimization Planning

API Application Program Interface

ARPANET Advanced Research Projects Agency Network

ASP Application Service Provider or Active Server Page

AT&T American Telephone and Telegraph

ATM Asynchronous Transfer Mode or Automated Teller Machine

B2B Business to Business

B2C Business to Consumer

BCG Boston Consulting Group

BLISS Banking and Loan Insurance Software System

BMW Bavarian Motor Works

BPO Business Process Outsourcing

BPR Business Process Redesign/Reengineering

C/C++ Programming Languages Used with UNIX

CAD/CAM Computer-Aided Design/Computer-Aided Manufacturing

CAPS Center for Advanced Purchasing Studies

CAS Credit Authorization System

CASE Computer-Aided Software Engineering

CBR Case-Based Reasoning

CC Computer Center

CCITT Consultative Committee for International Telegraphy and Telephony

CDMA Code Division Multiple Access

CDPD Cellular Digital Packet Data

CD-ROM Compact Disc—Read-Only Memory

CEO Chief Executive Officer

CFO Chief Financial Officer

CIO Chief Information Officer

CIR Corporate Information Resources

CIRANO Center for Interuniversity Research and Analysis on Organizations

CIS Corporate Information Services

CISR Center for Information Systems Research

CLEC Competitive Local Exchange Carrier

CMA Cash Management Account

COBOL Common Business Oriented Language

COE Common Operating Environment

COM Computer Output Microfilm or Component Object Model

COO Chief Operations Officer

CRAMM United Kingdom Central Computer and Telecommunication Agency Risk Analysis and Management Method

CRM Customer Relationship Management

CSC Computer Sciences Corporation

CSF Critical Success Factor

CTO Chief Technology Officer

CU Credit Unions
CXO A Group of "Chiefs" (CEO, CFO, CIO, COO, etc.)
DARPA Defense Advanced Research Projects Agency
DASD Direct Access Data Storage
DB Digital Business
DB2 Database 2 (an IBM product)
DBMS Database Management System
DDM Dialog, Data, and Modeling
DES Data Encryption Standard
DGMS Dialog Generation and Management System
DNS Distributed Name Service
DOS Disk Operating System
DP Data Processing
DPI Dots Per Inch
DSA Decision Support Application
DSL Digital Subscriber Line
DSS Decision Support System
DVD Digital Video Disc
EAI Enterprise Application Integration
EDI Electronic Data Interchange
EDM Electronic Document Management
EDP Electronic Data Processing
EDS Electronic Data System
EIS Executive Information System or Enterprise Information Solutions
EJB Enterprise Java Bean
E-mail Electronic Mail
EMR Electro Magnetic Radiation
EPRI Electric Power Research Institute
ERD Enterprise Reference Data
ERP Enterprise Resource Planning
ES Enterprise System
ESOP Employee Stock Ownership Plan
ESP External Service Provider
ESS Executive Support System
EUC End User Computing
EVP Executive Vice President
E-zines Electronic magazines
FAQ Frequently Asked Question
Fax Facsimile
FBI Federal Bureau of Investigations
FDA U.S. Food and Drug Administration
FDDI Fiber Distributed Data Interface
FT Financial Times
FTC Federal Trade Commission
FTP File Transfer Protocol
GDSS Group Decision Support System
GOTOs Go-to's, in computer programming code
GPRS General Packed Radio System
GPS Global Positioning Satellite
GSM Global System for Mobile Communication
GSS Group Support System
GTE General Telephone Company
HEC Hautes Etudes Commerciales
HICSS Hawaii International Conference on System Sciences
HKEx Hong Kong Exchanges and Clearing
HP Hewlett-Packard
HR Human Resources
HTML Hypertext Markup Language
HTTP Hypertext Transfer Protocol
IBM International Business Machines Corporation
IC Intellectual Capital
ICT Information and Communication Technologies
ID Identification
IDE Integrated Development Environment
IDS Integrated Data Store or Intrusion Detection System
IEA Information Engineering Associates
IFTF Institute for the Future
IIML Indian Institute of Management, Lucknow
ILEC Incumbent Local Exchange Carrier
IM Information Management or Instant Messaging
INR Indian Rupes
IOS Inter-Organizational System
IP Internet Protocol
IPng Internet Protocol Next Generation
IR Information Resources
IS Information Systems
ISDN Integrated Services Digital Network
ISM Information Security Management
ISO International Standards Organization
ISP Internet Service Provider
ISS Internet Security System
IT Information Technology
IXC Inter-exchange Carrier
J2EE Java 2 Enterprise Edition
JAD Joint Application Design
JDS Job Diagnostic Survey
JIT Just-In-Time
Kbps Kilobytes per second
KM Knowledge Management
LAN Local Area Network
LEC Local Exchange Carrier
LLC Limited Liability Company
LN Local Network

LTL Less-Than-Truckload
Mac Apple's Macintosh Computer
MAN Metropolitan Area Network
MBMS Model Base Management System
Mbps Megabytes per second
MGM Metro-Goldwyn-Mayer
MIPS Millions of Instructions Per Second
MIS Management Information Systems
MIT Massachusetts Institute of Technology
MOM Message-Oriented Middleware
MU Multiple-User system
MVS Multiple Virtual System
NASA National Aeronautics and Space Administration
NBC National Broadcasting Corporation
NC Network Computer
Net, The The Internet
NetBIOS Network BIOS, a proprietary network transfer protocol
NFL National Football League
NIC Network Interface Card
NOC Network Operations Centers
NSS Negotiation Support Systems
NT Network Technology
NTT Nippon Telephone and Telegraph
NYNEX A New York–Based Telecom Company
OEM Original Equipment Manufacturer
OLAP Online Analytical Processing
OLTP Online Transaction Processing
OM Owens & Minor
OO Object-Oriented
OPEC Organization of Petroleum Exporting Countries
OR/MS Operations Research/Management Science
ORB Object Request Broker
OSI Open System Interconnection
OSS Open Source Software
OX Operations Expediter System
PAN Personal Area Network
PARC Xerox's Palo Alto Research Center
PBX Private Branch Exchange
PC Personal Computer
PCS Personal Communication Service
PDA Personal Digital Assistant
PDF Portable Document Format (proprietary file format in Adobe)
PIN Personal Identification Number
PL/1 Programming Language/1
PLL Phase Lock Loops
PODD Point of Delivery Device
POTS Plain Old Telephone Service
PPSR Personal Property Securities Register Service
PRA Passenger Revenue Accounting
PRAC Plymouth Rock Assurance Corporation
PROFS Professional Office System
PSTN Public Switched Telephone Network
PTT Postal, Telephone, and Telegraph Authority
PwC PricewaterhouseCoopers
QoS Quality of Service
R&D Research and Development
RAD Rapid Application Development
RBOC Regional Bell Operating Company
RCA Radio Corporation of America
RF Radio Frequency
RFID Radio Frequency Identification
RIPP Rapid Iterative Production Prototyping
RN Remote Network
ROI Return On Investment
RPC Remote Procedure Call
RSA Encryption method named for developers Rivest, Shamir, & Adleman
RU Remote Utility
SAP Systeme Anwendung Produkte (System Application Product)
SAP R/3 SAP Release 3; the client-server version
SBT Scan-Based Trading
SCM Supply-Chain Management
SDLC System Development Life Cycle
SEC U.S. Securities and Exchange Commission
SEI Software Engineering Institute at Carnegie Mellon University
SET Secure Electronic Transactions
SLBG Sara Lee Bakery Group
SLICE Simple Low Cost Innovative Engine
SMS Short Message Service
SNA System Network Architecture
SOA Service-Oriented Architecture
SOAP Simple Object Access Protocol
SOHO Small Office/Home Office
SQL Structured Query Language
SRM Supply Relationship Management
SSL Secure Sockets Layer
SSP Security Service Providers
STS Socio-Technical System
SU Single-User systems
SUMURU Single User, Multiple User, Remote Utility
TCO Total Cost of Ownership
TCP/IP Transmission Control Protocol/Internet Protocol

TDL Teleport Denver, Ltd.
TDMA Time Division Multiple Access
TQM Total Quality Management
TV Television
TVA Tennessee Valley Authority
UCC Uniform Commercial Code
UCLA University of California at Los Angeles
UDDI Universal Discovery, Description, and Integration
UHF Ultra High Fidelity
UMT United Management Technologies
UNIX "Unics" Operating System; an attempt at a pun
UPS United Parcel Service
URL Uniform Resource Locator
VAN Value Added Network
VoIP Voice-over Internet Protocol
VPN Virtual Private Network
VSAT Very Small Aperture Terminal
WAN Wide Area Network
WAP Wireless Application Protocol
Web World Wide Web
Wi-Fi Wireless Fidelity
WiNS Wire Nova Scotia
WISP Wireless Internet Service Providers
WS Web Services
WSDL Web Services Definition Language
XML Extensible Markup Language
XP Extreme Programming
Y2K Year 2000

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