INFORMATION SYSTEMS MANAGEMENT IN PRACTICE

Brief Contents

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Preface

This book deals with the management of information technology (IT) as it is being practiced in organizations today. Successfully managing IT has become crucial for several reasons:

- For a business, IT is a strategic asset that is being used to mold competitive strategies and change organizational processes.
- The situations in which organizations are applying IT have increased in complexity, including more inter-organizational and global environments.
- The capabilities of IT and the complexities of using the technologies are also growing at an accelerating, and sometimes disruptive rate.

The net result is a growing need for guidance on the issues, strategies, and tactics for managing the use of IT. To partially satisfy this need, universities and colleges have developed courses that focus on the management of IT. Textual material for these courses has been sparse for two particularly troublesome reasons.

First, IT is changing so rapidly that textbook authors, practitioners, researchers, and academics have a difficult time staying current. For example, two major developments stand out. One has been the fast uptake of business uses of the World Wide Web, whose size is estimated to have reached more than 30 billion Web pages in 2007. This dramatic shift appears to be a precursor of a present revolution—mobile computing—which is beginning to change how we all work, live, and play. Thus, while information systems (IS) departments are busily maintaining their corporate Internet-based platforms, they must also be experimenting with another emerging technology: small wireless devices for on-demand, real-time computing needs.

The second major development is the changes in the business world itself. Increased international trade, national and global security, cybercrime, outsourcing and offshoring, corporate malfeasance, terrorism, and regional conflicts are changing how for-profit and not-for-profit enterprises conduct business. As a result, the work of IS organizations and the roles CIOs need to fill are changing as well. Keeping abreast of these business-world changes, and the responses businesses are making to them, is also challenging.

Another reason for the paucity of IT textual material for these courses is that the principles and strategies of effective management are evolving out of the experiences of practicing managers. Merely collecting reports from current academic literature fails to provide the interaction needed to decipher principles from the lessons learned in practice. Current developments and experiences need interpretation and coalescence to provide the guidance that new and practicing managers need to further develop their knowledge and managerial skills.

CONTRIBUTION OF THIS BOOK

We believe this book makes a major contribution to addressing both of these challenges. One resource for this book is work we have performed for several organizations—Gartner EXP; the Sourcing Interests Group; the CIO online forums; the Hawaii International Conference on System Sciences (HICSS); and large, private and governmental organizations affiliated with the Pacific Research Institute for Information Systems Management (PRIISM) at the Shidler College of Business. Our work for these organizations does not merely report current developments and practices; it includes thoughtful interpretation to provide practical guidance, principles, and strategies for IS executives. A systematic feature of the book is our chronological walk-through approach to explaining the evolution of information technologies in business since their inception and up to the latest developments. The historical perspective is useful to understand the roles, functions, and impacts of IT at different stages of the technologies and the maturity of the organizations that adopt them. This perspective also allows the readers to appreciate the pervasive issues related to information systems migration.

Our objective in this book is to selectively capture the material of most current and relevant importance to IS executives, and to organize it around a framework that provides guidance for IS organizations. A key element of our writing continues to be examples of actual work in companies. This book includes over 80 case examples. We seek to equip the readers with fascinating insights into the past; present; and most importantly, the future.

NEW IN THE EIGHTH EDITION

We have carefully reviewed the facts, concepts, methods, and techniques in this text. Whenever applicable, we have updated the statistics, the case examples, and have highlighted emerging issues and the glossary. We have extended the discussion on security management, the use of IT to deal with crisis response, and supply-chain management in a global context. Based on numerous feedback from faculty, students, and practitioners, who used the previous edition of this book, we have restructured many sections to ensure a smoother flow of ideas and concepts. We also condensed a number of sections to keep the reading more concise, without loss of content.

The following describes how the Eighth Edition has been updated:

Chapter 1: We have added a section that provides a historical perspective of the use of information and communications technologies in business. This discussion is used as a backdrop for substantiating the latest computing trends and their future impacts on competitiveness and business strategies, from the use of number-crunching machines to mobile computing for real-time transactions. We also inform the readers with some latest business challenges, to include the emergence of micro-markets, and the constant struggle between outsourcing and insourcing and the increasing influence of social computing in strategic formulation.

Chapter 2: We expand the discussion on the role of leadership in the digital economy. IT does matter, and the responsibilities of the CIOs are no longer limited to IS tasks. We add one new "wave of information," one that leverages partnership through supply-chain management or other forms of collaboration. The case discussions have been revised and updated to stress the importance of IT in a networked economy, and the necessity for IT managers to embrace the outgrowth of social computing (e.g., blogs, instant messaging, e-mail, social network services, Wikis, and social software).

Chapter 3: We revised this chapter to underscore the significance of new, and potentially disruptive, technologies on strategic formulation and implementation of IT in business. We extended the discussion on the importance of IT deployment to deal with a "reputation" economy and the predominant role of niche markets in the networked economy. The case examples were rewritten to draw attention to the innovative use of IT for competitive advantage in the global economy.

Chapter 4: In this methodological chapter, we provide an evolutionary perspective of information systems planning. The new focus is on how strategic planning has evolved along with the rapid change of Internet-driven technologies. We have expanded the socio-biological view of information systems, and have supplemented the seven planning methods with new change drivers: digitalization, globalization, and deregulation. Through an update of the case discussions, we continue to stress the necessity to find, or combine, many planning methods to creatively deal with technological and environmental uncertainties.

Chapter 5: We have extensively edited this chapter to bring more clarity to the technical discussion on IT architecture. First, we walk the readers through various stages of corporate IT architectures. We then end the chapter with a fresh view of IT architecture in the digital economy, one that would embrace the realities of the new economy: extended enterprises, strategic alliances, and virtualization. The goal here is to introduce the readers to the new trend in distributed computing: building an IT architecture with a secure global intelligent network.

Chapter 6: There are two major updates in the "Managing Telecommunications" chapter. The historical walk-through of telecommunications now includes some of the latest ICT developments to meet the demand for high-speed multimedia mobile communications services. We provide a revised outlook of telecommunications, highlighting a number of emerging trends, such as the accelerated competition in the broadband markets; mass-individualization of real-time programming; and the impacts of deregulation, consolidation, and technological innovation on the economics of telecommunications. We also put more emphasis on effective management of telecommunications from a business perspective. Since telecommunications services account for some of the largest expenses in many corporations, we propose specific guides to contain excessive telecommunications costs.

Chapter 7: We live in an era of information abundance with millions of Web pages being added daily. To provide the readers with a comprehensive view of information and the art and techniques to manage information resources, we have thoroughly revised the description of the business data models. We offer an overview of Enterprise Resource Planning (ERP), and suggest a number of strategies to deal with information resource planning and control. Web content management is another new feature in this chapter.

Chapter 8: The pursuit of efficiency and effectiveness remains the main goal of this chapter on "Managing Partnership-Based IT Operations." In this edition, we put more emphasis on how a business can manage operations from a partnership perspective. In addition to the discussion on best practices in managing IT operations, we add a couple of sections on managing open source, large-scale data warehousing, outsourcing, and insourcing.

Chapter 9: Technologies for developing systems have matured over the last two decades. As such, this chapter has not been extensively edited. We did, however, streamline the text to make it more concise, and, in return, added more discussion on agile computing, and how how to develop and maintain Web Services.

Chapter 10: Readers were very satisfied with this chapter in the previous edition. We did minor editing of the text, with some additional discussion on the importance of change management and risk management. We also draw more attention on managing legacy systems.

Chapter 11: This is a new chapter. We provide a comprehensive view of information security from a business perspective. We systematically cover all areas of potential threats, clearly define the scope of security management, and suggest a number of tools for computer security. We present two case examples. The "Credit Card Fraud" case highlights the responsibilities of the customers to guard against Internet crimes. The second case looks at an organization under siege, and how countermeasures can be deployed. The old adage "Prevention is the best defense" holds true for dealing with information security. We argue that any organization that seeks to secure sustainable competitive advantage should adopt security as an integral part of its core competency. We outline in this new chapter a planning approach for ensuring business continuity.

Chapter 12: We have refined this chapter with a coverage on business intelligence. We have expanded the discussion of various computer components that are needed to support organizational decision making, in particular, software architecture for decision support. We show how data mining can be deployed, and how it relates to agent-based Executive Information Systems.

Chapter 13: This chapter deals with IT-enabled collaboration. In addition to the discussion on supporting collaborative teams, we supplement the chapter with topics that have taken a increasingly important role in organizations: workflow management, technologies for negotiation support, and emergency response. We propose a new IT approach to enhance the organization readiness in dealing with unexpected events.

Chapter 14: In this chapter, we address a number of new issues in managing organizational knowledge. These include social and ecological issues and Wikis, along with ethics in business.

Chapter 15: In this edition, we begin the final chapter with a recap of the "hottest" issues of information systems management: information overload, green computing, virtualization and parallelization, and shortage of IT talents. We then propose a number of proven organizing principles to help managers move ahead in the networked economy.

Unlike other texts that keep adding more and more references at the ends of the chapters, we have conscientiously limited the references to the minimum. We chose to provide the readers with a coherent set of ideas, concepts, and issues, and we invite them to constantly take advantage of the Web to seek complementary materials. We live in an era of increasing amounts of digital information. What we aim in this book is to address the key issues in managing information systems in simple, clear, and insightful terms. At a time when we are deluged with change of every kind—in demographics, culture, technology, and economics—combined with a tidal wave of information, we seek to provide a systematic development of thought processes that is needed to successfully take advantage of information technology in business settings.

USE OF THIS BOOK BY PRACTICING MANAGERS AND CONSULTANTS

In the management of IT, this book is useful to several levels of managers:

- To senior business executives who want an overview of the issues and strategies in managing IT, with examples of what other enterprises are doing
- To CIOs who must implement IT as a strategic resource to help their enterprises attain their overall goals and objectives
- To IS managers who are responsible for managing major technical areas, such as system development, technology planning, and architecture
- To managers of functional units who (1) want to better understand the issues and processes of providing IT support for their areas of responsibility, (2) want to promote the use of IT in their organization, or (3) are now responsible for overseeing the management of IT in their function.

We believe that managers of all types will find this book valuable. By focusing on issues and strategies while explaining technical concepts, this book provides an overview of IS management for business executives and managers. By combining the experiences of successful executives, this book provides a real-world perspective for all IS managers.

Consultants to executives and managers will also find this book a useful reference for staying up to date on important issues in the field.

USE OF THIS BOOK AS A TEXT

Future IS managers, who are graduate or undergraduate senior students, will find that this book presents a view of what "the real world" has in store. As a text, it is intended for students who have had at least one IS course.

At the graduate level, it has been used since its first edition in 1986 for the second course, beyond the required IS course. It is especially well suited for the final course in a graduate curriculum on IS management. In addition, as MBA students have become more computer literate, the book has been increasingly used as the text in the MBA IS core course. In both uses, the book gives students conceptual and practical guidelines for dealing with the management of today's IS function.

At the undergraduate level, the book can serve as the text for a course dealing specifically with the management of IT or in the capstone course that summarizes the practice of IS for students about to begin their careers. Most undergraduate majors in IT take entry-level positions in the IS organization and then proceed into management. In the short term, they work with IS managers who are facing the problems and using the principles dealt with in this book.

Although this book has not been aimed at students majoring in other areas, non-IS majors are taking IS courses in increasing numbers to better understand how to work with systems professionals. All the chapters are pertinent to them because the theory is illustrated by real-life case studies, which are easily understood by students in all business disciplines.

At the end of each chapter are three types of questions and exercises to reinforce the material in the text.

- *Review questions* are based directly on the material in the chapter, allowing the reader to assess comprehension of the chapter's key principles, topics, and ideas.
- *Discussion questions* are based on a few topics in the chapter for which there is a legitimate basis for a difference of opinion. These questions focus discussion on these issues when the book is used in a seminar or classroom setting.
- *Exercises* provide an opportunity for the reader to put some of the concepts and ideas into practice on a small scale. In particular, one exercise in each chapter requires a student, or a team of students, to visit a local company and discover how the ideas in the chapter are being implemented in that company.

THE INSTRUCTOR'S GUIDE

We accompany this eighth edition with an online Instructor's Guide, originally prepared by Jerry McBride of Marist College in Poughkeepsie, New York. Ralph Sprague Jr., Alex Tan, and Rajib Subba, of the Shidler College of Business at the University of Hawaii, have taken the lead in revising the guide. The purposes of the guide are (1) to help instructors prepare a strategy and outline for conducting an advanced systems course using this text and (2) to provide support materials and techniques to enhance the course.

We believe there are six approaches for using this text. The six course modes are:

1. A lecture-based course
2. A seminar-based course
3. A directed-study course
4. An independent-study course
5. An action research course
6. An Internet-based course

In the Instructor's Guide, we suggest some useful and whenever possible, updated resources to use in these approaches. For example, we suggest how a computer-based simulation game can be used to help students understand and appreciate of their decisions and actions as they try to introduce technology innovation into the organization.

The Instructor's Guide includes:

- Outlines for the six course approaches
- An expanded outline for each chapter
- Answers to the review questions in each chapter
- Study notes for the Part Discussion Cases
- A listing of case studies appropriate for each chapter
- Suggestions on how to conduct site visit exercises
- Several sample syllabi

- An approach to using simulation software
- Critical questions for each chapter and how to create them

These critical questions deserve a short explanation. Like the discussion questions in the text, critical questions are designed to stimulate critical thinking and discussion among students. A course in IS management can be exciting—to teach and to take. We have provided the Instructor's Guide to make this one of those exciting courses.

WEB SITE: WWW.PEARSONHIGHERED.COM/MCNURLIN

The Web site for this text, provided by Prentice Hall, houses the Instructor's Guide, the Test Item File in Word, TestGen and TestGen in WebCT/BlackBoard-ready files, PowerPoint slides, and the Image Library in a secure area for faculty download only.

FORMAT AND CONTENTS

This book is divided into five major parts, each dealing with a major portion of the field of IT. Chapter 1 precedes Part I because it serves as the framework around which the rest of the book is built. It traces the growing importance of IS management and presents a conceptual model to show the key areas, how they fit together, and the principal issues for executives in each area. It also presents a very interesting longitudinal case example of how these ideas have been implemented in a company over the lifetime of this book—since 1986. In a nutshell, it presents a 25-year historical view of the evolution of IS for management.

Part I deals with leadership issues, including the top IS jobs, strategic uses of IT, and approaches to systems planning. Part II treats the all-important issues in managing the essential technologies, including distributed systems, telecommunications, information resources, and operations. Part III deals with managing system development; its evolution continues to present management with important, yet risky, challenges. Part IV explores systems for supporting decision making, collaboration, and knowledge work. Part V concludes the book and discusses the opportunities and challenges ahead.

Throughout the book, our objectives have been to keep the material practical, to give examples, and to derive guidance for today's and tomorrow's IS executives, based on the experiences of others. To that end, chapters are sprinkled with company examples. These are not so much case studies that require solutions or recommendations; rather, they are case examples of how companies have put some of the concepts in a chapter into practice.

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We wish to acknowledge the contribution of Richard G. Canning, Barbara's father. His insight and foresight originally made this book possible in 1986. In the early 1960s, he recognized the data processing executive's need for case studies, practical research findings, and thoughtful analysis. Through publishing and editing EDP Analyzer from 1963 until his retirement in 1986, Dick Canning devoted a major portion of his professional career to that purpose. His legacy continues in this book. We wish to thank

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CHAPTER

1

INFORMATION SYSTEMS MANAGEMENT IN THE GLOBAL ECONOMY

INTRODUCTION

Information technology (IT)—computers and telecommunications—continues to have the revolutionary, restructuring impact that has been expected and touted for years. The rapid advances in the speed and capacity of computing devices, coupled with the pervasive growth of the Internet, digital storage, wireless and portable devices, and multimedia content, are constantly changing the way we live and work.

Although IT affects nearly all aspects of human endeavor, this book emphasizes its use in managing and operating organizations, including business enterprises, public institutions, and social and charitable communities. Anytime people work together to jointly pursue objectives, IT is changing the way they work.

Managing and operating IT for these purposes has been a field of practice for some 50 years. First known as business data processing and later as management information systems (MIS), the field is now called information technology (IT). In this book, we distinguish between IT (the technology) and the organization that manages the technology, which we call the IS (information systems) organization. IS combines the technologies, people, data, and business processes for fostering the use of IT to improve organizational performance.

THEMES OF THIS BOOK

Due to the growth and pervasiveness of IT, organizations are operating in a different environment from that of just a few years ago. The nature of this environment is explored in several themes in this edition of the book. The following three themes are woven through the book:

- ***Globalization.*** You may have heard this common wisdom. The world seems to be getting smaller or flatter. Events in a faraway land can impact others in another part of the globe. As a result, a major theme in today's world is globalization, whereby companies seek to offer or procure their goods and services around the world. However, the worldwide expansion of brands and the emergence of global institutions continue to encounter major protests from groups, and even nations, that want to maintain their local identity. Companies feel this backlash in their use of IT: locales and regions want systems that suit their culture, preferences, or lifestyles. In addition, they want jobs to stay put, and not move to a far-off country. In response, IS executives are seeking to achieve a balance between implementing a single, enterprisewide IT infrastructure and tailoring systems to fit local needs—and locating work where it is most cost effective.
- ***E-enablement.*** Doing business electronically has been fundamental since the 1950s, but now the Internet has transformed the way people conduct business. The before-Internet economy is evolving into an electronic economy where clicks and bricks exist side by side. The 2001 dot-com crash might have seemed a hiccup in the increasing use of the Internet for business and commerce. However, it has not deterred companies from e-enabling their businesses, that is, integrating the Internet into how they work. In fact, the term "e-business" has the broad connotation of doing business electronically. E-business has much to do with building e-enabled relationships with consumers and other enterprises,

not just executing transactions electronically. E-commerce, on the other hand, is being used in the more limited sense of buying and selling electronically, as in handling commerce transactions.

The vision is ubiquitous connectivity among everyone on earth, with the ability to communicate electronically, transfer multimedia files, and access information—anywhere and anytime—from around the world at the touch of a button on a wireless device.

- ***Business Intelligence Through Knowledge Sharing and Knowledge Management.*** The third major theme is how to deal with all the world's knowledge. One aspect of this is the transfer of knowledge between people (sharing), because the most important asset in enterprises is the people and the knowledge they possess. The other aspect is the transfer of knowledge from people's heads into lasting things, such as processes, products, best practices, databases, directories, software, and such. People walk out the door each night (or leave the company); these other artifacts do not, but they do grow stale and outdated. This second area is called knowledge management. Both aspects have to do with managing people and the knowledge they possess. IT can be used for both.

  Later in this chapter, we discuss two kinds of knowledge work: procedure based and goal based. Emphasis on knowledge work is shifting from the former to the latter. At the same time, a major shift is taking place from information access to content management, which includes searching, filtering, synthesizing, assimilating, and sharing knowledge resources. The importance of content management is reinforced by the fact that intellectual assets are considered by many to be the only source of sustainable competitive advantage for organizations. The ultimate goal is to devise an IT-enabled environment to promote creativity that would benefit all participating communities of practices.

MANAGEMENT OF IS

Although IT is used in space exploration, national defense, medicine, entertainment, and many other aspects of human activity, the majority of information technologies are used to manage organizations.

The process of managing IT in organizations is becoming increasingly complex as it becomes more important. To illustrate why, here are just three major trends that impact IT management:

- Governance of IT—that is, deciding who makes which IT decisions—is shifting from being handled exclusively by IS executives to being a collaborative effort between IS business and their constituencies.
- The role of IS is shifting focus from application delivery to system integration and infrastructure development.
- The constant struggle between outsourcing and insourcing is becoming a way of life for many IS organizations, to the extent that a major responsibility of IS is developing and managing relationships with external service providers (ESPs).

In a historical perspective, it is interesting to note that the use of computers has been elevated to a new level every decade. As illustrated in Figure 1-1, the first use of

TIME FRAME	COMPUTER USE TRENDS	EMERGING APPLICATIONS	SOME LEADING VENDORS
1950s	Calculator	Bookkeeping	Texas Instruments
1960s	Computer	Accounting, Payroll	IBM, Honeywell, CDC, Univac, Burrough, GE
1970s	Management Information Systems	Financial Applications, Inventory Management, Production, etc.	Digital, IBM, Unisys
1980s	Decision Support and Applied Artificial Intelligence	Portfolio Management, Project Management, Executive Information Systems	IBM, Lotus, Apple, Sun Micro Systems, Oracle, Microsoft
1990s	Communicator	Office Automation, E-mail, Instant Messaging, File Transfer	IBM, MCI, AT&T, AOL, Netscape
2000s	Partnership Promoter/Social Enabler	E-commerce, Supply Chain-Management, Social Networking, Mobile Computing	IBM, Oracle, SAP, Microsoft

FIGURE 1-1 Evolution of Business Computing

computer chips was the calculator, primarily for the many bookkeeping activities of business in the 1950s. Texas Instruments invented the first electronic handheld calculator and has since significantly contributed to the use of mathematical modeling in business. About a decade later, IBM offered to the world its first generation of business computers with sufficient processing power to run data-intensive business applications. Managers in the 1960s saw the introduction of computer applications for accounting and payroll. During this era, most IT activities emerged from the bookkeeping and accounting departments.

The next decade saw the development of mainframes, and many organizations create the department of Management Information Systems (MIS) or IS Department to keep these systems running. IBM consolidated its leadership position in the computer industry. However, it saw the birth of two potential competitors, SAP and Oracle, all inspired by IBM work. Oracle improved the relational database concept initially developed by IBM to launch the first commercial SQL (Structured Query Language) relational database management system. Oracle has become a major provider of computer-based business solutions. SAP, founded by five former IBM employees, focused on real-time, collaborative, inter-enterprise business solutions. Thus, the 1970s marked the debut of the most successful business software ever—Database Management Systems (DBMS). MIS applications have allowed managers to increase the efficiency of their daily operations.

The 1980s marked a new era for the computer. While scientists were busy fine-tuning computer networks, IBM released the first PC that ran on a 4.77-Mhz Intel 8088 processor with MS-DOS written by Microsoft in 1981. A quarter of a century later, it is estimated the world had produced more than one billion personal computers. The phenomenal adoption of the personal computer has facilitated the deployment of a new generation of business software, known as Decision Support Systems and Applied Artificial Intelligence. Computers are not only used for data processing of daily business operations (such as payroll and accounting). They are embedded with decision algorithms that help managers make decisions ranging from cash-flow management to inventory decisions.

Thanks to the rapid growth of the Internet, the 1990s saw an exponential use of computers for office automation and networking. As "the communicator," computers allow users to do e-mails, transfer files, and use instant messaging. A research estimated that in 2003, 65–72 percent of world's computing power was dedicated to supporting human needs for communications. In addition to e-mail, Microsoft's Word, PowerPoint, and Excel software have become the industry standards for sharing information. Later in the decade, the World Wide Web allowed billions of pages to be made available on the Internet.

The Internet economy has come of age in the 2000s, thanks to a number of significant developments in e-business software, and open source software such as Linux, Enterprise Resource Planning, and supply-chain management software. The first years of the 2000s can be characterized by the widespread adoption of computer networks as a means to promote business partnerships and implement strategic alliances and global cooperation.

As we prepare to move onto the 2010s, the Internet has firmly changed the social fabric. It is a platform where people do business, find entertainment, and enhance social life.

This brief historical review reminds us of the growing importance of IT. The purpose of this book is to describe how IT is being managed today in leading-edge enterprises. Thus, this book is appropriate for anyone who is using IT to improve organizational performance—IS executives, technical managers, top executives, business unit executives, line managers, and employees at all levels of an organization.

This chapter briefly reviews the recent history of IT and its management in organizations. Then it identifies a number of organizational and technical trends that are affecting IT management. Finally, it presents a framework for thinking about how IT is used and managed in organizations. This framework serves as the roadmap for the rest of the book.

A LITTLE HISTORY

Most people are surprised to learn that the United States passed from the industrial era to the information era in 1957. In that year, the number of U.S. employees whose jobs were primarily to handle information (information workers) surpassed the number of industrial workers.

In the late 1950s and early 1960s, though, information technology to support information work hardly existed. Only the telephone was widespread, and did not reach every desk. Computers were just beginning to be used in data-processing applications, replacing electric accounting machines. Even where computers were in use, their impact was modest.

Most other information work in general offices was done without much support from technology. Xerographic office copiers were introduced in 1959. Electric typewriters were commonplace, but the first word processor would not arrive until 1964. Facsimile machines were used only in specialized applications and would not be in general office use until the 1970s. However, the future of technology support for information workers was extremely bright. Many of the foundations of IT had been invented, and costs were starting their steady long-term fall.

Another milestone was reached in about 1980, when the number of U.S. information workers surpassed the number of U.S. workers in all other sectors combined. In other words, information workers exceeded 50 percent of the U.S. workforce. However, the technology to support these information workers remained slow, expensive, and segmented into special-purpose categories.

IT was initially used to perform manual information work more quickly and more efficiently. Then it was used to manage work better. Now we are well into the third stage of technology assimilation, in which IT makes pervasive changes in the structure and the operation of work, business practices, organizations, industries, and the global economy.

Today, the information and communications technologies (ICT) sectors continue to grow strongly, with significant and rapid growth in developing nations. As the ICT global market is constantly exploring new technologies (such as mobile computing), emerging Asian and eastern European countries are rapidly becoming both leading producers and adopters of disruptive technologies. According to a study by OECD ("Information Technology Outlook 2006 Highlights," 2006, Geneva, OECD), the ICT section is expected to grow at 6 percent in 2006 and the market is accelerating its global restructuring of ICT production and services.

In its 2007 IT salary and skills survey, Global Knowledge reported that salaries are rising again, and the increase is proportional to the level of education and training of IT workers.

The next two sections explore the changes in the work environment and the technical environment.

THE ORGANIZATIONAL ENVIRONMENT

How IT is used depends on the environment surrounding the organization that uses it. This environment includes economic conditions, characteristics of principal resources (especially labor), management philosophies, societal mores, and other factors. This environment changes constantly. Simultaneously, technological advances affect the way IT is used. An ongoing debate centers around whether technology drives change in organizations or merely supports it. This "chicken or egg" debate is giving way to the realization that IT and its use and management co-evolve, each influencing the other.

This section explores two aspects of the organizational environment: the external forces that are causing executives to reexamine how their firms compete, and the internal structural forces that affect how organizations operate or are managed. It then considers how these environmental trends have led to a new set of goals for the new work environment.

The External Business Environment

Today, the turbulent business world includes shorter and shorter product cycles, a U.S. telecommunications industry in constant turmoil, investor doubts about corporate truthfulness, computer security, and terrorism. For better or worse, IT contributes to this turbulence because it allows information to move faster, increasing the pace at which individuals and organizations can respond to events. One result is higher peaks and lower valleys, caused by an IT-charged herd instinct. The following are the main changes taking place in our global marketplace.

The Internet Economy

The *new* economy has been much publicized by the outgrowth of business-to-consumer (B2C) retailing and selling over the World Wide Web (Web). The pioneer of the Web-only business model was Amazon.com, with its ability to use the Internet to sell and ship books to consumers at substantially lower costs. However, the overwhelming bulk of e-business belongs to business-to-business (B2B), with buyers and sellers using Internet exchanges (or e-marketplaces) to find and consummate business deals. eBay is the most well-known exchange, but there are other industry-specific exchanges, such as business procurement along the value-chain network. The main point is that today's economy is encompassing both old and new ways of operating, and IT is a major underpinning of the way these two worlds interface with each other.

Global Marketplace

The entire world has become a conglomeration of electronic marketplaces. To succeed, large companies believe they need to be global, meaning huge and everywhere. Merger mania is occurring across industries as companies aim for this goal. Mergers even cross national boundaries. It is not unusual for a British food company to own U.S., French, and other food and beverage companies; for a Swiss pharmaceutical company to buy out its American and Japanese counterparts; or for a Chinese computer manufacturer to buy a laptop division of a major American IT company. "Think globally, act locally" has become a popular adage among multinational corporations.

In addition, the Internet enables companies to work globally—with three main operating arenas, Asia/Pacific, the Americas, Europe and the Middle East and Africa (EMEA)—and work around the clock by passing work from one region to the next, following the sun.

The global marketplace has become a two-way street. Firmly entrenched companies find unexpected competitors from halfway around the world bidding on work via the Internet. Parts and subassemblies are being manufactured in many countries to cut overall labor costs and then shipped to other countries for final assembly.

The Internet also allows small firms to have a global reach. Norwegians can order extra-hot chili sauce from Texas. Europeans can order books over the Internet from U.S. companies before those books become available in their own country's bookstores, at a more advantageous currency exchange rate. And so on. The business environment is now global, but local tastes still matter. As noted earlier, local backlashes against globalization are a factor that global enterprises need to include in their planning.

Micro-markets

The Internet has created new markets for new kinds of goods and services: digital micro-products. Digital micro-products—such as Apple's 99-cent I-tunes songs, Amazon.com's 49-cent short books, Disney's $4.99 short videos, or freeware—are products in digital forms that can be delivered anywhere, at any time, at a low or zero acquisition cost and no delivery costs. These products illustrate two emerging trends that have been identified in electronic commerce as micro-commoditization and micro-consumption, which are expected to significantly impact the market for digital goods. Unlike other products, digital micro-products often have a selling price that is very low, fixed, and identical for all products. With these product characteristics, the impact of price on sales (quantity) is trivial and thus mitigated and channeled into quality perception, so price is no longer the primary demand factor. Alternatively, quality signal is likely to become a key demand factor.

Business Ecosystems

A new term is creeping into the business lexicon: ecosystem. An ecosystem is a web of self-sustaining relationships surrounding one or a few companies. For example, Microsoft and Intel are the center of the Wintel ecosystem that has dominated the PC world. And, the new generation of Intel-based Apple's iMac computers is expected to consolidate this ecosystem, further enabling participating members to move toward shared visions, securing their investment strategies through strategic partnership. Yet, although they dominate the PC ecosystem, they are far less dominant in other ecosystems, such as the Internet ecosystem and the wireless communications ecosystem. The point about ecosystems is that they appear to follow biological rules rather than industrial-age, machine-like rules. They require flexibility because relationships change more frequently; they are more organic. Relationships and co-evolution require a different corporate mind-set from the command-and-control mind-set of the past.

Decapitalization

Tangible items, such as capital, equipment, and buildings, were the tenets of power in the industrial age. Today, intangible items, such as ideas, intellectual capital, and knowledge, have become the scarce, desirable items. Many argue that the business world is moving from tangible to intangible; it is decapitalizing. In many situations, knowledge is more important than capital. For this reason, managing talent has become as important as managing finances. Without talent, ideas dwindle, the new-product pipeline shrivels up, and the company becomes less competitive.

Faster Business Cycles

The tempo of business has accelerated appreciably; companies do not have as much time to develop new products or services and move them into the marketplace. Once on the market, their useful lives tend to be shorter as well, so speed has become of the essence. Efforts to accelerate time to market or to reduce cycle time often depend on innovative uses of IT to transform creative ideas into profitable products.

Instant Gratification

The Internet is about instant gratification. One of the successes of YouTube is due to the use of the Flash technology that allows instant viewing of video clips without the need to download large video files. The need of instant coffee, lottery tickets with instant-win notification, and instant pain relievers is extended to the need for instant access to digital products and services. Google builds one of its successes on the ability of its search engines to instantly deliver relevant information to its surfers, and its new Web-based uploader that allows users to share their break-up stories. The desire to satisfy society's demand for instant gratification could, however, lead to quality problems as products are hastily brought to the markets.

Accountability and Transparency

The rise and fall of dot-coms probably should have been expected; some of their business plans truly could not make money. However, the ensuing debacle in the overbuilt telecommunications industry and the corporate financial shenanigans in several industries around the world have shaken investor confidence and led to calls for greater transparency of corporate operations and greater accountability of corporate officers. These events have increased the pressure for corporate ethics, and the expensive-to-comply-with Sarbanes-Oxley Act in the United States was passed in 2002 to reinforce investment confidence and protect investors by improving the accuracy and reliability of corporate disclosure. IT will surely play a role in implementing the ensuing regulations and fostering transparency. Discussions of IT ethics might also increase.

Rising Societal Risks of IT

In spite of the unequivocal benefits that IT has brought to the world, it has also negatively affected millions of people—through network shutdowns, computer viruses, identity thefts, e-mail scams, movement of white-collar jobs to lower-cost countries, and such—which has led to increasing calls for government regulation and for vendors and corporations to take action. This edition includes more discussion of the societal risks that accompany the benefits of IT.

Now, more than in the past, CIOs need to address the dark side of IT, which includes protecting the privacy of individuals whose information they store and securing their networks, databases, and computers from cybercrime, computer viruses, and such. They also need to consider the societal effects of outsourcing, and ease, as much as possible, the human misery that comes from employees losing their jobs or having to oversee work performed in distant places.

The Internal Organizational Environment

The work environment is also changing, and the art of managing people is undergoing significant shifts. These changes are profound enough to change organizational structures. Frances Cairncross,[1] management editor at the *Economist*, writes in her book, *The Company of the Future,* that the relationship between IT and enterprise structure is growing more widespread and deeper. She believes that the company of the future will look much like the Japanese keiretsu (the associations of independent and interdependent businesses working in concert). Here are some of the changes we see affecting how people work and how organizations operate. Some support Cairncross's belief.

From Supply-Push to Demand-Pull

In the industrial age, companies did their best to figure out what customers wanted. Firms were 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 Internet, which allows much closer and one-to-one contact between customer and seller, is moving the business model to demand-pull. In this 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, or rather, the demand chain.

To move to this consumer-pull mass customization business model, companies need to essentially reverse their business processes to be customer driven. In fact, this model can lead to suppliers and customers co-creating or negotiating products and services. For example, book buyers who put their critiques of books through online reviews and useful votes on Amazon.com's Web site are, in a sense, co-creating part of Amazon's service to other book buyers.

Here's another bookseller example. Borders is the second-largest book retailer in the United States. Its president has decided to replace the industry's supply-push approach with a new demand-pull approach. Traditionally, and still today, booksellers push those books that publishers pay them to promote in their bookstore windows, on near-the-door tables, and in other high-traffic areas.

Borders' president thinks these short-term incentives might actually hurt overall sales in categories, so he is shifting Borders to "category management," which means publishers will help co-manage 250 book categories, reports Trachtenberg.[2] In return for being part of the decision-making process by recommending titles to Borders, the publishers will help pay for the market research Borders will do to find out what book buyers want. For instance, Borders wants to find out which books are bought on impulse, which ones sell better when the cover is showing, which types should be grouped together, where sections should be located, and even how to price books.

Borders' competitors are watching this demand-pull experiment with great interest. Some doubt that it will work, reports Trachtenberg, arguing that selling books is not like selling screwdrivers or prescription drugs. One thing Borders has already learned through its market research, though, is that one-fourth of its cookbooks are bought as gifts.

"Customer-centricity" is another term for this trend. It means replacing product-centric thinking with customer-centric thinking. The result: Organizational structures shift from product groups to customer groups. One way to view this shift is to see it as turning traditional thinking inside-out. When companies focus on products, they are thinking inside-out. When they think about customers and customer groups, they think outside-in.

Although you might think this shift means keeping customers happy, it can actually have the opposite effect for some customers. When companies create customer clusters using data-warehousing and data-mining techniques, they find out which clusters are profitable and which are not. They may then institute policies that cater to the profitable customers and charge or let go the unprofitable ones.

Self-Service

Bank automated teller machines (ATMs) were an early and successful example of customer self-service. The 1990s saw an increase in systems that let consumers access corporate computer systems to purchase products, inquire about the state of an order, and, in general, do business with the firm online on their own. FedEx was one of the first companies to leverage the Web by allowing customers to directly access its package-tracking system via its homepage. Today, companies that ship products via FedEx have links to the same homepage, providing that service to their customers. When customers serve themselves, employees can concentrate on services that customers cannot help themselves and other kinds of work. More importantly, self-service has shown to be an effective means for customer empowerment, extending the value from the business to the customer.

Real-Time Working

The genesis of the notion of real-time enterprise, we believe, was the military, whose personnel fly planes and drive tanks using instrument panels. These panels show the pilots and soldiers the surrounding terrain as it exists at the moment, so that they can respond to changes and threats in real time. The term has been adopted in business and means operating a business in as close to real time as possible, using computer systems to indicate the state of the "business terrain" as it exists at the moment.

For example, members of a sales team about to talk to a potential global customer can have up-to-the-minute information about that customer—late-breaking news about the company, recent management changes, latest orders to the company (if any), sales tips from other employees—all gathered for them from many sources.

Other examples of real-time working are knowing inventories as of right now (not one week or one month ago), knowing cash on hand right now (not at the end of last month), and being able to reach someone when you need them, perhaps via instant messaging. With accurate, up-to-date information on company operations, customer orders, inventory stocks, and on-demand access to others, people have better information to make decisions. Thus, businesses are making a major push to have real-time information in hand and real-time access to people, which are not easy feats, especially for enterprises with global operations.

Real-time working is more than just providing instant up-to-date information. According to (Gartner), a respected research firm in I.T. and Business, it is a quest for strategic gain. Firms will have to implement new collaborative business rules and roles before event-driven actions. IT can help implement real-time working with computer-based content management and Internet portals.

Team-Based Working

The trend is toward people working together on projects. Rather than depending on chains of command and the authority of the boss, many organizations emphasize teams to accomplish major tasks and projects. Peter Drucker's classic article in the *Harvard Business Review*[3] uses the analogy of a symphony, where each member of the team has a unique contribution to make to the overall result. Task-oriented teams form and work together long enough to accomplish the task, then disband. This project-based working, where people sometimes work simultaneously on several projects with different teams across different organizations, is generating major interest in the information systems called "groupware." Groupware provides IT support for meetings, collaborative work, and communications among far-flung team members. Cairncross[1] believes the increased ability to collaborate in new ways using IT is one of the forces driving the changes in organizational structures, and that enterprises that use the technology to work in new collaborative ways will be the winners.

Anytime, Anyplace Information Work

Information workers are increasingly mobile, so computers and networks are needed not just for accessing information, but also for communicating with others. One of the hallmarks of IT today is that the communication capabilities of computers are seen as more important than their computing capabilities. Communication technology has developed to the point where information work can be done anywhere with a laptop computer, cell phone, or PDA. Electronic mail, voice mail, and instant messaging (IM) cross time zones to allow work to be conducted anytime, anywhere. People sporadically work from home, rather than commute every day, and they work in their preferred geographical location, even if it is remote from the main office. The advances in wireless technology enable people to work in an airport, at a customer site, while walking, and so on.

Outsourcing and Strategic Alliances

To become more competitive, organizations are examining which work they should perform internally and which they should give to others. Outsourcing, having a third party perform information work for you, may be a simple contract for services or a long-term strategic alliance. Between these two extremes are a variety of relationships that are redefining the way organizations work together. The thinking is: We should focus on what we do best and outsource the other functions to people who specialize in them, to make us more world-class in all our functions. The result is becoming known as the extended enterprise. IT is providing the information and communication means to manage complex sets of workflows.

Demise of Hierarchy

In the traditional hierarchy, people performing the same type of work are grouped together and overseen by a supervisor. The supervisor allocates the work, handles problems, enforces discipline, issues rewards, provides training, and so on. Management principles such as division of labor and chain of command define this traditional work environment.

This structure is no longer best in many instances. Self-managed groups, whether working on an assembly line or in an insurance company, provide much of their own management. In these quality circles, they have lower absenteeism, yield higher productivity, produce higher-quality work, and are more motivated than workers in traditional settings.

A major reason for the demise of hierarchy is that the more turbulent business environment—represented by the changes just noted—challenges the premises of a hierarchical structure because it cannot cope with rapid change. Hierarchies require a vertical chain of command, where lines of responsibility do not cross and approval to proceed on major initiatives is granted from above. This communication up and down the chain of command can take too much time in today's environment. IT enables team-based organizational structures by facilitating rapid and far-flung communication.

Business Strategies in the New Work Environment

Thomas Friedman's bestseller, *The World Is Flat*, is another forceful essay on unfolding the new structure of the global economy. As a result of these changes in the internal and external organizational environment, enterprises around the world are redefining their work environment—a tumultuous proposition, at best—without any true guidance. We see the following overarching goals for thriving in the new work environment:

- Leverage knowledge globally
- Organize for complexity
- Work electronically
- Handle continuous and discontinuous change

Leverage Knowledge Globally

Knowledge is now being called intellectual capital to signify its importance. This is not the knowledge in an expert system or a Lotus Notes database, but rather the knowledge in people's heads. Knowledge that people know but cannot really explain to others is called tacit knowledge, as opposed to explicit, explainable knowledge. Companies that are able to leverage tacit knowledge globally will be successful—provided, of course, its use is directed by a sound strategy.

Brook Manville and Nathaniel Foote of McKinsey & Company[4] point out that knowledge-based strategies begin with strategy, not knowledge. Intellectual capital is meaningless unless companies have the corporate fundamentals in place, such as knowing what kind of value they want to provide and to whom.

They also point out that executing a knowledge-based strategy is not about managing knowledge but about nurturing people who have the knowledge, tapping into the knowledge that is locked in their experience. Although companies have numerous systems in place to share explicit knowledge, the key to unlocking tacit knowledge is a work environment in which people want to share. A manufacturer that tried to foster greater knowledge transfer while downsizing discovered that the combination was impossible. Why would employees share what they know when the bosses were looking for ways to consolidate expertise?

The means to tap tacit knowledge is to foster sharing and to support the sharing with technology. E-mail and groupware can provide the interconnection, but the driving force is the culture. When people want to share, they form worknets—informal groups whose collective knowledge is used to accomplish a specific task. The sharing and leveraging of knowledge happens through organizational "pull"—people needing help from others to solve a problem—rather than organizational "push," which overloads people with information. Therefore, leveraging knowledge is all about raising the aspirations of each individual, say Manville and Foote.

Organize for Complexity

A second overarching goal of companies, whether they recognize it or not, is to be able to handle complexity. Why? One reason is that the world has become so interconnected that simple solutions no longer solve a problem. Another reason is that issues are systemic. Corporate decisions can have an environmental impact, a human resources impact, an economic impact, and even an ethical impact. Furthermore, capturing market share oftentimes requires allying with others who have complementary expertise. Alliances increase complexity; so does specialization. Have you bought shampoo, crackers, or tires lately? These used to be fairly straightforward decisions. Today, the choices are so numerous that consumers can spend an inordinate amount of time making a selection. To thrive in such an age, companies need to be organized to be able to handle complexity.

Work Electronically

Just as the marketplace is moving to the marketspace, the workplace is moving to the workspace. Taking advantage of the Internet, and networks in general, is a third major goal of enterprises these days. But just as the move from horse and buggy to train to automobile to jet plane was not simply a change in speed, but a change in kind, so, too, is the move to working in a space rather than a place a change in kind. It requires different organizing principles, management tenets, compensation schemes, organizational structures, and such. It also changes how organizations interact with others, such as their customers.

George Gilder,[5] columnist and author, noted that business eras are defined by the plummeting price of the key factor of production. During the industrial era, this key factor was horsepower, as defined in kilowatt hours. It dropped from many dollars to

7.5 cents. For the past 40 years, the driving force of economic growth has been transistors, translated into millions of instructions per second (MIPS) and bits of semiconductor memory. The latter has fallen 68 percent a year, from $7 per bit to a millionth of a cent. Likewise, the cost of storage has become almost trivial, less than 50 cents per gigabyte.

MIPS and bits have been used to compensate for the limited availability of bandwidth. The microchip moved power within companies, allowing people to vastly increase their ability to master bodies of specialized learning. Microchips both flattened corporations and launched new corporations. Bandwidth, on the other hand, moves power all the way to consumers. That is the big revolution of the Internet, Gilder contends, and the reason behind the move to relationship marketing with consumers.

The use of bandwidth is becoming more available as the economy changes. For example, TV is based on a top-down hierarchical model with a few broadcast stations (transmitters) and millions of passive broadcast receivers (televisions). The result is "lowest-common-denominator" entertainment from Hollywood. The Internet, on the other hand, is a "first-choice" culture, much like a bookstore. You walk in and get your first-choice book. First-choice culture is vastly different from lowest-common-denominator culture. As the Internet spreads, the culture will move from what we have in common to one in which our aspirations, hobbies, and interests are manifested.

Handle Continuous and Discontinuous Change

Finally, to remain competitive, companies will need to innovate continually—something most have generally not been organized to do. Continual innovation, however, does not mean continuously steady innovation. Innovation occurs in fits and starts. Change takes two forms: continuous change (the kind espoused by total quality management techniques) or discontinuous change (the kind espoused by reengineering). When a product or process is just fine, but needs some tuning, continuous change improves its efficiency. However, when it is not fine, discontinuous change is needed to move to an entirely new way of working. The two often form a cycle. Companies need to be able to handle both for their products and processes.

These four major goals underlie the new work environment. This organizational environment sets the backdrop for exploring the emerging technology environment.

THE TECHNOLOGY ENVIRONMENT

The technology environment enables advances in organizational performance. The two have a symbiotic relationship; IT and organizational improvements co-evolve. IT evolution can be described using the four traditional areas of hardware, software, data, and communication.

Hardware Trends

In the 1950s and 1960s, the main hardware concerns of data-processing managers were machine efficiency and tracking new technological developments. Batch processing was predominant; online systems emerged later. At that time, hardware was centralized, often in large, showcase data centers behind glass walls.

In the mid-1970s, processing power began to move out of the central site, but only at the insistence of users who bought their own departmental minicomputers and word processors. In the 1980s, mainly due to the advent of personal computers (PCs), this trend accelerated far beyond the expectations of most people, especially IS managers. In the 1990s, the IT world was focused on networks, ranging from local area networks (LAN) to high-speed wide-area networks to support client-server computing. In this underlying structure, a client machine on the desktop, a laptop, or a handheld provides the user interface, and a server on the network holds the data and applications. This same client-server model is used for interacting with the Web.

The major development in hardware toward mobile and handheld devices is led by two factions: telecommunications companies (and the cell phone manufacturers that serve them) and handheld computer manufacturers, such as Palm and Microsoft. Functionality is expanding with devices handling both voice and data. Use of wireless hardware has become the norm for the anytime-anyplace workforce.

These hardware trends are further distributing processing beyond organizational boundaries to suppliers and customers. The result is the movement of enterprise-wide hardware and processing power out of the control—although perhaps still under the guidance—of the IS organization. Many futurists predict that hardware will evolve from the desktop to embedded devices. These are self-contained special-purpose applications with a dedicated computer installed in the devices, such as Personal Digital Assistants (PDAs) and handheld computers.

Software Trends

The dominant issue in software and programming in the 1960s was how to improve the productivity of in-house programmers—those who created mainly transaction-processing systems. Occasionally, IS management discussed using outside services, such as time-sharing services, application packages, and contract programming from independent software houses. The software industry was still underdeveloped, though, so application development remained the purview of IS managers.

Later, programming issues centered first around modular and structured programming techniques. Then the topic expanded to life cycle development methodologies and software engineering, with the goals of introducing more rigorous project management techniques and getting users more involved in early stages of development. Eventually, prototyping (quick development of a mock-up) became popular.

Then two other software trends appeared. One, purchased software, became a viable alternative to in-house development for many traditional, well-defined systems. Two, IS managers began to pay attention to applications other than transaction processing. Software to support decision support systems (DSS), report generation, and database inquiry shifted some programming from professional programmers to end users.

During the 1990s, the push for open systems was driven primarily by software purchasers who were tired of being locked in to proprietary software (or hardware). The open systems movement continues to demand that different products work together, that is, interoperate. Vendors initially accommodated this demand with hardware and software black boxes that performed the necessary interface conversions, but the cost of this approach is lower efficiency.

Another major trend in the 1990s was toward Enterprise Resource Planning (ERP) systems, which tightly integrate various functions of an enterprise so that management can see cross-enterprise financial figures and order and manufacturing volumes. Some firms implemented ERP to replace legacy systems that were not Y2K compliant (i.e., the systems would think that an "02" would mean 1902 rather than 2002). Implementing ERP involves integrating components, which is called systems integration, rather than application development. Implementation has been expensive and troublesome, especially for companies wanting to modify the ERP software to fit their unique processes. However, for many large corporations, their ERP system has become their foundation information system, in essence, defining their IT architecture.

Like hardware, software is becoming more network-centric. Rather than replacing legacy systems, many companies are adding Web front ends to broaden access to the systems to employees, customers, and suppliers. Companies are establishing corporate portals where employees log into their company intranet to use software housed at that site. This approach moves the software from being decentralized (on PCs) to being centralized (on a server somewhere).

Another change in software is the move to Web Services. Web Services are packages of code that each perform a specific function and have a URL (Uniform Resource Locator; an address on the Internet) so that they can be located via the Internet to fulfill a request. For example, if you have accessed FedEx's Web site to track a package, you have used a Web Service. MacAfee's virus protection also is delivered to PCs using a Web Services approach. The software industry is morphing into a Web Services industry.

The significance of Web Services is that it moves software and programming to being truly network-centric. As SUN Microsystems claimed more than a decade ago, the network becomes the heart of the system, linking all Web Services. Packages of code can be concatenated to produce highly tailored and quickly changed processes. In the past, once software was programmed to handle a process in a specific way, it essentially cast that process in electronic concrete because the process could not change until the software was modified. The tenet of Web Services is that a process is defined at the time it is executed, because each Web Service decides at that time which of its many options to use to answer the current request. The world of Web Services entails its own jargon, standards, and products. Importantly, it builds on the past—functions in legacy systems can be packaged to become Web Services. The last two years have witnessed the widespread adoption of service-oriented architecture (SOA). Service orientation refers to an architecture that uses loosely coupled applications or services to support the requirements of business processes.

As discussed in the hardware trends, embedded applications will eventually become a major task for software developers. With an estimation of more than 10 to 15 billion connected devices in the next few years—from PDAs to mobile phones—networking and security remain key priorities.

Another emerging trend is the increasing recognition that Web-based interface alone is not sufficient. With the proliferation of ubiquitous computing, Web-based interfaces should be supplemented with complementary "anywhere accessible" applications that require a new type of interface rich in interactivity and intuitiveness.

Data Trends

The evolution of the third core information technology area—data—has been particularly interesting. At first, discussions centered around file management and techniques for organizing files to serve individual applications. Then generalized file management systems emerged for managing corporate data files. This more generalized approach led to the concept of corporate databases to serve several applications, followed a few years later by the concept of establishing a data administration function to manage these databases.

As discussed earlier, in the 1970s, the interest in data turned to technical solutions for managing data—database management systems (DBMS). As work progressed, it became evident that a key element of these products was their data dictionary. Dictionaries now store far more than data definitions; they store information about relationships between systems, sources and uses of data, time cycle requirements, and so on.

For the first 20 years of information processing, discussions about data concerned techniques to manage data in a centralized environment. It was not until the advent of fourth-generation languages and PCs that interest in letting employees directly access corporate data began. Then users demanded it. If data across systems are defined the same way, they can be more easily exchanged.

In addition to distributing data, the major trend in the early 1990s was expanding the focus from data resources to information resources, both internal and external to the firm. Data management organizes internal facts into data record format. Information management, on the other hand, focuses on concepts (such as ideas found in documents, especially digital documents such as Web pages) from both internal and external sources. Thus, information resources encompass digitized media, including voice, video, graphics, animation, and photographs.

Managing this expanded array of information resources requires new technologies. Data warehousing has arisen to store huge amounts of historical data from such systems as retailers' point-of-sale systems. Data mining uses advanced statistical techniques to explore data warehouses to look for previously unknown relationships in the data, such as which clusters of customers are most profitable. Similarly, massive amounts of document-based information are organized into document repositories and analyzed with document mining techniques. In addition, as noted earlier, businesses now emphasize intellectual capital management. Some believe knowledge can reside in machines; others believe it only resides in people's heads. Either way, knowledge management is of major importance in the new economy because intangibles hold competitive value.

The Web has, of course, broadened the term "data" to mean "content," which encompasses text, graphics, animation, maps, photos, film clips, and such. Initially, Web content was managed by the content creators, such as marketing departments. However, with the huge proliferation of sites, enterprises realized they needed to rein in all the exuberance in order to standardize formats, promote their brands in a common manner, establish refresh cycles for their content, and create approval and archival processes. Content management has become very important, and as one manager observed, it is a lot like running a newspaper.

Three major data issues now facing CIOs are security (protecting data from those who should not see it) and privacy (safeguarding the personal data of employees and customers). Furthermore, regulations (such as the 2002 Sarbanes-Oxley Act in the United States) now require company officers to verify their financial data. Because the processes that handle financial data are undoubtedly automated, CIOs need to document and ensure the accuracy of these processes. Thus, numerous aspects of data safeguarding have become important. In the coming years, content management solutions, thanks to the ease in which they can manage unstructured data, will likely constitute a software foundation for other applications to build, retrieve, and store data.

Communications Trends

The final core information technology is telecommunications and technology convergence. This area has experienced enormous change and has now taken center stage. Early use of data communications dealt with online and time-sharing systems. Then interest in both public and private (intracompany) data networks blossomed.

Telecommunications opened up new uses of information systems, and thus it became an integral component of IS management. Communications-based information systems were used to link organizations with their suppliers and customers. In the early 1980s, a groundswell of interest surrounded interorganizational systems, because some provided strategic advantage. Also during the 1980s, the use of local area networks (LANs) to interconnect PCs began. PCs started out as stand-alone devices, but that only took advantage of their computing capabilities. It soon became clear that they had communication capabilities as well, so companies jammed even more wires in their wiring ducts to connect desktops to each other and then to the corporate data center.

Until the Internet appeared, enterprises leased lines from telecommunications carriers to create wide area networks (WANs) that linked their offices and factories. The only publicly available telecommunication system was the voice telephone system. Transmitting data from PCs in small offices that did not have leased lines generally entailed using a modem to dial up a computer at another site.

The Internet changed all that. Internet Service Providers (ISPs) appeared seemingly overnight to provide PC users with a local number for dialing into the Internet to search the Web, converse in a chat room, play text-based games, send e-mail, and transfer files. The Internet provided for data the equivalent of the worldwide voice network. Today, the Internet's protocol has become the worldwide standard for LANs and WANs. In fact, it will soon be the standard for voice as well.

Perhaps the most exciting developments in telecommunications technology is wireless—wireless long distance, wireless local loops (the last-mile connection of a home or office), wireless LANs (increasingly handled by Wi-Fi technology), and even wireless personal area networks (PANs). Wireless does not just enable mobility; it changes why people communicate, how they live, and how they work. It is a paradigm shift, and we are in the early days of wireless. VoiP (Voice over Internet Protocol) has become popular in many organizations or countries, with greater penetration in developing countries such as China and India. Many industry analysts predict that by 2009, over 70 percent of worldwide voice connection will be wireless.

While the Internet continues to be the key networking technology, alternate technologies such as peer-to-peer technology, Bluetooth, or wireless mesh network, make it possible to deploy communications or collaborative applications without the reliance on Internet servers. Examples include local messaging systems, or RFID-based inventory management.

A number of unresolved issues remain salient. Reliability and security of networks, development and migration to new communications standards, and uneven access to networks (digital divide) are among a few but critical issues that management needs to strategize.

THE MISSION OF IS ORGANIZATIONS

With the organizational and IT environments as backdrops, we now turn to the mission of the IS organization. In the early days, transaction processing systems (TPS) acted as "paperwork factories" to pay employees, bill customers, ship products, and so on. During that era, the performance of the IS organization was defined by efficiency (or productivity) measures such as the percentage of uptime for the computer, throughput (number of transactions processed per day), and the number of lines of program code written per week.

Later, during the MIS era, the focus of IS departments shifted to producing reports for "management by exception" or summary reports for all levels of management. This era gave us the classic IS objective to "get the right information to the right person at the right time." In this era, IS was judged on effectiveness measures (in addition to the efficiency measures of the previous era).

For today's environment, the mission of IS organizations has broadened to the following:

> *To improve the performance and innovativeness of people in organizations through the use of IT.*

The objective is improvement of the enterprise, not IS; so, ideally, IS performance is based on business outcomes and business results. IT is but one contributor to improving enterprise performance and competitiveness. This book focuses on the resources used by IS organizations.

A SIMPLE MODEL

We propose a simple model to describe the IS function in organizations. Figure 1-2 represents the process of applying IT to accomplish useful work. On the left is the technology, and on the right are the users who put it to work. The arrow represents the process of translating users' needs into systems that fill that need. In the early days of IT, this translation was performed almost entirely by systems analysts.

Figure 1-3 is a simple representation of what has happened over the past 50 years. Technology has become increasingly complex and powerful; uses have become increasingly sophisticated. Information systems are now viewed as system products and users

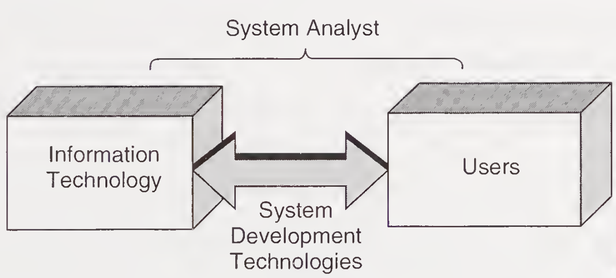


FIGURE 1-2 A Simple Model of Technology Use

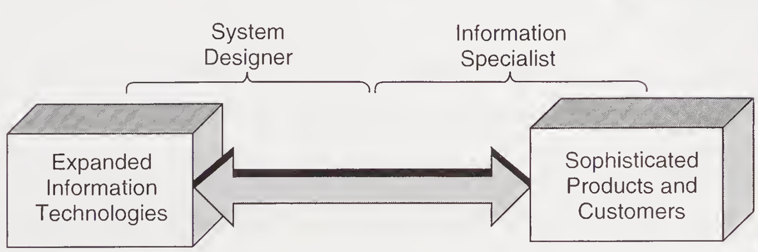


FIGURE 1-3 Systems Professionals Bridging the Technology Gap

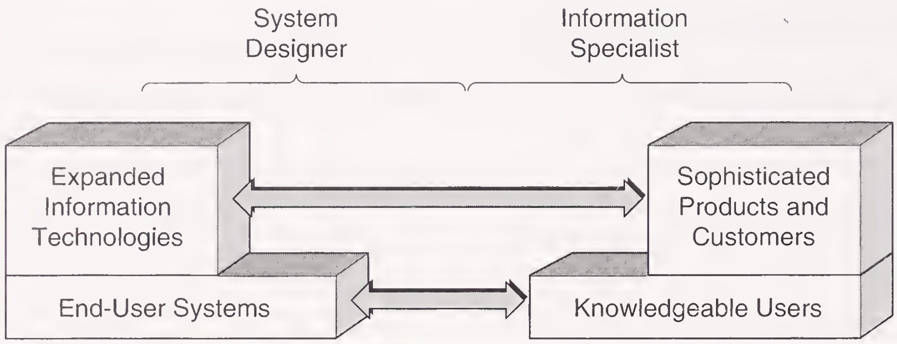


FIGURE 1-4 Users Bridging the Technology Gap

have become customers. The increased distance between the two boxes represents the increasingly complex process of specifying, developing, and delivering these system products. It is no longer feasible for one system analyst to understand the fine points of all the technologies needed in an application as well as the nuances of the application. More specialization is required of systems professionals to bridge this wider gap.

Systems professionals are not the only ones who can help bridge this gap between the technology and its users. Technology has become sophisticated enough to be used by many employees and consumers. At the same time, they are becoming increasingly computer literate; many employees even develop their own applications; hence, the notion of end-user computing. Figure 1-4 depicts this trend. Today, some of the technology is truly user-friendly, and some applications, such as Web page development, database mining, and spreadsheet manipulation, are handled by non-IT staff. Transaction systems, however, are still developed and maintained by professional developers, either inside or outside the firm.

The main point of this discussion is that technology is getting more complex, applications are becoming more sophisticated, and users are participating more heavily in the development of applications. The net result is that management of the process is becoming more complex and difficult as its importance increases.

A BETTER MODEL

Expanding the simple model gives us more guidance into managerial principles and tasks. We suggest a model with four principal elements:

1. A set of technologies that represent the IT infrastructure installed and managed by the IS department
2. A set of users who need to use IT to improve their job performance
3. A delivery mechanism for developing, delivering, and installing applications
4. Executive leadership to manage the entire process of applying the technology to achieve organizational objectives and goals

Let us look more carefully at each of these elements.

The Technologies

Several forces contribute to the increased importance and complexity of IT. One, of course, is the inexorable growth in computing and communications capacity accompanied by significant reductions in cost and size of computers and telecommunications components. Another is the convergence of the previously separate technologies of computers, telephones/telecom/cable TV, office equipment, and consumer electronics. Still a third contributor is the ability to store and handle multiple forms of data—including voice, image, and graphics—and integrate them, resulting in multimedia. Here is a brief list of some rapidly growing technology areas:

- Handheld wireless devices and multifunction cell phones
- Web Services
- Wireless networks
- Integration of voice, data, and video
- Integration of consumer electronics and IT
- Green technologies

These technologies form products that are useful to employees, customers, suppliers, and consumers. No longer relegated primarily to automating transactions, information systems now fill major roles in management reporting, problem solving and analysis, distributed office support, customer service, and communications. In fact, most activities of information workers are supported in some way by IT; the same is becoming true of suppliers, customers, business trading partners, and consumers.

The Users

As IT becomes pervasive, user categories expand. The users of electronic data processing and MIS once were relatively easy to identify; they were inside the company. These systems performed clear-cut processes in specific ways. Now, though, many people want open-ended systems that allow them to create their own processes on the fly. They want systems that act as a tool, not dictate how to perform a task.

If we concentrate only on business use of IT, one helpful dichotomy divides the activities of information workers into two: procedure-based activities and knowledge-based (or goal-based) activities. The value of this model is that it focuses on the important characteristics of information workers—their job procedures and knowledge—rather than on the type of data (e.g., numbers versus text) or the business function (production versus sales), or even job title (managerial versus professional).

Procedure-based activities are large-volume transactions, where each transaction has a relatively low cost or value. The activities are well defined; therefore, the principal performance measure is efficiency (units processed per unit of resource spent). For a procedure-based task, the information worker is told what to accomplish and the steps to follow. Procedure-based activities mainly handle data.

Knowledge-based activities, on the other hand, handle fewer transactions, and each one has higher value. These activities, which can be accomplished in various ways, must therefore be measured by results, that is, attainment of objectives or goals. Therefore, the information worker must understand the goals because part of the job is figuring out how to attain them. Knowledge-based activities are based on handling concepts, not data. Figure 1-5 summarizes these two kinds of information-based work, giving several examples from banking.

Some authors use the words "clerical" and "managerial" to refer to these two types of activities. Looking at the attributes, however, it is clear that managers often do procedure-based work, and many former procedure-based jobs now have knowledge-based components. Furthermore, the distinction between manager and worker is blurring.

Procedure Based	Knowledge Based
• High volume of transactions	• Low volume of transactions
• Low cost (value) per transaction	• High value (cost) per transaction
• Well-structured procedures	• Ill-structured procedures
• Output measures defined	• Output measures less defined
• Focus on process	• Focus on problems and goals
• Focus on efficiency	• Focus on effectiveness
• Handling of data	• Handling of concepts
• Predominantly clerical workers	• Managers and professionals
• Examples	• Examples
Back office	Asset/liability management
Mortgage servicing	Planning department
Payroll processing	Corporate banking
Check processing	

FIGURE 1-5 A Dichotomy of Information Work

The most important benefit of this dichotomy is that it reveals how much of a firm's information processing efforts have been devoted to procedure-based activities, which is understandable because computers are process engines that naturally support process-driven activities. As important as they are, though, it is clear that procedure-based activities are no longer sufficient to sustain competitiveness. The wave of the future is applying IT to knowledge-based activities. For the task "pay employees" or "bill customers," the system analyst can identify the best sequence of steps. On the other hand, the task "improve sales in the Asian market" has no best process. People handling the latter work need a variety of support systems to leverage their knowledge, contacts, plans, and efforts.

System Development and Delivery

In our model, system development and delivery bridge the gap between technology and users, but systems for procedure-based activities differ from systems for knowledge-based information work.

The left side of Figure 1-6 shows the set of technologies that form the IT infrastructure. Organizations build systems on these technology resources to support both procedure-based and knowledge-based activities. The three main categories, called essential technologies, are computer hardware and software, communication networks, and information resources. We call the management of them infrastructure management, which includes operations, that is, keeping the systems that use these technologies up and running.

The right side of Figure 1-6 shows the two kinds of information work: procedure based and knowledge based. These two categories are not distinct or separate, of course, but it is helpful to keep their major differences in mind because they lead to different approaches, and frequently different teams, in the bridging of systems development and delivery.

In between the technologies and the information workers is the work of developing and delivering both procedure-based systems and support systems.

IS Management

The fourth component of this book's model is executive leadership. IT leadership comes from a chief information officer (CIO) who must be high enough in the enterprise to influence organizational goals and have enough credibility to lead the harnessing of the technology to pursue those goals. However, the CIO, as the top technology executive, does not perform the leadership role alone, because IT has become too important to enterprise success to be left to one individual. Thus, CIOs work with their business peers, C-level executives—CEO, COO, CFO—and the heads of major functional areas and business units. The technology is becoming so fundamental and enabling that this executive team must work together to govern and leverage it well.

To summarize, this model of the IS function has four major components:

1. The technology, which provides the enabling electronic and information infrastructure for the enterprise
2. Information workers in organizations, who use IT to accomplish their work goals
3. The system development and delivery function, which brings the technology and users together
4. The management of the IS function, with the overall responsibility of harnessing IT to improve the performance of the people and the organization

ORGANIZATION OF THIS BOOK

This book is written for the current and would-be business and IS executives. As its title suggests, the book provides a comprehensive discussion of past, current and future issues related to the management of information systems in business. It raises problems, provides methods for finding solutions, and guide the users to look into the future role of IT in business, organizations and society. The organization of the book corresponds to the major parts described in Figure 1-6.

- Part I (Chapters 2 through 4) deals with the strategic issues that are the responsibility of the CIO, the IS managers and the IT governing boards. Chapter 2 focuses

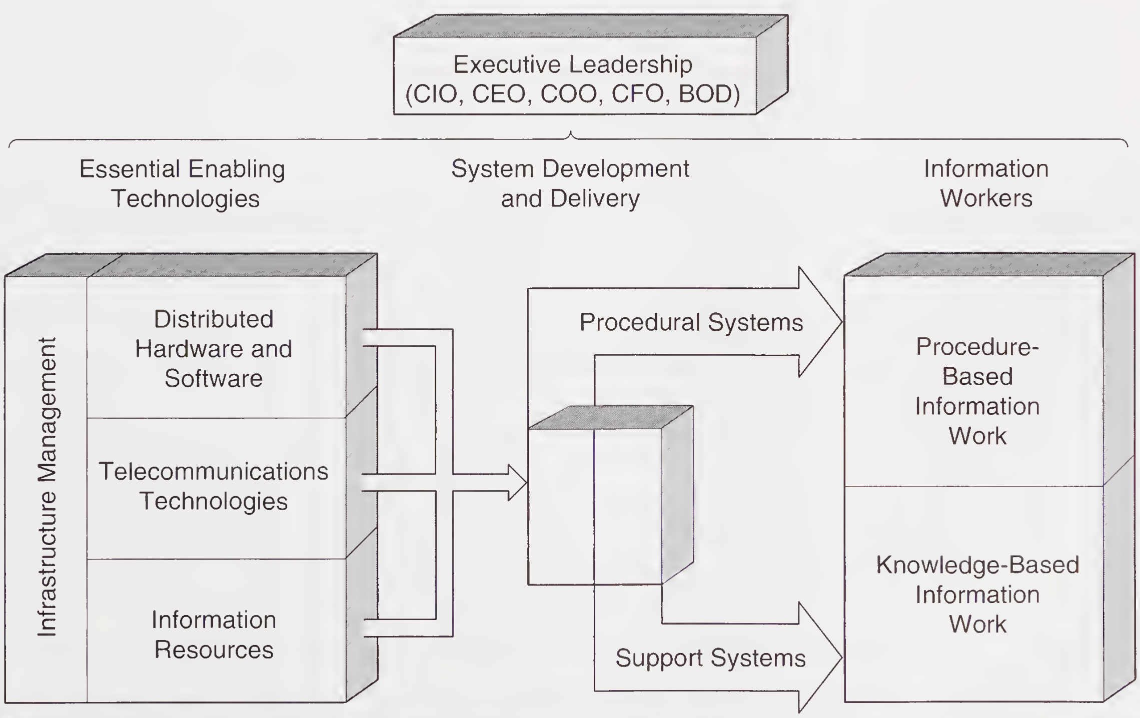


FIGURE 1-6 A Framework for IS Management

on the evolution of the IS function and the CIO's job. Chapter 3 looks at strategic uses of IT in a global economy. Chapter 4 provides a comprehensive review of information system planning techniques and methods and suggests how they could be effectively used in guiding the organization through the various stages of technological and business evolution.

- Part II (Chapters 5 through 8) discusses the management of the essential information technologies (the left side of Figure 1-6). The chapters address, in turn, the distributed systems architecture that now dominates computing, building and managing telecommunications, managing corporate information resources, and managing day-to-day partnership-based IT operations.
- Part III contains three chapters that deal with developing and delivering systems, primarily procedure-based systems. Chapter 9 describes the evolution of system development, tools and approaches, the trend toward system integration, and the growth of Internet-based development. Chapter 10 covers important issues in managing system development and delivery. We address specific issues to effectively manage legacy systems. Chapter 11 provides an overview of information security. We suggests methods to identify areas of potential threats and discuss possible solutions.
- Part IV consists of three chapters that discuss different types of systems that support knowledge work. Chapter 12 looks at using IT to support decision making and business intelligence. Chapter 13 discusses systems that support collaborative work. We cover a wide spectrum of techniques ranging from workflow technologies and crisis management. Chapter 14 shows how IT can support knowledge work in a society that increasingly relies on social networking.
- Part V, the final chapter of the book, looks to the future. We propose of number of proven principles to help managers move ahead in the networked economy.

To illustrate how one IS organization has evolved over the years, following is the case of MeadWestvaco. The story begins with the first edition of this book, in 1985. The evolution of the case study to the present eighth edition mirrors the changes that have taken place in many IS organizations over the past 20 years.

CASE EXAMPLE

MEADWESTVACO CORPORATION

www.meadwestvaco.com

MeadWestvaco, with headquarters in Stamford, Connecticut, is a $7-billion global company that produces specialty and coated paper, packages specialty chemicals, and manufactures consumer and office products. It owns and manages some 3 million acres of forest using sustainable forestry practices. The company operates in more than 29 countries, has about 24,000 employees around the world, and serves customers in approximately 100 nations.

Mead Corporation and Westvaco, two comparably sized forest products companies, merged in early 2002 to form MeadWestvaco Corporation. This case study begins in 1985 and follows the evolution of Mead's IT function up to the present time, in its merged form. In 2001, *InformationWeek* magazine listed Mead No. 193 in its top 500 of the most innovative users of information technology. The IT organization has remained in Dayton, Ohio, the former headquarters of Mead Corporation.

The 1960s and 1970s: Reorganization of Information Services

In the 1960s, Mead's corporate information services (CIS) department provided all divisions with data processing services. By 1967, the department's budget had grown so large that management decided to spin off some of the functions to the divisions. Divisions could establish their own data processing and process engineering groups or they could continue to purchase data-processing services from CIS. Many of the divisions did establish their own IS departments, but all continued to use the corporate data center for their corporate applications. In the late 1970s, the CIS department had six groups. The director reported to the vice president of operations services. The six groups under the director were:

- *Computer Operations* to manage the corporate data center
- *Telecommunications* to design the telecommunications network and establish standards
- *Technical Services* to provide and maintain systems software
- *Developmental Systems* to handle traditional system development
- *Operational Systems* to maintain systems after they become operational
- *Operations Research* to perform management science analysis

The 1980s: Focus on End-User Computing

In 1980, management realized that its CIS organizational structure would not serve the needs of the rapidly growing end-user community. Furthermore, to become an "electronic-based" organization, Mead needed a corporate-wide network. Therefore, the department reorganized so that the director of corporate information resources (CIR) reported directly to the company president. This change signaled the increased importance of information resources to Mead.

CIR was responsible for creating hardware, software, and communication standards for the entire corporation; it ran the corporate data center; and it operated the network. All the divisions used the network and corporate data center, and they followed the corporate standards; some operated their own small, distributed systems as well, which linked into the corporate network. The three departments within the new group were as follows.

Information Resources Planning and Control was responsible for planning future information systems and technology. This department grew out of the company's strong planning culture. The decentralization in the 1970s highlighted the need for a coordinating IT body. Although it was small, it had two important roles. First, it took the corporate perspective for IT planning to ensure that Mead's IT plans meshed with its business plans. Second, it acted

(*Case Continued*)

as planning coordinator, helping various groups and divisions coordinate their plans with corporate and CIR plans.

Information Services was responsible for most of the traditional IS functions from the old information services department—company-wide telecommunications support, data center operations, development of corporate-wide systems, database administration, system software support, and technical support for end-user computing.

Most divisions developed their own applications, following the guidelines created by this department. The IS steering committee—composed of the president and group vice presidents—established a policy that applications should be transportable among the various computing centers and accessible from any Mead terminal. The company's telecommunications network established the guidelines for making this interconnection possible.

Decision Support Applications (DSA) provided all end-user computing support for the company. At the time of the reorganization, DSA had no users, no products, no common applications among multiple locations, and only five staff members in operations research and two in office systems support. By 1985, they were serving 1,500 users in some 30 Mead locations with 10 staff members. DSA offered 14 products and 8 corporate-wide applications through the following 4 groups:

- *Interactive help center* provided hotline support and evaluated new end-user computing products.
- *Office systems* supported the dedicated word-processing systems and IBM's Professional Office System (PROFS), which Mead used as the gateway to end-user computing. Divisions were free to select any office system, but most followed the recommendations of this group to ensure corporate-wide interconnection.
- *Decision analysis* built a number of company-wide decision support systems, such as a corporate budgeting model and a graphics software system. It also used operations research tools to develop linear programming models and simulations for users needing such sophisticated analysis tools.
- *Financial modeling coordination and EIS* was in charge of Mead's integrated financial system. It also supported executive computing through IBM PCs used by corporate executives and an executive information system (EIS) accessed through PROFS.

Late 1980s: Structure Adjustment

The 1980 reorganization separated the more people-oriented activities under DSA from the more technical activities under the information services department. The technology was better managed, and relations with users improved. However, this split caused two problems. The first was that traditional programmers and systems analysts felt that DSA received all the new and exciting development work. The second problem was coordinating the two departments. A matrix arrangement evolved to handle both problems, with both information

(*Case Continued*)

services and DSA people staffing most projects.

The departmental structure implemented in 1980 remained essentially intact throughout the 1980s with only two major changes. In early 1988, the vice president of information resources began reporting to Mead's chairman and CEO. Second, the DSA group was reorganized.

As users became more sophisticated and less generic, the department created small groups with expertise in specific areas. By the end of the 1980s, they were supporting more than 5,000 users in three ways:

- The *service center* continued to introduce new users to technology and provide telephone hotline assistance to experienced users.
- The *application development consultants* helped users develop more sophisticated applications and guided maintenance of user-written applications, which had become a noticeable problem. They also updated traditional applications to permit end-user systems to access the data.
- The *local area experts* worked in the functional departments supporting users in their area. They reported directly to their area manager and indirectly to CIR. Due to the growing number of user-written applications, they, too, helped users keep their applications up to date.

During the 1980s, Mead found its end-user computing focus shifting from introducing new technology to making more effective use of the technology in place. By the end of the decade, Mead was concentrating on harvesting its investment in IT by using it as a lever to change the way it was doing business.

1990: Leverage the IT Infrastructure

In 1990, CIR underwent another reorganization to bring it in line with a new strategy. We first discuss the reorganization, then the strategy.

Management realized that the end-user systems and large-scale business systems needed to cross-pollinate each other. Users needed one place to go for help; therefore, application development was placed in one group, which was renamed information services.

The emphasis of the reorganization was to strengthen Mead's mainframe-based infrastructure that the corporate-wide network depended on. Although the network had been created in 1983, its value in connecting Mead to vendors and customers had not been recognized until the late 1980s. Therefore, in 1990, CIR created a new group—network services—to handle computer operations, technical services, and telecommunications. The 1990 reorganization also consolidated administrative functions (such as chargeback) into the technology planning and control group.

Although the 1990 reorganization did not add any new functions, it shifted emphasis from end-user computing to building an infrastructure and integrating development of all sizes of applications.

1990 Strategy In the early 1980s, Mead installed its first information resources business plan, which emphasized networking and end-user computing. By the late

(*Case Continued*)

1980s, the objectives had been accomplished. In hindsight, management realized the 1980 plan had been a technology plan, not a business plan, because its goal had been to get control of IT. Having accomplished this goal, Mead decided to create a true business plan, one that addressed its employing IT resources.

Using the two-by-two matrix management realized that Mead had only been building systems that fit into the lower-right quadrant—systems to support traditional products and internal business processes. Rather than focus on company operations, management decided to shift emphasis in two directions: (1) toward reengineering company operations and (2) toward using IT to work better with suppliers and customers.

Business process reengineering—that is, significantly restructuring the internal operations in a business—became a major strategic direction, with the companywide network playing a key role. Because IT removes many time and distance barriers associated with business processes, Mead decided to use IT to build new processes rather than simply accelerate existing ones.

One of the major processes carved out to be recentralized and reengineered was purchasing. The reengineering group discovered, for example, that 240 people handled accounts payable, mainly reconciling mismatches between goods received and purchase orders. By reengineering purchasing, the need for such reconciliations was eliminated. Mead outsourced the function while developing the new purchasing system.

Putting in the corporate purchasing system was Mead's first big venture into reengineering. The company learned a lot from that experience. It also accomplished something few others had achieved: standard part numbers for all 800,000 MRO (maintenance, repair, and operations) parts. This excruciating data-cleansing exercise was done so that Mead could automatically consolidate parts orders from all 10 divisions and reap larger discounts due to the higher volumes. The result was large savings.

The second emphasis involved doing business electronically by extending current business processes and products to suppliers and customers. The motto was: "It is easy to do business with us," meaning that customers could specify the transaction format they wished to use, from electronic data interchange (EDI) for application-to-application transactions across company boundaries to terminals at customer sites linked to Mead's computers to the telephone using voice response. In essence, Mead installed various front-ends on its mainframe applications. For the purchasing system, Mead went to major parts suppliers and required them to use EDI as a condition of selling to Mead. The system was fully automatic. If a part was in stock, it was supplied; if not, an order was generated.

Thus, the basic strategy set forth in 1980 remained in force in 1990—to retain central control of the IT infrastructure and distribute responsibility for building and maintaining applications in the operating divisions. As the uses of IT changed, CIR reorganized to focus on those new uses: end-user computing in the 1980s and business reengineering and customer-oriented systems in 1990.

(Case Continued)

The 2000s: Technology Integration and Creation of a Global, Process-Based, Business-Driven Organization

In 1993, CIR management recognized that client-server computing was a paradigm shift in computing. In their new vision, applications would be of three types: enterprise-wide, division, and local; and they would use a global network that reached out beyond Mead.

CIR continued to focus on shared services (providing the infrastructure and supporting enterprise applications), whereas divisions would tailor systems to their customers and business. Users would not need to worry about where processing occurred, where data was housed, or how the mechanics of information processing were handled; CIR would handle all of these details. Data were to be viewed as a resource and managed accordingly, balancing access with integrity and security. Users would have greater geographic independence than in the past.

This vision is based on a demanding partnership in which the divisions buy into the infrastructure and its standards while CIR provides a flexible and responsive infrastructure.

New Organizational Structure Mead sought to absorb the new client-server paradigm into CIR's organizational structure. The core was the technology layer of the CIR organization—the four core technologies that provided the IT infrastructure on which Mead operated. Data Services provided data and information. Server Technology Services handled all servers on the network, from mainframes on down. Client Services handled all devices that customers touched, which included desktop workstations, fax machines, and telephones. CIR defined their customers as Mead employees as well as others who interfaced with Mead. Network Services handled everything that tied these other pieces together, both voice and data communications, as well as the Internet, intranet, gateways, firewalls, and interactions with their ISP.

On the outside layer of the organization chart, closer to the customer, were the application groups. Division Support supported the applications developed by Mead's 10 operating divisions. Reengineering Support was concerned with a few company-wide business processes that had been recentralized and reengineered to improve efficiency and lower costs. These processes included Mead's financial systems and purchasing system, which did not touch customers. Enterprise Tools and Applications provided a common desktop toolkit to all Mead staff, which consisted of hardware and a suite of software products, such as spreadsheet, e-mail, word processing, graphics, browser, EDI, and knowledge tools (such as Lotus Notes). Corporate Center Solutions handled application development and maintenance of corporate applications. Technical Standards and Planning was a one-person thinktank devoted to future scenarios, whereas everyone else worked on the day-to-day issues. Finally, CIR Administration, shown beneath the circle, handled contracting and financials.

Like other companies, Mead encountered the typical staff problems of getting the mainframe staff to move into the client-server environment and getting new client-server talent to follow the

(*Case Continued*)

discipline needed to develop enterprise-wide systems.

The Internet had a large impact on Vision 2000 in that more and more of the vision was being served by it. For example, the vision foresaw storing lots of data on servers, so that CIR, not users, could handle backup. However, with so much information on the Internet, CIR did not need to acquire, install, or maintain as much public information as was originally planned. For instance, CIR had planned to install the U.S. telephone directory on a CD-ROM server. After it became available on the Internet, CIR simply added an icon to the standard desktop for quick access to the directory.

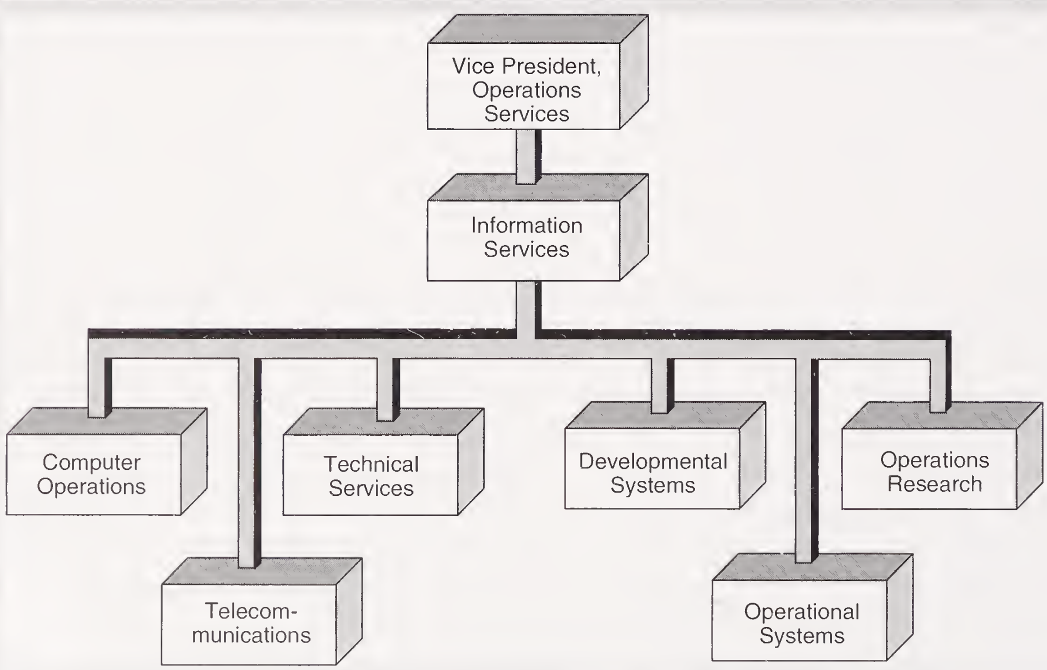
Mead learned that client-server computing was not cheaper than mainframe computing, as was touted in the early 1990s. In 1993, Mead placed the cost of a PC at $9,024 a year ($2,517 hard costs, $6,507 soft costs). With the new standards, Mead believed the soft costs had been cut to $3,005 a year.

The vision was conceived in 1993, implementation began at the end of 1994, and by 2000, right on schedule, the company rolled out 8,000 workstations. During that time, only one change was made to the organization structure: adding Vision Support Services to handle operations (Figure 1-7).

Into the 2000s: Leverage Centralization

By 2003, Mead would have spent $124 million dollars on the endeavor. The first division went live in late 1999, the second in 2000, and so on. Thus, from the 1960s to 2000, Mead's Information Resources

FIGURE 1-7 Mead Corporation's Pre-1980 Information Services Department



Source: Courtesy of the Mead Corporation.

(*Case Continued*)

division would have moved from significant decentralization to significant centralization of systems.

Implementing ERP In the early 1990s, Mead looked at SAP, the leading ERP system, but decided that the software was not appropriate for the forest products industry. In 1995, Mead looked again, and although the software was better, management felt the company did not have the necessary companywide standards, so it declined to move forward on ERP again.

In 1997, though, management forced the issue. The company had increasingly been using a shared-services vision, where functions were taken out of divisions and centralized, making them best-of-breed. Logistics, purchasing, finance, and information resources were provided via shared services. This collaboration left the divisions with the customer-facing work. Management saw a train wreck coming once the first division wanted to install an ERP system. The company would then have to decide, "Do we want to be good at satisfying customers or have good shared services?" Management decided, "We have to do both." To do so, they had to put in the same ERP system companywide to leverage back-end shared services and be number one in customer satisfaction.

Mead spent 1998 determining the design of the enterprise-wide system and began implementation in the first division in 1999. From the reengineering work on the purchasing system in the 1990s, Mead learned that significant company change required business leadership, thus the SAP effort was led by a business executive, and 70 of the 100 team members also came from the business; only 30 came from CIR. In addition, some 80 IBM consultants were involved. Mead chose IBM as its SAP implementation partner because IBM had helped Monsanto implement SAP and had created the IBM/Monsanto Solution Center. Mead was able to draw on that center and Monsanto's experience and even reuse 80 percent of Monsanto's business design, down to the general ledger, giving Mead a running start. ERP implementations are huge and expensive, and many have failed. Mead avoided those pitfalls by learning from others.

Mead used the entire suite of SAP modules except human resources, which was handled by PeopleSoft; it was installed in the mid-1990s and has worked well. Mead was one of the first to install a recent module, Advanced Optimization Planning (AOP), which handles all planning and scheduling. SAP was originally designed to support build-to-inventory manufacturing, which is 60 percent of Mead's business. AOP is for the other 40 percent, which is build-to-order manufacturing.

Lotus Notes, a sophisticated database/executive information system from IBM, was invaluable in providing the building blocks for defining the new ways of working under SAP. SAP required Mead to define 800 roles and describe the workflows and security flows among these roles. This task was not handled by SAP, so Mead used Lotus Notes for it and other SAP support work.

SAP unified the company, but it is a large and complex system. In addition, it requires strict adherence to its rules, which is its downside. A division can no longer tailor its own systems to meet its market's changing needs; in some instances, changes can be accommodated easily, but for major changes it must get concurrence from the

(*Case Continued*)

other seven divisions to change SAP. This could make Mead less nimble; it remains to be seen.

As SAP was turned on, old systems were turned off. In fact, SAP replaced the last generation of systems Mead built itself. Now, all software work is integrating packages, or systems integration. Nothing is coded from scratch. Once SAP was implemented, the development work done by the divisions went away through natural attrition. However, each division has an executive information officer, who mentors the division and coaches it on how to use IT. They focus on reengineering to leverage SAP. They are businesspeople with IT exposure and IT people with business exposure.

E-Commerce The greatest effect of the new implementation has been internal. Mead's intranet has become the way the company conducts its business processes. The homepage is employees' gateway to most of what they need to do at Mead. SAP is browser based.

Mead would have preferred to implement e-commerce on SAP because e-commerce exposes all of a company's legacy-system inefficiencies. However, the company could not wait until 2003, and because its legacy systems still functioned in 2000, it put browser-based front ends on its legacy systems. Once SAP was in place, only the system interfaces needed to change.

In some sense, Mead sees B2B e-commerce as old wine in new bottles. In 1986, Mead built a cluster terminal system for its paper business. The system was proprietary; it ran on Mead's network, and Mead gave proprietary terminals to customers to order paper. Even though the terminals were only character based, with no graphics, customers could see Mead's stock levels, delivery times, and prices. One-third of its business came through this system. In 2000, the system became Internet based. All a customer needed was a browser to log into Mead's extranet to place orders.

However, Mead discovered that although it broke down its own internal silos in installing SAP, it encountered silos in customers' operations. True end-to-end e-commerce will not occur until these partners improve their internal operations.

Peering into the Future in 2000: Merger and IT Alignment In 2000, Mead's industry, like most others, was experiencing unprecedented global competition. To survive, a company needed to become larger or become a niche player. Mead expected to be one of the survivors, and management saw SAP aiding in achieving that goal. If, for example, Mead acquired another company, it would be able to merge operations within 90 days because of SAP. That capability made SAP a valuable acquisition tool.

"The CIO job has definitely changed since 1985," says Langenbahn. "In the 1990s, we always talked about IT being strategic, but it was really a wish. In 2000, it is reality. The role of the CIO has become more strategic and the role has grown, but at the end of the day, information technology is inherently valueless. Value is created by business change and true business change cannot be led by the IT side; it must spring from the business side. The major role of the CIO is to bridge the gap between the business and technology, and to have the enabling technology in place to deliver what the business requires, although the business might not as yet realize what it requires."

(*Case Continued*)

To be a leader in this fragmented market, Mead had to grow. One route would be to grow internally, but with too much capacity already in the market, this option made little sense. A second route would be to acquire companies and consolidate. Management declined this option because of its unfavorable economics, saying, "You always overpay when you buy another company." The third choice was to merge with a competitor of comparable size. That was the route chosen; Mead and Westvaco combined their assets without taking on any debt in 2002.

John Langenbahn saw the merger through and then retired, turning over the CIO job to Jim McGrane. Langenbahn wanted to ensure that it was viewed as a business investment, not an IT investment. Therefore, the project lead, McGrane, worked for the business executive who chaired the SAP steering committee. Both McGrane and Langenbahn were on that committee. Their goal was to create a process-centered IT organization, because with the implementation of SAP and its focus on processes, CIR's new role would be working on business process design enabled by IT. CIR was renamed Enterprise Information Solutions (EIS) to reflect its scope and its mission: process solutions, rather than systems.

Evolving to a New Process-Centered Structure Balancing centralization (and standardization) with local autonomy caused an age-old tension. McGrane dealt with this tension through a "strategic conversation between the corporation and EIS" to decide how MeadWestvaco would address it. The issue was governance: Who would be making which decisions? "Restructuring EIS is very akin to what the framers of the U.S. Constitution struggled with," noted McGrane, "instituting a federal government while preserving states' rights. IT has moved from a mysterious, technical backroom activity into the mainstream, so we now need to hold this business-EIS conversation to do the same."

As an interim step, McGrane put in place the outlines of a new EIS organizational structure, one that would facilitate the creation of a process-based, business-driven organization. He viewed the former Vision 2000 structure as taking a techno-centered view of the world—with a workstation in the center, surrounded by services, and then an application layer. The new structure took a process view.

The interim organization, as shown in Figure 1-8, included:

- *Planning and Administration*, which included an information standards and policy quarterback
- *Technical Services*, which was in charge of application design and staging processes
- *Chief Technology Officer*, who was in charge of architecture
- *Operations*, which was in charge of the deployment process
- *Manufacturing Solutions*, which built and maintained mill and manufacturing support systems
- *Business Solutions*, which included ERP, emerging solutions, and other business systems. Members of this group also handled sunrise/sunset systems, which means they were in charge of managing down ("sunsetting") legacy systems as SAP was implemented in plants and replaced those systems and explored emerging ("sunrising") technologies.

(*Case Continued*)

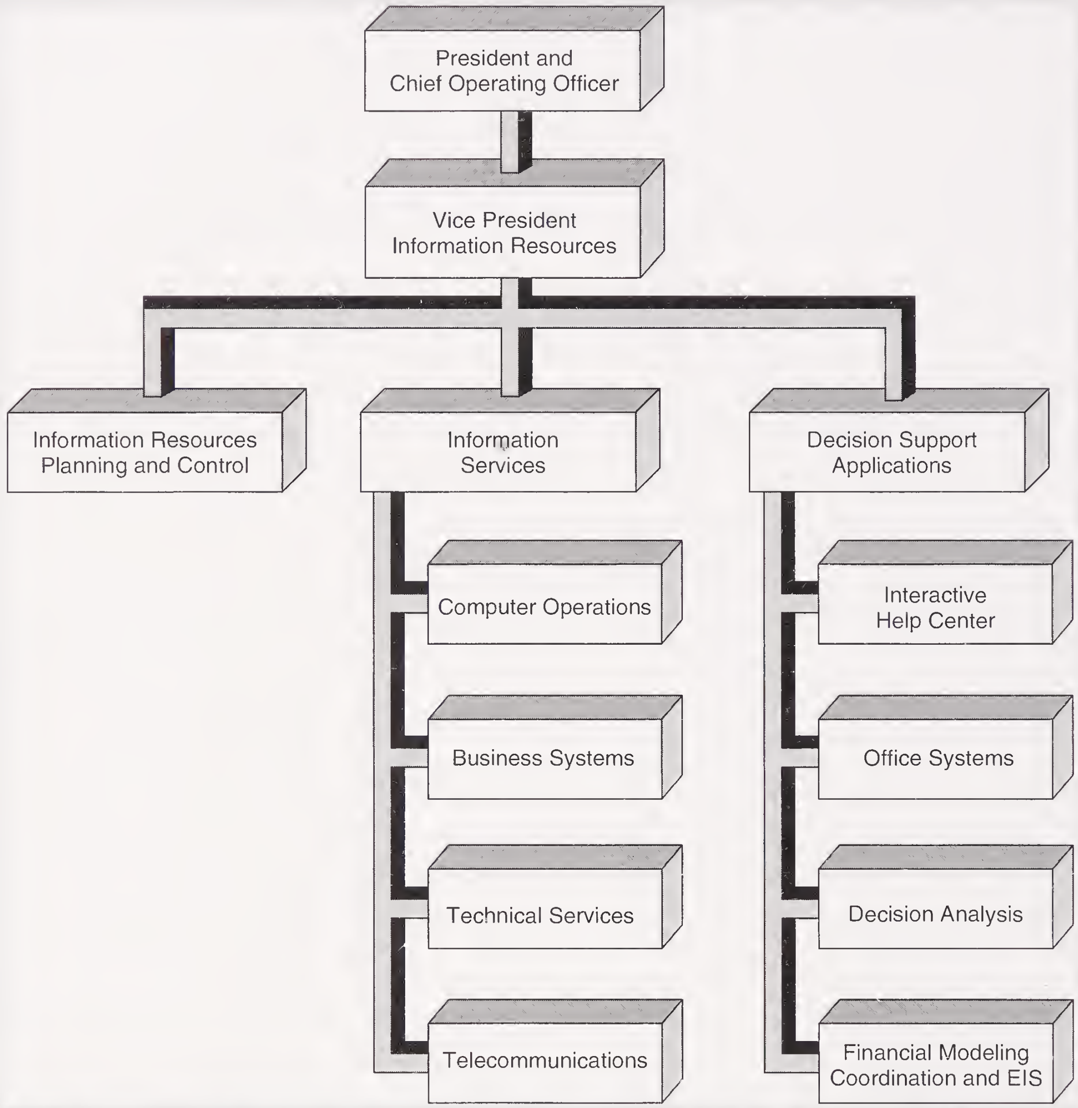


FIGURE 1-8 Mead Corporation's 1980 Information Services Department

Source: Courtesy of Mead Corporation.

McGrane's goal was eventually to evolve EIS along three major areas of focus:

1. *Business Processes and Applications* so that EIS was viewed as a business enabler
2. *Infrastructure* so that by designing and developing the right kind of infrastructure, business processes could be automated using advanced software applications
3. *Administration* to ensure return on investments, end-user education and support, asset management, information security, and business continuity, to name just a few

(*Case Continued*)

Within these three areas, a series of processes needed to be defined. For example, one administrative process was security. Creating this process started with defining it, stating policies and procedures (that is, what was to be protected), and then creating tasks to ensure execution. Today, people who do security work reside in different functions throughout the company. The question McGrane asked was, "Do we organize them around a security process or use a matrix, with a security quarterback?" The business goal was end-to-end security and protection of vital information. To achieve that, the company had to move from viewing security as an activity to viewing it as a process. This was the organizational challenge.

This three-area focus had actually been in use since preplanning for the merger. The integration teams were organized around these three areas. Each team's objectives were to find synergies and adopt standards. Adopting Mead's SAP model, for example, shaved millions of dollars off future expenses.

During the first four months following the merger, the new EIS team closed down Westvaco's data center and migrated the systems to Dayton. Desktops, networks, and e-mail systems were migrated to one standard each. In integrating the two IS organizations, EIS saved additional millions of dollars and freed resources to focus on more strategic investments.

Creating a Governance Structure A major issue was investment. How could the company ensure that the EIS portfolio was aligned with the business strategy? And how could EIS engage the business units in constructive conversations about what to do next? How would the company decide between, say, an investment in infrastructure and an investment in a Web-based application? Should they be measured the same way? What should the measurements be?

Based on research outside the organization, McGrane estimated that perhaps only 50 percent of an IT organization's investments were aligned with the business's goals because there have been few mechanisms for holding conversations with the business. MeadWestvaco knew it could not afford that level of misalignment. Now that EIS spending was more than 3 percent of sales (rather than 0.5 percent in the 1970s) and embodied how the business operated (such as how orders were filled), business-IT conversations had to become the norm. From the mechanisms used to hold these conversations, EIS's organizational structure would emerge.

Thus, EIS experimented with some governance structures. To govern overall IT investments, for example, an executive steering committee was formed. It consisted of the executive vice presidents of the business units, the CFO, CIO, and head of manufacturing research and development. These seven executives meet monthly to review and approve new investments and resolve conflicts. MeadWestvaco moved toward an IT investment portfolio with four "buckets":

1. ***Infrastructure:*** Value is measured by total cost of ownership (TCO) benchmarked against the world.
2. ***Utility applications:*** These included payroll, compliance software, and such; value is measured by benchmarked TCO.
3. ***Business applications:*** Value is measured by return on investment (ROI). The total cost of the

(*Case Continued*)

application will be made visible. Thus, if it requires modifying or expanding the infrastructure, that cost will be made visible.

4. ***Emerging and experimental applications:*** No expectations are made of these investments, which deal with technologies that might transform the business but have associated technology risks. ERP was experimental in 1995; reverse auctions and Web applications were experimental in 2002. This category is no more than 5 to 10 percent of EIS's budget.

Extending Standardization Administration of most of the development resources was centralized. Formerly, business units managed their own IT developers. "We are finding that as we engage in conversations that make total cost visible, and we provide alternatives that deliver equal value at lower cost, we have arrived at a point where the business units are willing to give centralization of development a try," says McGrane. SAP has actually driven this move; its development was centralized and its configuration is centrally controlled. As SAP replaces the legacy systems, the business units' need for local developers has gone away. EIS extended that central model to Web technology; most development was central.

To balance the tension between centralization and local needs, EIS worked with business leadership to create governing councils, which include business leaders. These councils "own" specific processes and direct the technology enhancements required to improve those processes. The benefit of these councils, notes McGrane, is that once a council approves an enhancement, that enhancement happens across the corporation at one time. Thus, an improvement in plant maintenance occurs at all the plants; the businesses decide the priorities, and they occur company-wide.

Implementing ERP drove MeadWestvaco to leverage resources to solve problems as a joint entity. The company came to see that a problem for one is generally a problem for all. Thus, central design is leveraged. The result is that a business unit that wants to make a change needs to have conversations with the others, and those conversations revolve around what is good for the whole.

"The answer might not be reached as quickly, but it is a more effective answer," states McGrane. "Our business does not change at Web speed. So needing to make a decision quickly is often a red-herring argument. Standardization has forced real business discussions to occur. And it is forcing our business leaders to become more technology literate, and those of us in EIS to become more literate about the business issues we are trying to solve. That's all for the good." McGrane was elected vice president in 2002.

2004: Creating the Process-Based, Business-Driven EIS Organization

In mid-2004, McGrane was two years into his five-year plan to turn EIS into a process-based and business-driven organization. "It's a bit tougher than I expected," he admits. According to McGrane:

> *It's essentially reengineering the organization from being functionally oriented to being process oriented. We are moving from managing work to managing outcomes.*
>
> *We characterize our future state as "nimble," where IT is embedded in*

(*Case Continued*)

our business strategies and we in EIS can support change without disrupting our operation, which is global, mobile, and always-open-for-business.

If you look at what it will take to survive, CIOs have to figure out (1) how to achieve better strategic alignment across the corporation, the business units, and IT investments; (2) how to deliver high-quality service while driving out costs; and (3) what the right organizational model for IS should be. We don't yet know the right organizational model for EIS, but we do know we must transition our skill set from managing subordinates to negotiating and delivering services.

During their due diligence on how to put the theory of process orientation into practice, McGrane's team discovered ITIL (Information Technology Infrastructure Library), a process-based framework for managing IT service delivery. Rather than start from scratch on defining IT processes, ITIL has been adopted.

"We chose ITIL because it supports our strategy. It focuses on service management—aligning services with future needs, improving service quality, and improving long-term costs—just the issues we need to solve," says McGrane.

ITIL ITIL was developed by the U.K. Office of Government Commerce (OGC) in the late 1980s to improve IT service delivery by the U.K. central government. The result was a set of books that describes best practices in IT service delivery. The books, edited by OGC, were written by numerous organizations and verified by others.[6] An entire industry has grown up around ITIL, providing training, consulting, certification, and even trade associations.

The main tenet of ITIL is that the IT infrastructure—which includes not only hardware and software but also skills, communications, and documentation—supports the delivery of IT services and thus needs to be managed professionally. ITIL calls this management IT service management, and it has two main sets of IT management processes: service delivery and service support. The two ITIL books on these subjects describe the key components of these processes and provide guidance on how to create and operate them.

Service delivery is composed of five tactical processes, all aimed at the long-term planning and improvement of IT services:

- *Availability management* is the process of optimizing the capacity of the IT infrastructure.
- *Capacity management* is the process of managing resources at a time of high demand (such as a crisis) and predicting the need for extra capacity in advance.
- *IT service continuity management* is the process of managing the organization's ability to continue providing an IT service after a business interruption.
- *Service-level management* is the process of continually improving the quality of an IT service.
- *Financial management for IT services* is the process of being a good steward of the organization's money.

Service support is composed of one operational function and five operational processes. All aim to ensure that customers have access to the services they need to support their business. The

(*Case Continued*)

processes differ from the function in that they are measured by their outcome:

- *Service desk* (a function, not a process) provides one point of contact for users.
- *Incident management* is the process of restoring a disrupted service.
- *Problem management* is the process of diagnosing the causes of incidents and preventing them.
- *Change management* is the process of handling changes efficiently.
- *Release management* is the process of managing new versions of a service.
- *Configuration management* is the process of managing all the components of a service or the infrastructure.

The five other ITIL books deal with the processes of security management; infrastructure management (such as managing network services); application management; planning to implement service management; and three books for business managers on integrating IT into the business in times of change, dealing with transitions in the IT infrastructure, and understanding the role of managers in improving IT service delivery.

Implementing ITIL at MeadWestvaco The EIS structure McGrane implemented in 2002 has not changed. Four major steps toward the transformation of EIS have been to (1) put IT governance in place, (2) assign the first business relationship manager, (3) begin creating the service catalog, and (4) pilot test three ITIL-based processes.

IT Governance Is in Place. "In our industry, the economics dictate that we centralize IT to cut costs. We cannot afford decentralization. To achieve business alignment, we are using IT governance structures," notes McGrane.

The overall model is one of stewardship; that is, actively managing the assets that have been entrusted to us for the good of the organization. The three bodies handle IT governance:[7]

- The *EIS Steering Committee* acts as an internal board of directors for IT. It is chaired by the business, approves IT's strategic direction, oversees IT investments, and resolves disputes.
- The IT Council represents the interests of the business units and the corporation. It is chaired by the CIO and includes information officers from the units. On the one hand, the members advocate projects that drive unique value for a particular business. On the other hand, they present decisions to their respective areas to ensure alignment. The council also drives standards, oversees service level management, and approves the IT infrastructure.
- Business Performance Teams represent the interests of business process teams. They are chaired by process owners or business leaders, they drive initiatives aimed at improving business performance, and they ensure that standards are being followed.

The First Business Relationship Manager Has Been Assigned. So far, one business relationship manager has been assigned to a MeadWestvaco business unit. This senior IT executive acts as both coach

(*Case Continued*)

and account executive for that unit—a step toward improving "the interface point" between EIS and the unit. Together, McGrane and the business unit's head (who was very open to having such an intermediary) decided on the new appointment. He was chosen for his business–IT acumen. Others will be chosen for the same capability.

"The benefit of this new position is that the business unit gets a single point of contact," says McGrane. "Later, these managers will become their unit's advocate within EIS. The benefit to us in EIS is that we will get better information coming back to us from the business units. The goal is more efficient and effective relationships."

The EIS Service Catalog Was Developed. The service catalog essentially documents the EIS–business conversation about what services EIS provides and what users and customers expect. It is a major part of the transformation, so EIS is going through formal planning stages to create it.

It contains a high-level listing of EIS's services, productivity tools, connectivity options, applications, consulting, and application development services. Each service has a service-level agreement that tells users and customers what to expect, and the cost. To support these services, EIS puts in place the formal ITIL support processes noted earlier.

ITIL is actually very complex. Each process has subprocesses (activities and tasks). Tasks become roles. Roles are aggregated into jobs. Once defined, McGrane faces the challenge of introducing this process-based organization into his current function-based organization. McGrane is spending about 50 percent of his time on this internal reorganization, 40 percent of his time on corporate and business unit issues, and 10 percent with MeadWestvaco customers. He says, "That's not enough time outside the company. Once the internal reorganization is accomplished, I hope to be working more externally with our larger customers, to exploit supply-chain technologies. At the moment, that work is happening at a lower level."

The Role of the Business "For business executives to be truly involved in guiding IT, they must have a fairly high level of IT maturity," notes McGrane. He continues:

> *In essence, they need to know as much about using IT to run their business as they already know about finance. They must be able to judge the value of an IT investment and balance that value against the operational changes they will need to make (in processes, people, investments).*
>
> *IT investment decisions are complex, and IT vendors' commercials do not portray this complexity. I wish they would stop promising simple silver bullets—like "Just outsource everything to us and we'll handle it for you"—because they are creating a hostile environment between IT and the business. In reality, we could not afford to outsource all IT to a vendor—nor would we.*

The IT governance structure, the business relationship managers, and the process teams are creating the context for the in-depth IT-business conversations that need to take place for the business

(*Case Continued*)

executives to understand the IT issues and become truly involved in guiding IT. They are a start to MeadWestvaco's emerging ITIL model.

Thanks to the new IT infrastructure, MeadWestvaco has reinvented its culture, business practices, and innovation. Its ability to effectively manage customer relationships has led to new solutions. The global company has been recognized as the power behind the consumer package. ■

QUESTIONS AND EXERCISES

Review Questions

Review questions are based directly on the material in the chapter, allowing the reader to assess comprehension of the chapter's key principles, topics, and ideas.

1. What changes are taking place in the external business environment?
2. What changes are occurring in the internal organizational environment?
3. What are the goals of the new work environment?
4. Give two or three characteristics of the technology trends in hardware, software, data, and communications.
5. What is the mission for the IS organization recommended by the authors? How does it differ from earlier perceptions of the purpose and objectives of information systems?
6. Summarize the four main components of the model of the IS function (Figure 1-6).
7. List several attributes of procedure-based and knowledge-based information activities. Which do you think are most important? Why?
8. How did Mead focus on end-user computing in the 1980s?
9. What was Mead's 1990 strategy?
10. Why did Mead choose to implement ERP?
11. Give an example of a MeadWestvaco governance structure to govern overall IT investments.
12. What four "buckets" is MeadWestvaco moving toward to define its IT investment portfolio?
13. What has been the effect of ERP on MeadWestvaco's decision making?
14. As of mid-2004, what four steps had McGrane taken to transform EIS into an ITIL-like, process-driven organization? Briefly describe each step.
15. Describe the three IT governance bodies at MeadWestvaco and what each does.

Discussion Questions

Discussion questions are based on a few topics in the chapter that offer a legitimate basis for a difference of opinion. These questions focus discussion on these issues when the book is used in a seminar or classroom setting.

1. Even though the PC dispersed control of processing power out of the IS organization, the Internet is returning control to the department. Do you agree or disagree? Discuss.
2. Do we really need a major change in the way the IS function is structured? Are the necessary changes just minor modifications to accommodate normal growth in computer uses? Discuss.
3. The procedure–knowledge dichotomy does not add much beyond the clerical–-managerial distinction. Do you agree or disagree? Give reasons for your opinion.
4. The Internet-based economy is going to end up just like the old economy with the huge conglomerates controlling everything. Do you agree or disagree? Is this situation desirable or not?
5. Discuss the limits and boundaries of the Internet. How pervasive is it in our lives, as workers and consumers? How it will affect the business landscape in the next 10 years?

Exercises

Exercises provide an opportunity for the reader to put some of the concepts and ideas into practice on a small scale. In particular, one exercise in each chapter requires a student, or a team of students, to visit a local company and discover how the ideas in the chapter are being implemented in that company.

1. Show how MeadWestvaco's 2002 interim organizational structure compares with the model in Figure 1-6 by entering its functions on the figure.
2. Contact a company in your community and prepare a diagram and narrative to describe the structure of its IS function. Compare it with Figure 1-6 and with MeadWestvaco's current structure.
3. Find an article about how companies are melding the Internet with their traditional ways of working. Present those ideas to your peers.

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PART

I

LEADERSHIP ISSUES IN THE DIGITAL ECONOMY

Part I consists of three chapters that address leadership issues of managing the IT arena, which includes information, IS, and IT in organizations. This part deals with the shaded portion of the following figure—executive leadership—which is based on Figure 1-6 of Chapter 1, the conceptual framework for this entire book.

The leadership of CIOSs is no longer limited to IS functions. Increasingly, CIOs share the top leadership role with the CEO and other C-level executives. Together with other members of senior management, they not only take care of issues internal to the organization, but play a critical role in managing external relations. If top management wants technological progress to continue to drive economic expansion and innovation, it has to focus more on new IT deployment that makes a competitive difference. Managing and nurturing this strategic and shared relationship is an underlying theme of this book. Failure to do so risks diminishing the CIO role to cost-cutting and maintenance.

Another theme of Part I is to emphasize the role of the CIO in the Internet economy. In the connected economy, IT has proved to profoundly change the way people work and relate to their co-workers, customers, and suppliers. The challenge is to establish a sound e-leadership.

Chapter 2 discusses the changing structure of the IS organization and four areas of responsibility for CIOs. Chapter 3 discusses strategic uses of IT. Chapter 4 completes this leadership part by discussing the changing world of IS planning and a number of planning approaches and techniques.

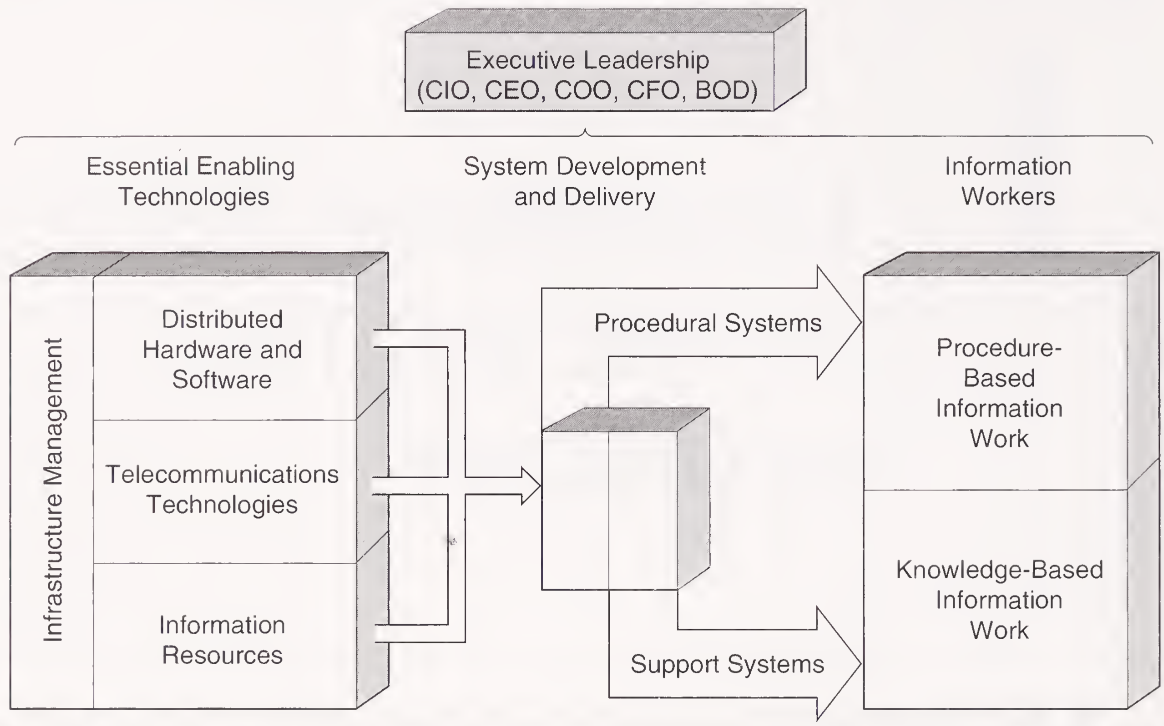


FIGURE P1-1 A Framework for IS Management

CHAPTER

2 THE TOP IS JOB

INTRODUCTION

According to the Bureau of Labor Statistics, the number of IT managers employed in the United States jumped 44 percent in 2006 since the dot-com burst of 2001. More interestingly, IT managers account for more than 11 percent of IT employment, the fourth-largest tech job category. Software engineers, computer scientists, and system analysts and programmers represent the largest groups of the IT workforce. At Dell, one in nine IT employees is a manager; a decade ago it was one in 15. Dell argues that smaller teams are required to deal with cutting-edge technology and evolving business requirements. According to a recent survey conducted in January 2007, by OCR

Worldwide, a New York–based provider of human resource management consulting and data services, the majority of U.S. firms echoed this sentiment. Finding, developing, and keeping talent will be among the top concerns for management.

The management of IT in organizations has changed drastically over the past 50 years. In the early years, the big job was to manage the technology—get it working, keep it running, and reduce the cost of doing business. Later, the main thrust was to manage the information resources of the organization, particularly to support management decision making by delivering information when and where it was needed. Today, IT is pervasive in organizations and is a mandatory link between enterprises, business partners, and competitors alike. Hence, it affects every aspect of organizational operations and performance and is leading to the formation of "business ecosystems" in which organizations operate. Proper deployment of IT can determine an organization's growth, direction, structure, and sustainability.

In this book, the term "IT" is used to denote the technology, whereas IS is used to denote the organization that manages IT. The responsibilities of the head of IS now go far beyond operating highly efficient "production programming shops." These executives are now part of top management and help form the goals of the enterprise in partnership with the CEO, CFO, and other C-level members of top management. Yet, the CIO is the focal point for IT deployment.

In this chapter, we look at two dimensions of the top IS job. First, we ask the question, "Where is the IS organization headed?" Second, we look at the responsibilities of CIOs.

WHERE IS THE IS ORGANIZATION HEADED?

The roles and responsibilities of the IS organization have been evolving since the first electronic data-processing departments were formed in companies in the 1950s. We set the context for discussing this evolution by looking at the escalating benefits of IT, which in turn change the way executives view IS's role in the business.

The Escalating Benefits of IT

Kenneth Primozic, Edward Primozic, and Joe Leben, authors of *Strategic Choices*,[1] present one view of the evolution of IT and the escalating benefits it provides firms. They introduce the notion of "waves of innovation," which they define as how IT is used by industries and by enterprises. They identify five waves of innovation, as shown in Figure 2-1, with time on the horizontal axis and benefit on the vertical axis. We add the sixth wave to this view. The waves are:

- Wave 1: Reducing costs
- Wave 2: Leveraging investments
- Wave 3: Enhancing products and services
- Wave 4: Enhancing executive decision making
- Wave 5: Reaching the consumer
- Wave 6: Leveraging partnerships through supply-chain management or other forms of collaboration

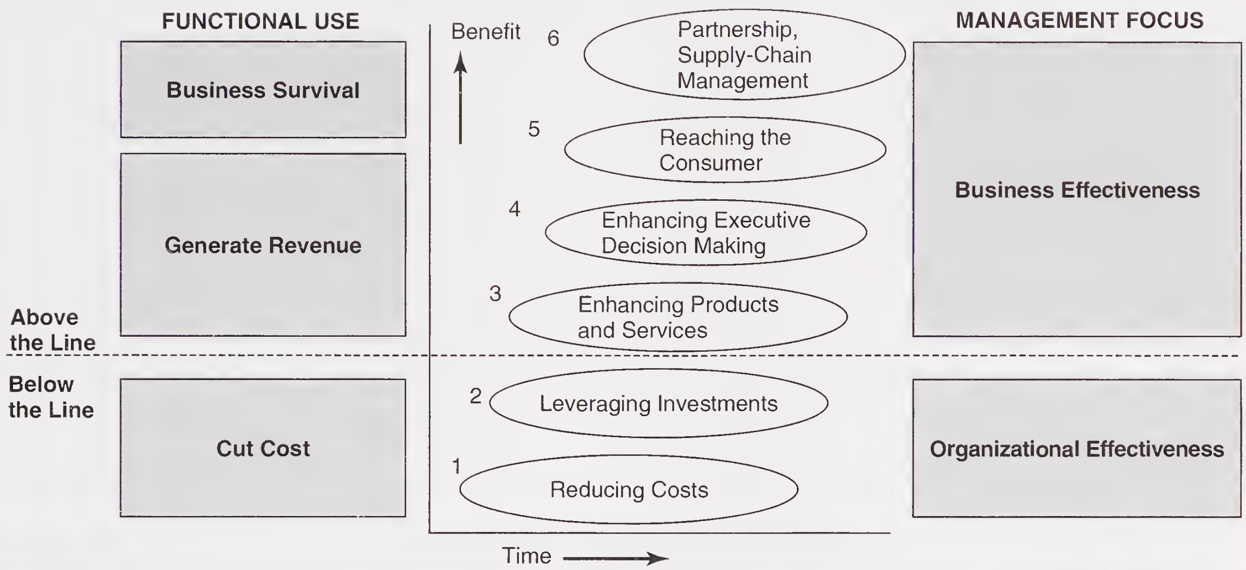


FIGURE 2-1 Waves of Innovation

Source: Adapted from Kenneth Primozic, Edward Primozic, and Joe Leben, *Strategic Choices: Supremacy, Survival, or Sayonara* (New York: McGraw-Hill, 1991).

Wave 1: Reducing costs. This wave began in the 1960s when use of IT focused on increasing the productivity of individuals and business areas. The goal was to achieve clerical and administrative savings by automating manual processes.

Wave 2: Leveraging investments. This wave began in the 1970s and concentrated on making more effective use of corporate assets to increase profitability. Systems were justified on return-on-investment and increasing cash flow.

As shown in Figure 2-1, both Wave 1 and Wave 2 are below the line, which means both focus on cutting cost through organizational effectiveness efforts. Systems are developed mainly for administration, finance, and manufacturing.

Wave 3: Enhancing products and services. This wave began in the 1980s and was the first time that attention shifted to using IT to produce revenue by gaining strategic advantage or by creating entirely new businesses. In conjunction with the new goals of using IT to grow the business or increase market share, IT was used to improve outward-looking functions, such as marketing, distribution, and customer service.

Wave 4: Enhancing executive decision making. This wave began later in the 1980s and focused on changing the fundamental structure of the organization as well as creating real-time business management systems.

The authors point out that Waves 1 and 2 can be implemented at any time, because of their internal focus, but Waves 3 and 4 can only be implemented once an industry leader has set the precedent. Companies that do not follow suit cease to be competitive.

Wave 5: Reaching the consumer. This wave began in the 1990s. IT is used to communicate directly with consumers, leading to new marketing, distribution, and service strategies. This wave changes the rules of competition, which has been precisely the focus of leading-edge firms—to restructure their industry by creating new businesses using the Internet, e-commerce, and now wireless technologies.

Wave 6: Leveraging partnership through supply-chain management or other forms of collaboration. We add a new wave that has become pervasive since the late 1990s. Thanks to the interoperable ability of IT to allow firms to share information and business processes, businesses have been able to form alliances, setting up cross-boundary supply chains. Online travel companies such as Expedia.com or Travelocity.com use IT to allow consumers to access airlines, car rentals, hotels, tour operators, restaurants, and the like together at the same site or portal. These partnerships are customer-driven and operate in real-time mode. An increasing number of organizations, large and small, are joining the globalization trend that uses services (such as call centers or production) around the world. Another high-profile example of Wave 6 is the creation of Electronic Data Systems (EDS) in 2004, a consortium with an initial group of six partners: Cisco, Dell, EMC, Microsoft, Sun, and Xerox. Subsequently, Oracle joined the alliance. The particularity about this partnership is that the partners work together under one roof, and operate as one team to pitch for contracts and to carry out the work together. Despite the difficulty of balancing the competing interests of partners, EDS's partners acknowledge they have benefited from piggy-backing on projects for which they might not otherwise have been selected. The alliance has helped EDS turn its business around. Just three years after the creation of the alliance, EDS's profit has more than doubled, with revenue rising 8 percent in 2007.

Waves 3, 4, 5, and 6 are above the line because they concentrate on revenue generation and business survival. Due to the worldwide ubiquity of the Internet and the standard browser software for accessing the Web, most organizations have jumped to Waves 5 and 6.

Once companies cross "the line," top management must be involved in guiding IT use, say the authors of *Strategic Choices*, because they must steer the company in the new business environment. The risks of inappropriately using IT for competitive purposes are too great for the senior executives to abrogate leadership to technicians. Therefore, joint planning by top management and IS management must take place.

To illustrate how one company has maneuvered through these six waves, consider the example of the American Airlines SABRE system.

CASE EXAMPLE

AMERICAN AIRLINES AND THE SABRE SYSTEM

www.aa.com; www.sabre.com

In 1953, C. R. Smith, then president of American Airlines, and R. Blaith Smith, an IBM senior sales representative, met on an AA flight. They sparked the ideas of an information system that could manage airline seat reservation. Six years later, AA and IBM jointly announced their plans to develop a Semi-Automatic Business

(*Case Continued*)

Research Environment (SABRE). The concept led to the first real-time business application. It allowed AA to replace the hand-written system of the 1950s with the Web-based inter-airline reservation system of the 2000s. SABRE represents a prime example of a system that has progressed through the six waves of innovation.

Waves 1 and 2

In 1960, the first Sabre® was installed in Briarcliff Manor, New York. SABRE was initially built to reduce the costs of making airline seat reservations and to leverage the reservation-making assets of the airline. The system moved American from a manual-based reservation operation to a computer-based one. Four years later, the network was completed, becoming the largest private, real-time data-processing system. The system saved American 30 percent on its investments in staff alone.

Wave 3

In 1976, American expanded the system so that it could be used by travel agents, giving them a means of making reservations directly through online terminals. American enhanced the offering by adding functions of importance to travel agents, such as tools for preparing trip itineraries, and finding low fares. SABRE was a win-win proposition—the travel agents liked the direct access and American increased the barriers to agents switching to another carrier's reservation system. By the end of 1978, 130 locations had received the system, triggering the wave of travel automation. With the rise of personal computing, easySabre® was introduced in 1985 to allow consumers to tap into the reservation systems.

Wave 4

Later in the same year, American expanded its reservation service to include hotels and rental cars. In so doing, American was transforming itself, and perhaps the entire industry, from an airline company to a travel company. Becoming an independent entity, a division of AMR, the parent company of American, Sabre Airline Solutions released the revenue management systems, allowing the airline to maximize airline income with a better pricing scheme. In 1988, the company offered services for yield management and crew scheduling and a host of decision support tools (e.g., BargainFinder).

Wave 5

American introduced its frequent flyer program, AAdvantage, thereby encouraging frequent business flyers to fly American and gain points redeemable for free trips. In addition, the airline began allying the program with credit card and long-distance telephone companies, giving AAdvantage members free airline miles when they use those credit cards and telephone companies.

American enhanced its Wave 5 connections to consumers via the Web. As reported by Patricia Seybold in her book *Customers.com*,[2] American was the first major airline to develop a Web site. This meant that passengers could not only plan their trip via the Internet, but could also buy tickets online and obtain real-time flight information, such as arrival and departure information. Even the names of the movies being shown on flights could be accessed. Before the Web site, some 85 percent of telephone calls to the SABRE call center were not

(*Case Continued*)

booking related. After the Web site, this percentage dropped significantly.

Importantly, American targeted its site at the most profitable customers—its 48 million AAdvantage members—practically all of whom had access to a computer. The goal was to give them better control of their travel planning and rescheduling. Thus, on the site, AAdvantage members can see their accumulated frequent flyer points, make reservations, book electronic tickets, and so on. American promoted use of the site by offering extra frequent flyer miles; bookings spiked every time a promotion was run, notes Seybold. American has continued to enhance the functionality of the site, helping flyers find hotels and restaurants.

In the meantime, Sabre spun off from AMR in 2000. It has its own ways to implement Wave 5. Sabre system became the industry standard in 1998. The company formed a joint venture with ABACUS International to establish the SabreSonic for the Asian market. It worked with the Frand National Railroad, SNCF, to develop RESARAIL.

Wave 6

To leverage its business through partnerships, American works with Citibank to offer "Citibank AAdvantage," which allows credit card users and AA frequent travelers access to a large number of AAdvantage partners and a huge variety of awards choices.

American has used the site to experiment with different offerings to flyers in general. One experiment proved to be a real winner. John Samuel, a marketing manager at AMR, American's parent company, asked, "How can we market to fill seats?" He and his team decided to offer to send an e-mail message every Wednesday listing "the specials of the week"—empty seats on flights during the upcoming weekend—to anyone who signed up for the NetSAAver service. Not knowing what to expect, they were overwhelmed with the response—20,000 subscribers within 30 days, 100,000 in 60 days, and 775,000 in one year, notes Seybold.

This marketing strategy not only lets American remind subscribers of its service each week, at the subscribers' own request, but it also enables American to sell distressed inventory (the unsold seats). This additional revenue drops directly to the bottom line.

Both uses of the Internet, the AAdvantage Web site and the NetSAAver e-mail service, have required American to appropriately manage knowledge about flyers, use the Internet to interact with them, and create an e-commerce engine to support the financial interactions involved. In the knowledge management arena, for example, the airline learned that keeping Web sites pertinent requires operating like a newspaper publisher, with strict deadlines, publishing guidelines, dispersed accountability, and so forth.

Meanwhile, Sabre Holdings goes on for an acquisition spree. Consistent with Wave 6, it holds a majority interest of Travelocity.com; acquires SynXix Corporation, which runs hotel reservations; purchases ShowTickets.com, a leading distributor of show tickets and tours in Leas Vegas; and other online travel agencies around the world.

This example makes clear that management had to be involved as soon as

(*Case Continued*)

SABRE moved into money-making, beginning with Wave 3, when it began offering the system to customers, the travel agents. That was a heart-of-the-business move, and it had to be led by the business executives, not the IS executives. The same has been true of its use of the Web.

Today, SABRE Holdings is the leading provider of technology, distribution, and marketing services for the travel industry. The company has approximately 9,000 employees in 45 countries. Its 2006 revenues totaled $2.8 billion. With its technology, SABRE owns a major share of Travelocity.com, the world's leading online B2C travel site; Sabre Travel Network, which includes the worlds largest global distribution systems connecting travel agents and travel suppliers with travelers; and Sabre Airline Solutions, the leading provider of decision-support solutions for airlines. ■

This American Airline-SABRE example illustrates that as the benefits of IT increase, the importance of executive guidance also increases. It also raises the question, "What's the job of the IS organization?" That's the topic discussed next.

Traditional Functions Are Being Nibbled Away

As SABRE demonstrates, IT has become an essential piece of business strategy; therefore, the speed of IT deployment affects when and how companies can carry out their strategy. Not keeping up in IT can even mean going out of business. The role of the IS organization is thus expanding. At the same time, management is realizing that traditional operational portions may not all need to be performed in-house. Others can perform them. The traditional set of responsibilities for IS has included:

- Managing operations of data centers, local and remote systems, and networks
- Managing corporate data and legacy systems
- Performing system analysis and design and constructing new systems
- Planning and integrations of systems
- Identifying opportunities for new systems

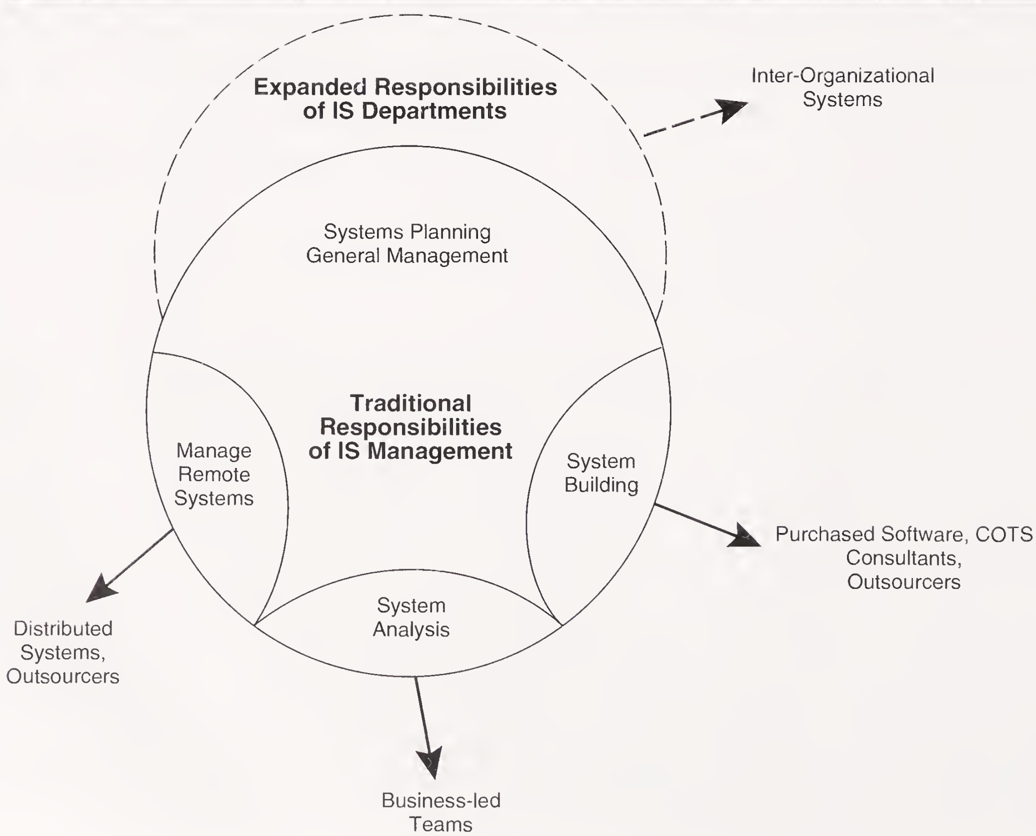
Although all these functions still need to be performed, the following trends are moving their performance out of IS into other parts of the organization or to other enterprises:

- *Distributed systems* have led to the migration of software applications to user areas. These applications are controlled by the users and generally purchased with their funds. Sometimes these applications are acquired following guidelines (or even standards) promulgated by the IS department; sometimes they are not. Some large organizations, such as federal departments, advocate for a centralized planning and a decentralized execution of systems development. For example, in some specific applications domain, the Department of Defense imposes the use of the adoption of the same data management policy, same software development approach, the same programming language, and the same bidding procedures; yet, it lets their many organizational units take care of their own development.

- *Ever more knowledgeable users* have taken on increased IS responsibilities. They often identify high-leverage applications and lead multifunctional teams (which include IS staff) that acquire these systems.
- *Better application packages* have resulted in less need for armies of programmers and analysts to develop systems in-house from scratch. The job of IS has changed to system integration, which means integrating purchased applications so that they function together as a system. A case in point is ERP systems. Implementing these purchased systems has involved system integration rather than system development.
- *Outsourcing* has spread widely, perhaps more than most people expected, because companies see value in turning IS functions over to specialist companies. Outsourcing can be an effective strategy, based on fiscal and managerial considerations, for handling data-center operations, application maintenance, network management, and PC support. As many companies outsource their data centers or customer services to foreign partners or to units located in countries with lower labor costs, there is ample evidence these outsourcing activities have helped significantly reduce operational costs. However, some recent research suggests that geographic distances and differences in cultures, languages, and work habits have caused some problems in service quality and production delays.

Thus, as shown in Figure 2-2, the work of the IS department is being "nibbled away." On the other hand, the IS job also is expanding from technological problems to organizational issues.

FIGURE 2-2 Traditional Responsibilities Being "Nibbled Away" from IS Departments



New Roles Are Emerging

IS has never been a single, monolithic organization, but rather a cluster of functions:

1. *Run operations*: Running computers and networks
2. *Develop systems*: Developing and maintaining systems, designing new systems, and updating existing ones
3. *Develop architecture*: Setting a strategy and maintaining an architecture for both IT and information, providing a framework or standard for systems operations
4. *Identify business requirements*: Helping articulate what the business needs from IT (George Cox,[3] Gartner Executive Programs)
5. *Help uncover innovative business strategies*: through enabling technologies

Each of these functions requires a different set of skills and a different management strategy. IT managers should:

- Maximize efficiencies of IT operations by streamlining all business processes
- Free IT personnel time to work on improving the business, not keeping the servers running
- Reallocate resources to demonstrate to leadership that new software projects can expedite new business models
- Innovate business processes with emerging and cost-effective technologies such as wikis, blogs, no-cost online applications

A function that aims for cost efficiency and requires technical skills (such as running operations) needs to be managed differently from one that aims to add business value and requires business expertise (such as identifying business requirements).

Figure 2-3 shows the four functions on a matrix with two dimensions: the kind of impact an activity has on the organization (from cost efficiency to value added) and the type of expertise needed by the activity (from technical to business expertise).

Two technical activities that focus on cost efficiency—operations and development and maintenance—are critical but of less importance to the business, hence they are smaller bubbles. Meanwhile, the business-oriented activities that seek to add value to the enterprise are of far greater importance to the enterprise, hence the larger bubbles. The CIO should constantly look for ways to off-load the grunt work, whether through automation, contracting, or outsourcing.

Companies that have failed to recognize the differences among these four areas—the relative importance of each and how to manage each properly—have, in some cases, misplaced their resources or underdeveloped their expertise. Until recently, most IS organizations invested heavily in computer operations and system development/maintenance, while neglecting the other two (converenge, integration and identifying business requirements). Operations and systems development can be purchased because they are commodity-like; but the other two cannot, because they are unique to each organization.

Most IS organizations have had to re-skill their staffs to move to these more value-added kinds of work. As they have, they see a "squeeze" similar to the "nibbling" discussed earlier. External services in the form of outsourcing compete well in the lower-left of the matrix, the technical arena. Meanwhile, increasingly knowledgeable users assume more of the responsibility and initiative in the upper-right area of the matrix, the business-centric arena.

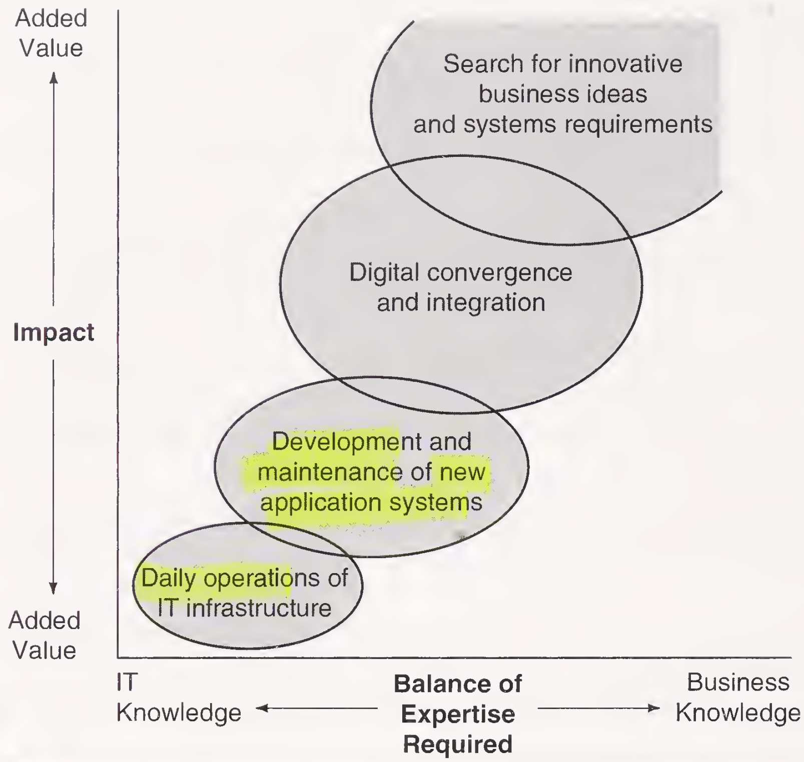


FIGURE 2-3 Four Major IS Activities

Source: Adapted from George Cox, *Time to Reshape the IS Department?* Wentworth Research Program (now part of Gartner EXP, Stamford, CT), June 1994.

Will these trends continue? Will the IS organization be squeezed into oblivion, outsourced on one end and absorbed into controversy on the other? Two roles will emerge as dominant for the IS function.

First, it is not reasonable to expect an outsourcing service provider to understand and satisfy all the needs of the organization without active management and counsel. They sell commodities. Therefore, the IS organization is needed to develop and manage these contractual relationships with a variety of external suppliers. Thus, IS is becoming the broker between technical service providers and business units. As such, the IS function takes an increasing role as an interface between the user community and the outsourcers. More importantly, it plays the role of quality control of the development process.

Second, a crucial role for IS organizations is development and management of the IT architecture for the enterprise, providing the framework for IT to support the business. Architecture is the biggest challenge, especially given IS organizations' systems development and operations heritage.

In short, Cox describes the metamorphosis of IS departments as follows:

- *In computer and network operations*, IS started out being the sole provider, then moved to being the preferred provider, next was seen as a competing supplier, and finally is becoming broker and contract manager for outsourcing this work.
- *In system development and maintenance*, in-house programmers initially wrote the code, then they became software product specialists, next systems integrators, and finally brokers and contract managers for acquiring software.

- *In systems and information architecture*, IS began as technology guru and standards setter, then evolved into being custodian of technical standards, later became specialist in IT trends, and most recently morphed into IT strategist.
- *In business requirements identification*, IS initially defined the specifics of computer programs, then focused on analyzing information flows and business systems, later moved to contributing to multidisciplinary analysis teams, and finally has been partnering with the business in looking at business processes.

In short, IS organizations have moved in Figure 2-3 from lower-left to upper-right in their role in the business, from efficiency to value added and from technical to business expertise.

Toward IS Lite

Roger Woolfe[4a] has furthered the thinking at Gartner EXP about the role of IS departments by studying how they have responded to this evolution. He notes that whereas IS may have started as a single centralized organization, it has evolved into a federal model, where some activities (such as standards setting and operations) are handled centrally because they can be leveraged across the enterprise, whereas other activities (such as application development) have been dispersed to business units so they can best meet local needs. Unfortunately, making this split has been far from easy and has produced continual swings between centralizing and decentralizing specific activities to try to best fit the current business environment.

As an example, where should Web sites be developed? Initially, most were built by enterprising businesspeople in marketing and other functions, without standards or guidance. When the importance of these sites was recognized, and the diversity began to impinge on "creating a single, powerful corporate image on the Web," Web site development was often pulled into a newly created e-commerce group. Yet the job is too large for one group, so those with responsibility for the content (in marketing, operations, and other functions) have added Web content management to their job—thus distributing that job—whereas Web site standards and operations are handled by central groups. The end result is the federal model.

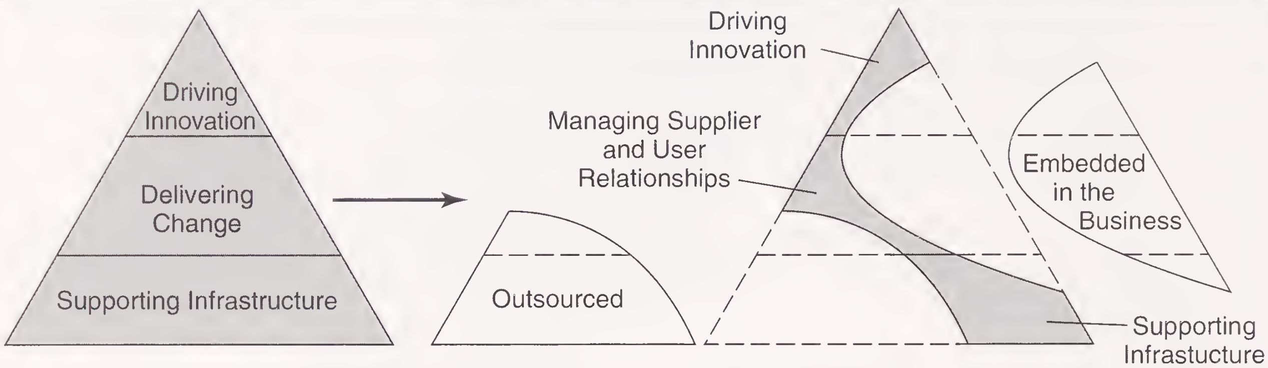
However, that is not the end of the story. As Web sites take on new uses and greater importance, some companies have outsourced Web site development to specialist firms, others outsource Web operations to hosting specialists (who can provide vaultlike security and handle large spikes in demand, for instance), and they perhaps outsource hosting of Web events to still others who specialize in that activity. In short, the federal model can become quite complex with lots of players.

To make the federal model work better, companies are shifting attention from roles to processes. In this view, the IS organization can be viewed as managing three overall processes:

- Driving innovation
- Managing change
- Supporting infrastructure

Applying the federal model to these processes sharpens the distinction between IS activities performed centrally and those performed in business units. Woolfe sees the division coming from distinguishing supply-side activities from demand-side ones.

FIGURE 2-4 IS Lite



Source: Reprinted with permission from Roger Woolfe, IS Lite, Gartner EXP, July 2000.

Supporting infrastructure and aspects of managing change (such as delivering applications) are supply side. They involve providing networks, databases, and processing; they are best centralized because they can leverage economies of scale.

Most managing change and all driving innovation, on the other hand, are demand side. They create the demand for IT services; they are best localized in business units, which can tailor services to their needs.

To serve this split, some IS organizations have created centers of excellence to pool expertise and leverage it across the enterprise. Such centers now exist for such areas as e-commerce, supply-chain management, policies and standards, help desk support, and systems integration.

The result is that much of the supply and demand sides of IS's work is being given up, as noted previously, to outsourcers and knowledgeable users. The result is that IS organizations are moving to IS Lite, as shown in Figure 2-4.

The remaining processes are driving innovation, which includes information and systems architecture, and managing supplier and user relationships, which includes brokering.

One company that is moving in this direction is LifeScan. Here is what its information management (IM) department is doing, as described in the paper submitted to the Society for Information Management's annual paper competition.[5]

CASE EXAMPLE

LIFESCAN

www.lifescan.com

LifeScan, a wholly owned subsidiary of Johnson & Johnson, is a world leader in blood glucose monitoring for diabetes management. Located in Silicon Valley, the company offers an array of consumer and hospital products. In 1981, LifeScan

(*Case Continued*)

pioneered the modern era of blood glucose monitoring by eliminating wiping and timing procedures. This breakthrough took blood glucose testing out of the laboratory and into the hands of patients. LifeScan's mission is to improve the quality of life for people with diabetes.

In 1986, Johnson & Johnson acquired LifeScan, and in 1996 it began promoting greater use of IT in business strategy. The company created the board-level position of CIO and encouraged all 188 affiliates (including LifeScan) to do the same. At the time, LifeScan Information Management (IM) was led by a director—two levels below the president.

In 1998, LifeScan appointed its first CIO, Hugo Yepez, who brought with him an agenda to align the department with the business. This agenda is leading the IM department to an IS Lite type of structure. Subsequently, Yepez was promoted to vice president of information systems of the parent company, Johnson & Johnson, in 2004.

The Alignment Road Map

Yepez has drawn on a three-stage maturation of IM departments as his roadmap to moving his department from supporting the business to partnering with the business. His framework defines maturity by the value the IM department delivers at each stage:

- Stage 1 IM organizations are backroom in nature. Their purpose is to keep the business running. Their value is defined through the internal IM measures of faster/better/cheaper.
- Stage 2 IM organizations work closely with business units. Hence, their value is measured from the business units' viewpoint in terms of delivery and execution. In measuring their success, some use the Balanced Scorecard because it measures performance on four dimensions—financial, internal performance, customer satisfaction, and health and growth.
- Stage 3 IM organizations partner with business units and have direct influence on business strategy. Their value is therefore gauged through the business's own performance measures. The two are integrated; there are no separate measures for IM.

Yepez believed the LifeScan IM department was at stage 1 when he arrived, but he believed it could move into stage 2 in a couple of years and into stage 3 in several more years.

To progress toward stage 2, Yepez focused on execution and measurement to gain credibility with the business units. Execution meant bringing in IM projects on time and within budget. Focusing on project execution would help move the department to a stage 2 mind-set because IM staff would view their performance from the results they deliver to the business.

To deliver on their promises in implementing new systems, IM staff learned that they had to have strong project management and not allow scope creep (users asking for additional functions in applications as development proceeded). To deliver on promises in maintenance, IM began outsourcing work on several major systems. They use Tata Computing Systems in Calcutta, India, which has impressive software quality processes and high-quality software maintenance programmers.

(*Case Continued*)

LifeScan also outsourced maintenance of its desktop machines, drawing on the corporate outsourcing agreement negotiated by Johnson & Johnson's IM department. Furthermore, LifeScan has turned over computer operations to Johnson & Johnson's corporate operations department, National Computing Service. Outsourcing these supply-side IT areas has freed IM staff from doing the work to overseeing the work—performing the brokering and relationship management role in the IS Lite model.

IM also began measuring new projects, to make execution visible, by giving LifeScan employees an IM scorecard on the company intranet to show which milestones were being hit or not. The scorecard is expanded, as appropriate, to include stage 2 and stage 3 measures, such as the business impact of new systems on customer service, operations, and so on. The goal is for the board of LifeScan to be able to link IM measures to LifeScan's corporate measures to identify where IM is best supporting the business.

In the areas of driving innovation and managing change, Yepez has undertaken several initiatives to involve business units in IM work. For example, he brought in an alignment process that assists business unit executives both to determine the priority of LifeScan's business drivers and then to rank IM projects in their support of those drivers.

Being a manufacturer, LifeScan has instituted quality processes. IM is aligning itself with that quality-driven culture so that the entire company speaks the same language. In one initiative, IM is working with three other departments that develop software (for products, services, and quality assurance) to implement a company-wide, quality-based software development life cycle.

In addition, all IM projects are business led, which moves ownership of systems to the businesspeople.

Finally, IM staff members who have the skills needed in a stage 3 IM organization—those with strong project management, business process, change management, and interpersonal skills—are being promoted and given opportunities to partner with business peers. In so doing, these employees present a leadership model, one that emphasizes relationship management and brokering skills, as noted in the IS Lite model.

Staying Course

With Yepez at the parent company, Madeleine Fackler becomes LifeScan's vice president of information solutions and its CIO. In 2004, she manages a budget of more than $68 million. One of her priorities is to continue to support LifeScan managers to better use information. She observes that most CIOs, even in Fortune 500 companies, still use several complex and separate spreadsheets to manage IT projects. These tasks include allocation of resources, cost estimation, progress monitoring, and the like. The issue is to provide managers with a more integrated IT infrastructure to help them integrate and compile critical information quickly. ■

Given these descriptions of how the IS department is evolving, we now look at the responsibilities of CIOs.

THE CIO'S RESPONSIBILITIES

In line with the evolution of IS departments, the emphasis of the top IS job has changed through the seven editions of this textbook as follows.

In 1986, when the first edition of this book was published, the leading IS executives were talking about their new role as architects of the enterprise-wide IT infrastructure. Much of the talk centered around the strategic use of IT.

In 1989, attention shifted to helping formulate corporate policy, with an emphasis on creating a vision of the role of IT in the future. In other words, from 1986 to 1989, the focus of the top IS job had swung significantly toward addressing business issues.

In 1992, the challenge for IS executives was to use IT as a catalyst for revamping the way enterprises worked. To accomplish this task, they needed to be in a high enough position to influence the use of IT as a major underpinning of the enterprise of the future. Reflecting this higher level of responsibility, the title Vice President of MIS or Information Systems Director evolved into Chief Information Officer (CIO), a position often occupied by someone with general management expertise, rather than a traditional technology manager.

In 1998, the need to revamp business operations using IT continued with the Internet expanding the CIO's horizon beyond company boundaries out to potential customers. IT began playing a more front-office role, especially in the rapidly changing Internet marketspace.

In 2002, the CIO had become the technical member of top management. The emphasis of the job was to make sure that the electronic infrastructure for e-commerce and e-business was being put into place, to ensure that IS staff were working as partners with business units on value-adding initiatives, and to rapidly deploy new IT uses.

In 2004, IS executives had a more sobering role than the high-flying "let's get into e-commerce fast" days of the late 1990s and early 2000s. Far more emphasis was placed on justifying IT investments, building a portfolio of IT projects that balanced risk and return, ensuring that the right people were involved in making IT decisions, and working outward with customers and suppliers to build interlinking systems.

Today, the cost emphasis remains, thus the use of outsourcing continues to grow (amid controversy with offshoring projects). However, CIOs are expected to do much more with not much more money. They are under pressure to implement protective measures to safeguard the privacy of customer data, to install increasingly sophisticated security so that viruses and other attacks do not cripple systems, and to add new financial reporting features to satisfy government regulations, such as the Sarbanes-Oxley Act in the United States. At the same time, they have to keep the IT innovations coming. It's a tall order, but one that can help IT managers' jobs relevant.

CIO Roles in Three Computing Eras

In looking at the role of CIOs, Jeanne Ross of MIT and David Feeny of Templeton College, Oxford University,[6] divide the world of computing into three eras: mainframe, distributed, and Web based. They distinguish between the three eras because they see discontinuities between them. Each era is defined by technology innovations, resulting in new uses of IT, and consequently new roles for CIOs. Figure 2-5 shows how these eras intersect.

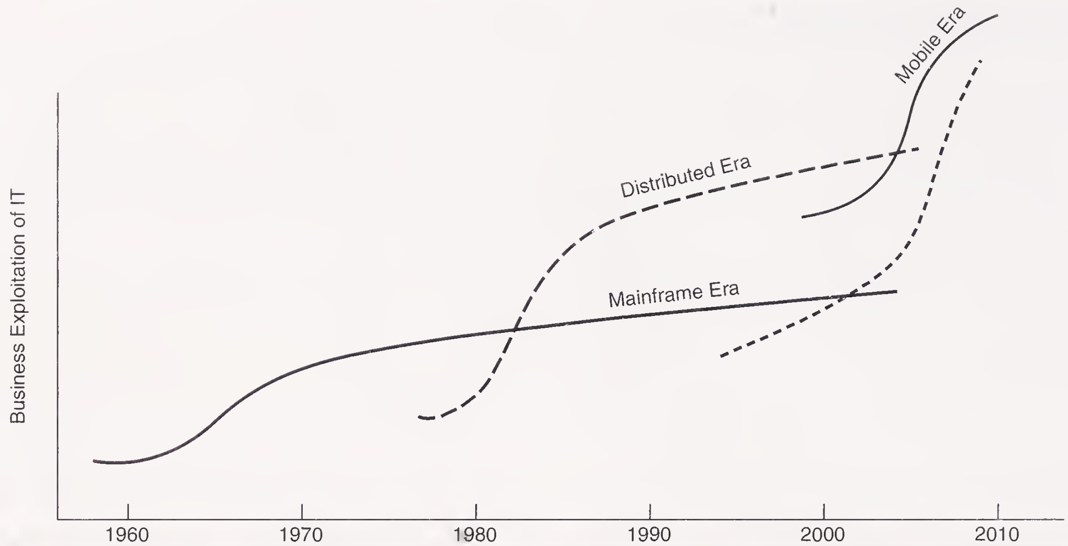


FIGURE 2-5 Major IT Eras

Source: Reprinted with permission from Pinnaflex Educational Resources, Cincinnati, Ohio, 2002.

The Mainframe Era

This era dominated from the 1960s to the early 1980s. Ross and Feeny see the role of the data-processing or information systems manager (the top IS job titles back then) as being the operational manager of a specialist function, IS. The priority was to deliver software applications on time and within budget, and to make sure that they run reliably. In short, as functional heads, they needed to deliver on promises to be credible.

The Distributed Era

This era started at the end of the 1970s and saw major changes. PCs became commonplace; LANs and WANs proliferated, linking computers of all sizes. The client-server concept arose (a client requests a service of a server). Eventually, companies recentralized IT by establishing standards for desktop machines and implementing ERP systems to coordinate company-wide data. This disruptive era was very different from the stable mainframe era. Thus, the role of CIOs was very different, say Ross and Feeny. In fact, they believe CIOs took on four more roles (in addition to being the operational manager): organizational designer, technology adviser, technology architect, and informed buyer.

As organizational designer, the CIO's job was to make the IS organization responsive to the business. The result, in general, was to create a federal structure, with a central IS organization responsible for corporate-wide IT and business-unit IS groups mainly developing applications for their business unit.

As technology advisor, the CIO's job was to align business and IS by educating business management on IT opportunities and helping the business solve their problems. In this job, CIOs spent a lot of their time outside the IS organization, working with their business peers as a technology advisor.

As technology architect, the CIO's role was to understand future capabilities, design the IT architecture for the entire enterprise, and then sell the business on adopting the appropriate technical standards. However, the role still had an operational aspect, ensuring that service levels remained high, no matter how many external service providers were involved.

Finally, as informed buyer, the CIO's role was to draw on external resources (third parties) by offloading work to them to leverage internal IS resources, such as expertise, money, space, location, and such, and thereby lower the overall cost of IS.

CIOs who mastered all four roles came to enjoy the status of being a member of the executive team, generally reporting to the CEO. Of the four roles, the most important was technology advisor, because that role provided the CEO and other top executives with an understanding of IT, its role in the enterprise, and their role in guiding its use. In short, as a strategic partner with the business, the CIO's job was to align IT with the business.

The Web Era

This era started in the mid-1990s for some. With the Web era still in its infancy, Ross and Feeny speculate that the main role of CIOs will be that of business visionary. By that, they mean that the CIO will need to believe and then convince others that the Internet will lead to new business models. The Internet is about fundamental business change, not technology. The challenge for enterprises is to think through possible business models; CIOs could lead this charge. Ross and Feeny even go so far as to say that CIOs who do well in this era will become leading contenders to become CEOs. Of course, CIOs still need to draw on the five former roles, but their key role will be to help the business leverage the Internet. In short, as a business visionary, their role is to be a main driver of strategy.

Obviously, this cut-and-dried pattern is an approximation of reality, but it demonstrates the thrust of change in the CIO's role.

Chuck Gibson,[7] who has presented executive education seminars for years and is coauthor of an article on the Stages of Growth theory described in Chapter 4, notes that the relationship between CIOs and other senior executives, especially CEOs, has changed over time as well. In essence, it has diversified.

At one end of the relationship spectrum is the traditional relationship between CEOs and CIOs. The CIO is expected to implement technology to support business plans in a boss–subordinate, and somewhat distant, relationship. Behind this relationship is the view and practice of business and IT services as separable, and IT in a support role.

The emergence of dot-coms, though, demonstrated a much closer relationship between technologists and CEOs, Gibson points out. This closeness represents the other end of the spectrum. In dot-coms, the business is inseparable from IT. Acting as a team to respond to change and build the infrastructure and applications quickly, CEOs know a lot more about IT and dot-com CIOs know a lot more about running the business because both see the two as inseparable.

One of the reasons for the breadth of this relationship spectrum is our current place in history. We are at the technological discontinuity on the Stages of Growth diagram (Figure 4-5 on page 146) where the Micro Era is ending and the Network Era is beginning. Today, both eras coexist, but the relationships, issues, and discussions of Micro Era executives are different from those of Network Era executives. Whereas Micro Era executives are talking about implementing and extending their ERP system (inside-out view), Network Era executives are talking about how to achieve customer-led product design (outside-in view).

Of course, these approaches fall along a spectrum, but the point is that not all CEO–CIO teams today talk about the same issues they did, say, before the dot-coms merged IS and business less than a decade ago. Moreover, the issues, roles for IS, and relationships required between CEOs and CIOs across businesses are more diverse. As a result, it is far less appropriate to generalize about CEO–CIO discussions; the context now sets the agenda, and agendas vary. Gibson speculates that as established companies integrate their business operations with their Internet operations, the relationship between CEO and CIO will become closer and discussion points may coalesce as the requirements of the Network Era come into clearer focus and apply more generally to all businesses.

Given these two historical overviews, we look at four aspects of the CIO role these days:

1. ***Leading***: Creating a vision by understanding the business
2. ***Governing***: Establishing an IS governance structure
3. ***Investing***: Shaping the IT portfolio
4. ***Managing***: Establishing credibility, managing IT functions, and fostering change

Leading: Creating a Vision by Understanding the Business

If CIOs are to play an important role in shaping a business's use of IT, they must understand the business. With that understanding, they can then create a vision of their firm's use of IT.

Understanding the Business

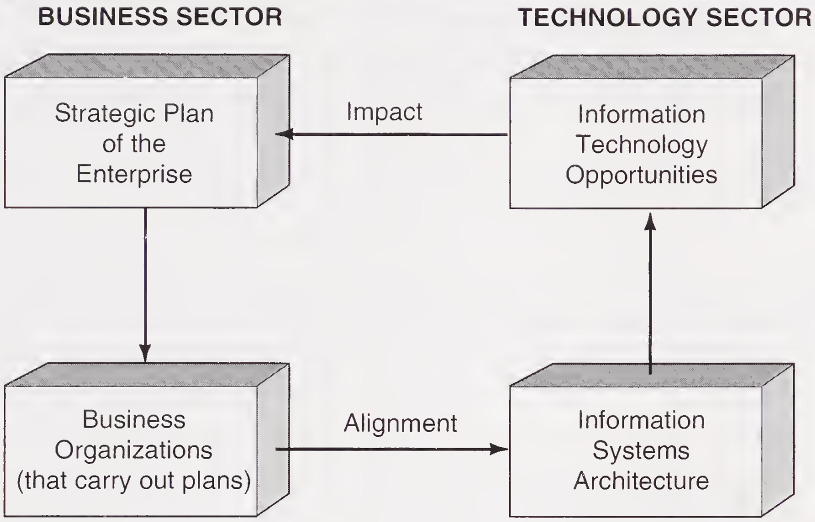
In the past, studying a business generally meant learning how it was run. However, studying internal operations is no longer enough. Today, it is important to understand the environment in which the business operates because the business's close relationships with other firms affect how the business competes. Here are seven approaches CIOs are using to understand a business and its environment.

- Encourage project teams to study the marketplace
- Concentrate on lines of business
- Sponsor weekly briefings
- Attend industry meetings with line executives
- Read industry publications
- Hold informal listening sessions
- Partner with a line executive

Encourage project teams to study the marketplace. To learn about the business, broaden the kinds of information that project teams seek in their study of the business. Then have them describe their findings to IT management. For example, the project study might begin with a broad overview of the company, gathering the following information about the company and its industry:

- Current industry environment
- Business goals and objectives
- Major practices of competitors
- Pertinent government regulations
- The inputs, outputs, and resources of the firm

FIGURE 2-6 The Enterprisewide Information Management Model



Source: Marilyn Parker and Robert Benson with Ed Trainor, *Information Economics: Linking Information Technology and Business Performance* (Upper Saddle River, NJ: Prentice Hall, 1988).

Such an overview study can be conducted for a business unit or a product in a few weeks. The study is apt to uncover some surprises, revealing things about the industry and the company that even people from the business unit might not know, especially now that e-commerce initiatives are no longer being touted, but are going on nevertheless. IT management can be briefed on the findings, educating them about the markets in which their firm participates.

Concentrate on lines of business. Robert Benson and Marilyn Parker[8] have long studied how to manage information on an enterprise-wide basis. IT needs to serve individual lines of business rather than the entire company, they found, because planning for an entire enterprise overlooks both competitive and performance matters. They believe that a line of business is where business and technology planning can be linked.

A line of business is an organizational unit that conducts business activities with common customers, products, and market characteristics, says Benson. For example, certain schools in a university have one line of business—undergraduate education. Others have two—undergraduate and graduate education. The customers, products, and market characteristics for the two schools are different, thus they are different lines of business.

Information technology can serve lines of business in two ways. One is by supporting current operations, which Benson and Parker call alignment. The second is by using systems to influence future ways of working, which they call impact (Figure 2-6). They recommend asking the following questions about each line of business to decide what each one needs:

1. Are we in IT organized to serve that line of business?
2. Do we have an account manager in IS who has responsibility for that line of business?

3. Do we have someone within that line of business who oversees IT activity and talks the business language?
4. Do we have a sponsor in the line of business?
5. Do we have the attention of the line's management?
6. Does the line of business offer an opportunity to use systems in new ways?

By becoming familiar with lines of business, CIOs can better help them use IT to support current operations and influence the future, say Benson and Parker.

Sponsor weekly briefings. Another way to learn about the business is to sponsor short briefings for IT management and staff that are presented by line management or staff. For example, in the aircraft industry an engineer could give the basics of the commercial aircraft business: sizes of planes, passenger capacity, distance capability, expected competition, changes in the industry, five-year market projections, and so on. In the financial services industry, a manager could describe various types of customers and how each is using the Internet, products now offered by the firm and competitors, the impact of globalization and the Internet on financial markets, the products and services they offered versus what the competitors offered, the strengths and weaknesses of the firm and competitors, growth projections, possible changes in the market, and so on. At such briefings, it is helpful if the presenter provides a written summary of the ideas presented, so attendees can take something away with them. A brief question-and-answer period also is useful.

To understand the business, people need to understand the marketplace. Few employees are given exposure to this breadth of knowledge. By sponsoring short presentations by the people closest to a business, IS management can help fix that problem without cutting into work time too greatly.

Attend industry meetings with line executives. Accompanying a line executive to an industry conference—not a computer conference—is another opportunity to appreciate the nature of business the CIO is in. We have found that attending a conference is one of the quickest ways to uncover issues currently facing an industry. These conferences contain the jargon used in the industry and the approaches others have used to market products, handle regulations, respond to competition, and so on. Attending a conference with a line executive can be even more enlightening because he or she can explain what the company is or is not doing in areas discussed by the speakers. Such joint attendance also is likely to foster a new friendship.

Read industry publications. One of the best ways to stay abreast of an industry is to read its publications. Online versions are making them even more timely and accessible. Getting a well-rounded view of an industry may require reading several publications a month. News publications can provide information on new products, current issues, company changes, and so on. Newsletters, reports, and research journals generally provide better analyses of industry trends, discussions of ongoing research, and projections about the future.

One CIO spreads this job around in his department. Every staff member is responsible for reading certain periodicals and routing interesting articles and URLs to others.

Hold informal listening sessions. In his book *Thriving on Chaos*,[9] consultant Tom Peters presents hundreds of suggestions on how managers can learn to not just cope with a chaotic business environment, but to thrive on it. In numerous places in the book, Peters urges people to simply listen and learn. His ideas are appropriate for IS management in their dealings with their customers, both for those internal to the firm and those external to it.

Partner with a line executive. CIOs and their staff can learn the businesses of the organization. Unless these or similar specific steps or mechanisms are implemented and become commonplace, the job of learning the business will be displaced by urgent, but less important, day-to-day work. With this knowledge, CIOs are in a better position to foster a vision of their firm's use of IT.

Creating a Vision of the Future and Selling It

CIOs used to be seen as followers because IT supported the business. Today, it still does, but as noted earlier, business and technology now co-evolve because technology breakthroughs allow companies to operate in new ways. Thus, CIOs have become the technical leaders of their enterprises. As such, they are not only involved in defining their enterprise's IT architecture and establishing its enterprise-wide technical standards, but they also must ensure that the enterprise buys into those plans. The reality in many enterprises is that top-down command only goes so far and often hits roadblocks. CIOs and their direct reports often have to sell the vision.

Once a vision is in hand, then a strategy can be formulated on how to bring the vision into being. For instance, a vision might be to become the leading manufacturer of a certain kind of pump. The strategy could be to assign salespeople to specific large customer firms rather than to a geographic area. Once the strategy is decided, planning comes into play to map out the steps for carrying out that strategy. In this case, plans are needed for when and how to make the new assignments, who will make the selections, how smaller customers will be handled, by whom, and so on.

Why develop a vision? A vision of a desirable future can provide stability when it sets direction for an organization. In the past, long-term strategies were created. They told how companies were going to get somewhere. Such multiyear plans are fine as long as the future is relatively predictable. However, in today's environment, people cannot predict important future events because those events are likely to appear random, not linear or rational. In such times, direction setting and short-term explorations within that space are most appropriate. Today, most corporate visions have an IT underpinning—leveraging the Internet for business purposes. That vision sets their direction.

To illustrate how one CIO is leading his enterprise via his vision and how he has structured his organization to sell that vision to the very independent-thinking business units, consider John Leggate, Group Vice President and Chief Information Officer at BP. His approach is described in the Gartner EXP report entitled *Globalizing Your IS* (meaning, simultaneously globalizing and localizing an IS organization).[4b]

CASE EXAMPLE

BP

www.bp.com

BP's main business activities are the exploration and production of crude oil and natural gas; the refining, marketing, supply, and transportation of these resources; and the manufacturing and marketing of petrochemicals. As of December 31, 2006, BP was a $266-billion business, with 97,000 employees serving more than 20 million customers daily through almost 29,000 service stations. An intense period of merger and acquisition activity has seen the absorption of Amoco, ARCO, Castrol, and Veba Aral in Germany.

BP sees the energy business as being driven by four major drivers: industry consolidation; shift in consumption from oil to natural gas; better technology to drive core operations—exploration and production, refining and petrochemicals, and sales and marketing; and the connected economy in which transactions and information exchange are becoming faster, cheaper, and more pervasive.

The Business Is in the Business Units: Speed Matters

BP's business units drive the business. There are 150 business units operating in over 100 countries. Ten years ago there were eight levels of organization separating executive management from business unit management. Today, this separation has been, and continues to be, radically simplified.

Business units have their own balance sheets and are held accountable via a performance contract, which is negotiated with the executive committee of their business stream. In exchange for delivering on their contracts, the business units have the freedom to operate independently.

Headquarters must convince the business units of the wisdom of BP-wide practices. Many decisions are made by peer groups—networks of business units in a business stream. They resemble federations and are a vehicle for sharing knowledge among peers. They are also where the businesses must justify the resources they seek.

Overarching this distribution of power is a set of groupwide policies based on shared core values. At the center is learning and sharing, which drive collegial behavior and enable peer-group decision making. The glues for BP's decentralized business approach are strongly shared core values and operational excellence. The key to success is to use technology to improve operational performance, driving business innovation, and re-creating business models to maintain competitive advantage and add value to shareholders. For BP, speed matters. It's important to be the first adopter of technology and put it to work for business. Or from a competitive perspective, says John Leggate, Group Vice President, "the corollary to speed of uptake is the speed at which companies and industries can be left behind."

(*Case Continued*)

Digital Business Underpins Transformation

In 1999, John Leggate's organization issued a rare company-wide mandate for a common operating environment (COE). All Amoco employees were moved to BP's operating environment. Then, in 2000, all BP desktops and laptops were moved to Windows 2000 and Office 2000. COE 3, the latest generation, bridges time and distance by providing the hardware and software needed for employees to live and work on the Web.

In early 2000, Leggate formed Digital Business (DB). This moved IT out of the beleaguered role of technology provider into a strategy-creation role. DB comprises four central groups, which deliver overarching strategy, enterprise infrastructure and projects, and policies and standards, while supporting differentiated service offerings driven by the business streams:

- *DB Strategy and Chief of Staff*: Aligns DB's strategic intent with the corporation and business objectives while developing clear business plans and objectives that move the agenda forward. BP's underpinning performance-management processes are used to ensure delivery of the strategy.
- *DB Chief Technology Office (CTO)*: Explores the external market to bring research and development (R&D) technology into BP to move its strategic direction forward, transforming BP into a digital corporation. The CTO group ensures that BP stays in tune with the external market through deployment of appropriate technological advancements.
- *DB Projects*: Undertakes the enterprise-wide projects necessary to move its strategic infrastructure architecture forward.
- *DB Operations*: Provides overarching operational policies and standards across the globe to ensure a secure and reliable enterprise infrastructure as well as deliver some operations for the business streams. This is accomplished through an operations peer group to ensure connectivity, alignment, and compliance among the business streams.

In 1998, BP and Amoco had a combined IT budget of $1.5 billion. The DB team managed to cut $500 million out IT spending within two years. In 11 months, the team reached the savings targets, and kept the IT annual budget at the $1 billion level for 1999 and 2000. Leggate notes that, in 2001, BP got twice as much information volume through the system.

Living on the Web

Embracing the notion of a connected economy, BP seeks to build the basis of the new economy inside the company. To make "Living on the Web" a reality, DB is moving processes and systems to the Web and simplifying both at the same time. BP is handing processes to service providers to consolidate, simplify, and then operate. For example, BP has externalized its human resource (HR) processes through the use of an external provider, Exult. Exult, located in California, has integrated the numerous HR databases and is managing the processes via the Web.

The paradox of business simplification is deciding where to seek commonality and

(*Case Continued*)

standards and where to seek flexibility and innovation.

Socializing Technical Directions

DB's visionary role is to provide thought leadership. Its implementation role is to socialize the idea of a new common good to the point where people accept it. Corporate edicts are not commonly used in BP's culture.

Socialization can take quite some time, especially when a common approach costs more than a local solution. It requires face-to-face enrollment and starts with conversations with the business leaders. From there, local governance boards decide how to implement the general principle locally.

BP's chief technology officer has established a powerful network of architects to help create consensus and drive choices that benefit BP as a whole. All of the architects on the various network teams work in the businesses. The role of each team is to create "the framework for conversation" with the business units about architecture for a specific area, such as wireless, Web Services, and so on. They use a template method to define an area of interest and drive toward consensus.

To educate communities of interest, DB reveals data, such as showing waste to a community so it will seek ways to reduce it. For example, BP had 36 systems reporting health and safety problems in 1999. Once the health and safety community knew this fact, it decided how to decrease the number. The rationalization was not centrally managed. The same is happening with the 100 maintenance management systems.

Technical choices are now made through business-based networks of experts. Similar communities handle major system upgrades. They define the global direction, evolve standards collegially, and then look to service providers to supply the components. These communities know they should not permit divergent local actions; thus, they must make difficult choices between corporate fit and local need.

Going Forward: Foster Learning and Focus on Exploitation

A major challenge is fostering learning. Today, too much prompting is needed to get BP employees to look at what others within BP are doing elsewhere in the world. Becoming a connected corporation helps, but the key is behavioral and cultural change.

Within the IT realm, the major question is, "How do we get 100,000 people to fully utilize BP's resources to change our underlying business?" The real leverage comes from the new value a new system opens up. Therefore, adoption and exploitation of the new technology and systems become a major challenge but a necessary component to realizing the value of the business transformation. This involves much effort in changing management to train and influence employees to accept and use the new technology.

By 2001, BP had set up Web-based learning tools: self-service courses, chat rooms to exchange information and best practices, Webcasts to bring teams together. Leggate's executive team has a broad portfolio of skills, which is critical when a leadership team is not only creating the future but is also responsible for selling it. Some have deep technical knowledge. Others are more commercially oriented people who want to use

(*Case Continued*)

digital technology as a transformational tool. The following are some examples of BP's transformation into a digital business that turn the company operations more mobile, more connected, and more productive:

- In the North Sea, all information related to infrastructure capabilities and specifications (platforms, pipelines, terminals, etc.) is posted on the Web;
- Fiber-optic cables are installed to provide media-rich, data-intensive interaction between platforms and field operations, pipeline operations, and on-shore support.
- 4D seismic technology to support sub-surface operation.

With a leaner IT budget, BP has used the Internet technology to move forward—by both looking inward and outward—connecting its employees with each other, and the company with its customers, suppliers, and the wide global community. The digital business experience was a journey of discovery for Leggate and his team. The big lesson for him is that "this is a learn-do-learn model." ■

Encouraging champions of IT projects. As the rate of change in the IT field has increased, we have heard CIOs say they need to encourage IT experimentation, especially by people in the operating units, to advance company IT experience and evolve the IT vision. Here are the ideas of two researchers and one user company on how to do that—by supporting IT champions.

A champion is someone with a vision who 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, say Cynthia Beath and Blake Ives.[10]

The first step in encouraging champions is to be able to recognize these people. They are likely to be people you already know about, and they may be doing things that make you uncomfortable. For instance, they are probably already circumventing established project approval processes, they are creating isolated information systems, and they may be using nonstandard equipment. They may already be pursuing a vision of how IT can help their business, whether systems people assist them or not.

These people are opinion leaders, and they have a reputation for creative ideas or being involved with innovations. They also have developed strong ties to others in their organization, and they command respect within the firm. They have the organizational power to get strategic innovations implemented.

According to the authors, IS champions need three things from IS management: information, resources, and support.

They need information. Championing an IT innovation is an information-intensive activity. Therefore, champions need information, facts, and expertise for persuading others that the technology will work. IS staff can help champions gather and assess information about a technology's capabilities, its costs, risks of operation, and how it might be used in an experiment. IS staff also can help by sharing their expertise and by putting champions in contact with other experts, such as vendors or users of a new technology.

IS staff can assist champions in understanding current applications and data relevant to their project. Finally, they can help champions understand how the company manages change, because systems people are continually involved in implementing system changes throughout the enterprise.

They need resources. The authors cite Rosabeth Kanter, author of *Change Masters,*[11] who says champions most need staff time. Giving champions free staff time is especially helpful during the evaluation and persuasion portions of a project. However, systems management can go even further, by assigning, say, information center consultants to help champions.

In addition to staff time, champions are likely to need material resources, such as hardware and software. These resources can be loaned to them free of charge or provided in some other way.

They need support. Finally, champions need supporters, people who approve of what they are doing and give legitimacy to their project. It is important that IS management corroborate statements made about the technology by the champion. The champion does not need to know how the technology works, only how it might be used. The IS organization should handle the technical aspects. Beath and Ives urge demonstrating the champion's claims about the technology and promoting the technology to build enthusiasm for it and to win support from others.

Finally, IS management can assist a champion win endorsement of upper management by helping to create the plans for introducing the new technology. The IS department can assist by contacting vendors and choosing an appropriate implementation approach. All of these supportive actions will improve the quality of the proposal and strengthen it in the eyes of management.

Thus it is important that IS management makes it easier for IT champions to arise and succeed. One company that supported champions is Aetna Life and Casualty.

CASE EXAMPLE

AETNA LIFE AND CASUALTY

www.aetna.com

Aetna is one of the nation's leading providers in health care, dental, pharmacy, group life insurance, disability, and long-term care benefits. In 2005, Aetna had a network of 14.4 million medical members, 12.8 million dental members, 9 million pharmacy members, and 14 million group insurance members. One of Aetna's missions is to set an IT platform that is capable of providing timely and

(*Case Continued*)

relevant resources to its members to help them make informed decisions about their health care and to protect their finances against health-related risks. In 2000, ING acquired Aetna Life and Casualty, a financial services company with headquarters in Hartford, Connecticut. ING is headquartered in Amsterdam, The Netherlands. Aetna is now ING Life Insurance and Annuity Company.

Before being acquired by ING, much of Aetna's IT work had been decentralized; therefore, the corporate administration department focused on three functions, which they called "plan, build, and run." The operations group ran data center and telecommunication operations. The corporate technology services group assisted divisions in selecting, building, and implementing computer systems. The people and technology group also helped divisions build and implement successful systems; they emphasized the human perspective.

The planning function was the responsibility of the corporate technology planning group, which was meant to be a catalyst for introducing new technology. Its charter was to help the insurance company understand and use breakthrough technologies. By breakthrough, they meant technologies that would increase performance by at least 100 percent. "We constantly seek to make the future credible by encouraging innovation, experimentation, and evaluation," a member of this group told us. They saw their job as encouraging end users to talk about new technologies and test them out in real-life situations. The corporate technology planning group fostered discussions and experimentation in three ways.

They Sought Out Business Champions

The group tested technologies by co-sponsoring business projects, acting as a magnet to attract people who wanted to experiment with a technology. They held workshops on specific technologies, published one-page issue papers describing certain technologies, and talked to people in a wide number of functions.

Their goal was to find business champions who thought a technology might solve their business problem. These champions also needed to be willing to share the funding and direction of a pilot project using that technology. The users agreed to let the planning group study their use and write about it. For a project to be funded, it had to have a business champion and be aimed at solving a business problem.

In several cases, the group found champions who recognized the need to test several technologies, some with expected results and others that might change future work life dramatically. These were smart champions, because they saw the value of investing in a portfolio of new technologies.

They Studied Pilot Projects

In one pilot project of a 500-user communication system, the planning group did systematic research during the pilot, using before-and-after questionnaires to measure how attitudes changed. They looked to see whether "telephone tag" increased or decreased, and they held focus group discussions. In addition, they had some users keep daily diaries of their activities.

Based on this research, they concluded that the system would benefit a

(*Case Continued*)

majority of employees. To then promote its use, they created a brochure and videos, which they handed off to the corporate operations group for the marketing and management of the system.

They Established Steering Committees

Steering committees can be surrogate champions to guide and build support for a new technology. When the corporate technology group saw a technology that appeared interesting, they sometimes held a one-day magnet session to find champions. Sometimes they found steering committees rather than individual champions when a topic was really hot. In one case, 200 people volunteered to do pilot projects. Because it made too large a group, a smaller steering committee was formed. It put on four seminars, got end users thinking about how they might use the technology, and oversaw some projects.

Challenges They Encountered

The technology planning group encountered three challenges.

One was simply getting people's attention. When a technology was not immediately available, people did not want to take any action. However, many technologies require a learning curve. Even when a technology is not readily available, people should be experimenting with it so that the company has in-house knowledge when products do begin to appear. Thus, making a future technology credible to people was one hurdle.

Keeping people in an experimental mode was another challenge. Once people were funded for a pilot, they wanted to do it right. They did not want to create a quick-and-dirty system; they wanted to create a production-quality system. It was hard to get people to create only quick, experimental systems.

The third challenge was making sure that the use would really pay off. The planning group did not want small productivity improvements; they wanted orders-of-magnitude improvements—at least two-to-one to three-to-one payoffs. They constantly asked users: How do you know you will get this payback?

The group's goals were education and action. They wanted end users to be comfortable using future technologies and to achieve a good payback at the same time. For more ideas on how to stimulate innovation, see *Managing Organizational Innovation*.[12]

In 2003, the Aetna Information Services accounted for approximately 3,000 employees who worked in IT infrastructure, solution delivery, and network services. The goal is to provide an IT infrastructure that enables members, plan sponsors, health care providers, and other constituents with actionable information to make informed decisions, when and where they want it. Such an approach puts companies in a better position to spot new opportunities, to experiment with them, and then to put them into widespread use before their competitors. In a fast-changing world, nimbleness—a sign of being open to accepting emerging technologies—is needed. ■

GOVERNING: ESTABLISHING AN IS GOVERNANCE STRUCTURE

The term "governance" has become prominent, not only in IT circles, but in business circles as well. IT governance is "the assignment of decision rights and the accountability framework to encourage desirable behavior in the use of IT," state Peter Weill and Richard Woodham.[13] Governance differs from management in that governance is about deciding who makes decisions, whereas management is about making decisions once decision rights have been assigned.

Governance has become important in the business world because financial scandals have shown that there was not much true governance in place in some very large enterprises. More often than not, decisions are made by a few top executives; subordinates do not question their superiors, and boards just rubber-stamp decisions. The principles of checks and balances do not seem to apply.

Governance has become important in the IS world because IT expenditures have become so large and so diverse that management has had to find a way to bring order to all the decision making. However, centralizing all IT decisions has not proved to be the right the solution, because business units and local employees legitimately need a voice in the decisions to tailor their business to the local culture and customers. Striking a balance between global and local needs (globalizing) is a major emphasis in IS these days. The main discussions are at the governance level, assigning decision rights. Just as the U.S. Constitution assigns rights to the states and powers to the federal government, enterprises now see the need to do the same. Finally, a third reason for the rising importance of governance is the issue of creating an IT portfolio that is in sync with business needs and stays that way.

Assigning Decision Rights

Peter Weill and Marianne Broadbent have undertaken a landmark study of IT governance, surveying 256 companies in 23 countries and conducting over 20 in-depth interviews.[4c] From their research, they see IT governance as having three components, as shown in Figure 2-7: (1) six governance styles of who makes which decisions (the rows), (2) five key IT decision areas (the columns), and (3) governance mechanisms used to carry out IT governance (the cells). The IT governance arrangements matrix in Figure 2-7 illustrates "a good general-purpose IT governance design that balances decision rights for a multi-business unit enterprise," state Broadbent and Weill.

Six governance styles (the rows). A governance style defines who has a decision right (the right and responsibility to make a decision) and an input right (the right to provide input to a decision but not make the decision). The six governance styles are:

1. A business monarchy is where C-level executives (increasingly including the CIO) hold the right to make decisions. A mechanism used to carry out this governance style could be an executive committee or perhaps an IT council with executive committee members.
2. An IT monarchy is where IT executives hold the right to make decisions. A mechanism could be an IT leadership council that includes corporate and business unit CIOs.
3. Feudal is where business unit leaders (or their delegates) have decision or input rights. Feudal governance might use a business-only committee as a mechanism.

Decision Domain / Style	IT Principles		IT Infrastructure Strategies		IT Architecture		Business Application Needs		IT Investment and Prioritization	
	Input	Decision	Input	Decision	Input	Decision	Input	Decision	Input	Decision
Business Monarchy										Cap appr comm
IT Monarchy				IT leaders		IT leaders				
Feudal										
Federal	Exec comm Biz leaders		Exec comm Biz leaders		Biz leaders Biz proc own				Exec comm Biz leaders	
Duopoly		Exec comm IT leaders					Biz leaders Biz proc own Biz/IT rel mgs	Biz leaders Biz proc own		
Anarchy										

Governance mechanisms

☐ Input rights ■ Decision rights

Exec comm	*Executive committee/C-levels*	Cap appr comm	*Exec comm subgroup includes CIO*
Biz leaders	*Business unit heads/presidents*	Biz proc own	*Business process owner*
IT leaders	*CIO, CIO offices and biz unit CIOs*	Biz IT rel mgs	*Business/IT relationship managers*

FIGURE 2-7 IT Governance Arrangements Matrix

Source: Marianne Broadbent and Peter Weill, *Tailor IT Governance to Your Enterprise*, Gartner EXP Club Report, October 2003.

4. Federal means that the rights are shared by C-level executives and one other tier of the business hierarchy, such as business-unit presidents. In IT governance, an IT group might also be involved as a third participant. The federal style is akin to the U.S. government structure, with a central nationwide government and dispersed state governments. A mechanism for implementing this IT governance style is committees that draw from several organizational levels.
5. A duopoly is where one IT group and one business group share a right. A mechanism might be an IT–business-unit committee that draws up a service-level agreement for IT to provide services to the business unit.
6. Anarchy is where individual process owners or end users hold a right. The anarchy governance style is rare in the five main IT decision areas because it is not effective in guiding IT in a large enterprise.

Five decision areas (the columns). There are five key decision areas in IT.

1. IT principles are high-level statements about how IT will be used to create business value. Three examples of IT principles follow:
   - Corporate IT is responsible for infrastructure; business units are responsible for business-unit applications.
   - Technical reporting relationships must match corporate reporting relationships.
   - IT purchasing from major vendors must be centrally coordinated to minimize costs and ensure consistency.

As shown in Figure 2-7, Weill and Broadbent found that an IT duopoly (with business and IT executives) provides the business–IT collaboration needed to set the principles that support the business. Input often comes from other business groups (federal).

2. IT infrastructure strategies state the approach for building shared and standard IT services across the enterprise. This decision area is technical, so it is generally made by an IT monarchy, as shown in Figure 2-7, often with federal input.
3. IT architecture states the technical choices that will meet business needs. Again, this is a technical decision area, so it is generally left up to the IT monarchy, with federal input.
4. Business application needs is where the business defines its application needs. As shown in Figure 2-7, these decisions, and input to them, are generally federal.
5. IT investment and prioritization defines the process for moving IT-based investments through justification, approval, and accountability. Often, the capital appropriation committee (a business monarchy) approves IT and all other capital investments. As in other decision areas, input comes from various sources (federal style).

The arrangement matrix differs, of course, among enterprises. Those seeking synergies among their business units are more likely to enforce top-down decisions. Those with autonomous business units are likely to emphasize local decision making. Enterprises with pulls both for synergy and local autonomy may make extensive use of IT principles to guide faster decision making in their sprawling enterprise. Such is the case with Duke Energy International by a Gartner EXP report on IT governance.

CASE EXAMPLE

DUKE ENERGY INTERNATIONAL

www.duke-energy.com

Duke Energy, headquartered in Charlotte, North Carolina, manages a dynamic portfolio of natural gas and electric supply, delivery, and trading businesses. Its international division, Duke Energy International (DEI), owns and operates power generation facilities and sells electric power and natural gas, primarily in Latin America.

Max Kennedy, then CIO, has been accountable for the company's IT performance and governance and reports to the president of DEI. The regional energy businesses also have CIOs who report to their regional managing director.

DEI Differentiates Itself by Being Nimble

Product and service innovation, combined with speed and flexibility, are the key drivers in DEI's regional businesses. The company can be nimble and capture opportunities because business governance is local. Lines of communication are short, so decisions can be made quickly.

(*Case Continued*)

For example, when DEI still owned interests in Australia, a gas plant operated by another firm encountered a maintenance problem and had to be shut down. Within a few hours, a half-million-dollar deal had been signed with Duke Energy to supply replacement gas. Competitors could not get near Duke Energy's speed; it was the mind-set under which the region operated and was one of its strengths.

IT Governance Is Based on Principles and Relationships

The regions also have pressures for synergy with Duke Energy International and among themselves. Principles play an important role in achieving synergy while maintaining agility. DEI's Information Management (IM) organization has principles for organizational and personal governance. Kennedy has espoused eight principles in managing IM:

1. Agree on the reason for being
2. Have a vision for IM
3. Put a clear organizational design in place
4. Implement successful IT governance
5. Implement demand management
6. Design useful reporting information flows
7. Manage business–IM value relationships
8. Implement global collaborative networks

As an example, part of the "Manage business–IM value relationship" principle is the guideline to establish multilevel relationships between IM and the business at different levels in the hierarchy. Such relationships are strong because more than one set of two people hold them together. This principle also is used to prepare top technical staff for their next job, which involves relationship management.

The regional CIOs follow the three-point stewardship and escalation guidelines to help them answer the question, "When am I free to decide on my own versus when should I involve others?" The guidelines are:

- I involve others if the consequences of my actions will come to bear on those others.
- I do not involve others if the consequences of my actions will come to bear just on me.
- I inform others when the consequences of my actions will be of benefit to others.

In general, regional CIOs would prefer to use the U.S. IM solutions, which could be done about 70 percent of the time, to leverage the lower negotiated licensing prices and to tap their technical expertise. They would only differ when the cost was too high or the product did not have adequate support in the region.

In essence, DEI's IM organization aims to foster relationships with the business. Relationships increase nimbleness, help identify opportunities to save costs, and lead to innovation. With a recent change in top leadership, A. R. Mullinax takes over Mr. Kennedy's CIO hat. More important, as the Group Vice President and CIO at the same time, Mullinax leads information technology and is responsible for global sourcing and logistics, corporate real estate services, and human resources services. If anything, Mr. Mullinax's appointment indicates the importance of IT governance as IT permeates in all critical business areas. ■

Investing: Shaping the IT Portfolio

IT departments enjoyed sustained growth during the 1990s. The trend has reversed for a large majority of corporations in the United States and many other countries. A Gartner report in December 2006 predicts that IT spending for 2007 will rise only 2.8 percent. However, IT spending remains so large and important to company success that the subject of how to make investments properly has gained increased attention. Business executives used to blame CIOs for poor IT investments. That view is becoming less tenable because CIOs can only implement good systems. They are not responsible for changing business practices to take advantage of those systems. That's the job of line executives.

Following are two perspectives on this IT investment topic: one strategic (what to invest in) and one tactical (how to make investment decisions). Both show the importance of having business and IT thinking behind IT investing.

A Strategic View of Making IT Investments

Diana Farrell, at the McKinsey Global Institute, conducted a study of 20 industries (8 in the United States, 6 in Germany, and 6 in France) to discern the connections (if any) among IT, competition, innovation, and productivity from 1990 to 2000.[14]

The key findings of the study are that a "new" economy did indeed emerge in the 1990s, but only in the six industries she studied where there was intense competition that was not throttled by government regulation. These six industries were retailing, securities brokerage, wholesaling, semiconductors, computer assembly, and telecommunications.

Farrell found that intense competition forced executives in these industries to innovate—by investing in IT, by improving their business processes, and by offering new products and services. These innovations, in turn, increased productivity. Thus, the "real" new economy has a virtuous circle: competition leads to innovation, which leads to productivity increases. See Figure 2-8.

As just one of many examples given by Farrell, the mobile telecommunications industry in France and Germany in the 1990s faced little government intervention, so there was intense competition among the national providers. Industry productivity increased 25 percent from 1990 to 2000. In the United States, on the other hand, regulation erected barriers to offering nationwide mobile telecommunications services, and productivity increased only 15 percent.

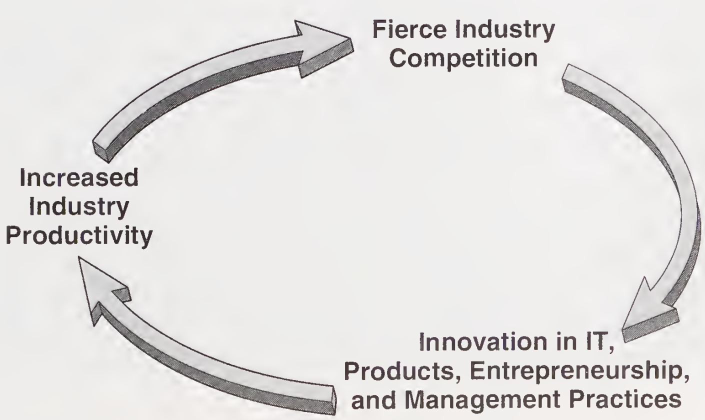


FIGURE 2-8 The Virtuous Circle of the "Real" New Economy

Source: Based on material from Diana Farrell, "The Real New Economy," *Harvard Business Review*, October 2003, pp. 105–112.

The McKinsey study also found that all IT investments were not alike. IT investments in industries that depended on information processing (such as large retailers that handled millions of transactions a day) and that faced growing competition had the greatest productivity increases—but only under three conditions:

1. The IT investments targeted the main levers of productivity,
2. The IT investments were made in the right sequence and at the right time, and
3. The IT investments were complemented with innovations in management practices.

Targeting IT investments. Firms that concentrated their IT spending on "levers that matter" gained the greatest productivity. Because productivity equals outputs divided by inputs, a lever either increases outputs (such as offering new higher-value services) or decreases inputs (such as reducing inventory or working capital). But the "levers that matter" differ among industries.

For example, the applications that mattered most for the big-box retailers, such as Wal-Mart, K-Mart, and Target in the United States, that sell high volumes and have low margins were warehousing and transportation systems that more tightly linked them to their suppliers and increased the retailers' inventory turns. On the other hand, for specialty retailers whose items have short shelf lives, the applications that mattered the most dealt with assortment and allocation planning systems that reduced their inventory-holding costs and the amount of out-of-style merchandise in their stores. Smart companies invest heavily in IT applications that increase productivity and seek the least expensive option for all their other IT systems.

Sequencing and timing IT investments. Companies that reaped the highest productivity generally sequenced their IT investments so that new ones built on existing ones. Wal-Mart and K-Mart present contrasting examples, notes Farrell.

CASE EXAMPLE

WAL-MART VERSUS K-MART

www.walmart.com; http://kmart.com

From E-business to Services

The sequence of IT investments at Wal-Mart and K-Mart offer one example of the effect of getting the sequence right, notes Diana Farrell of McKinsey Global Institute.[15] From a 1945 small variety store in Newport, Arkansas, Sam Walton has led Wal-Mart to become a global discount retailing store with more than 1.9 million associates worldwide and nearly 6,500 stores and wholesale clubs across 14 countries. Wal-Mart's success has been its relentless pursuit of the "Every Day Low Price (EDLP)" strategy. The digitization at Wal-Mart made this strategy possible. Walt-Mart invented the practice of sharing sales data via computer with major suppliers, such as Proctor & Gamble. One of the

(*Case Continued*)

consequences is that the stores rarely run out of stock of popular items, while reducing inventory and shelving spaces.

Wal-Mart has developed a blueprint for its digitization strategy:

- Customer focus: Delivering "Every Day Low Price" to create sustainable value and differentiation from the customer's perspective.
- Business services: Implement low-cost leadership through expertise in product differentiation, effective localized store management, efficient logistics, and supply-chain management with focus on global sourcing.
- Enterprise Application Infrastructure: Integrating and digitizing business processes with streamlined information flows.
- Technology infrastructure: Deploying a reliable global IT infrastructure to support a variety of business needs.

Wal-Mart Differentiator: IT Deployment

With a typical store that has 70,000 standard items in stocks, products have to be identified, ordered, inventoried, and replenished. All these activities must be done efficiently to keep costs low. Wal-Mart has used technology to achieve its strategy. Here are a few noted accomplishments:

- 1980s: Satellite communications to link stores to headquarters for Just-In-Time inventory management.
- Early 1990s: The Retail Link system to provide sales daily data, by item and store, to suppliers, allowing them to better plan production and distribution. This results in lower purchasing cost for Wal-Mart.
- Mid-1990s: Item Locator Scanning System to allow store to locate and manage inventory.
- Late 1990s: Improved Retail Link "Private Hub" to allow more than 10,000 suppliers to do market research online.

During this timing, Wal-Mart first automated the flow of products in its internal supply chain—from suppliers to its distribution centers and warehouses. Once this internal flow was being well-managed, Wal-Mart turned outward to its suppliers to more closely coordinate its own operations with in hopes of improving effectiveness and reducing costs. With the flow along its supply chain as a base, Wal-Mart again turned to its customers, using IT to better plan its merchandising mix and replenishment. Last, it built a data warehouse, pulling data from these systems and other sources, to answer complex questions to hone operations. As a result, Wal-Mart's productivity increased. Kalakota and Robinson note that the blueprint is critical to a successful execution, and Wal-Mart had the first-mover and proper approach.*

K-Mart: Catch-Up Game

The first K-Mart store opened in Garden City, Michigan, in 1962. As of 2006, K-Mart has 1,416 stores across the United States and the territories, employs approximately

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*Ravi Kalakota and Marcia Robinson, "Services Blueprint: Roadmap for Execution," *Addison Wesley Professional*, 2003.

(*Case Continued*)

133,000 associates. As a wholly owned subsidiary of Sears Holdings Corporation, K-Mart positions itself as a mass-merchandising company that offers customers quality products through a portfolio of exclusive brands and labels. K-Mart has lost a significant market share to Wal-Mart and other retailers.

Looking back, K-Mart did not get the sequence of IT investments right in the 1990s, says Farrell. Its productivity decreased. K-Mart first used IT to better target its marketing promotions rather than investing in supply-chain systems to manage fluctuations in product volume.

In 2000, K-Mart's new CEO, Charles Conaway, invested $1.4 billion in IT and launched a massive "Promotional Values" strategy to lure shoppers back to the store. However, when consumers went to the stores, they could not buy the advertised specials because the products were not available. The failure to set up an appropriate supply chain had in essence backfired the sales strategies. Perhaps another lesson learned here is that execution is as important as planning IT. Emerged from the Chapter 11 reorganization process in 2003, K-Mart is looking for a strategy to become competitive again.

In a larger picture, Wal-Mart is facing emerging competitors such as Costco, Sam's Club, and B2C retailers. If anything, the game is not over, either for K-Mart or Wal-Mart.

Timing Matters

Timing is also important. The question is whether to lead or to follow IT trends. Based on her study, Farrell recommends that companies rush into a new technology only when it advances company goals, builds on company strengths, and cannot be easily replicated by competitors. Jumping on a trend just because "everybody is doing it" signals that the new technology is not likely to provide enough differentiation to increase the company's standing against its competitors.

Complementing IT Investments

IT investments do not reap anticipated results until accompanying management practices change to take advantage of potentially better ways of working. The value of IT largely depends on the ability of the organization to maximize its return on the management of IT. This lesson about the symbiotic relationship between IT and its use has been illustrated time and again for decades. And it's still true.

Farrell notes that Wal-Mart simplified its logistics practices as it automated the flow of products to and from its distribution centers. It also redefined its relationships with suppliers when it was more tightly coordinating its information systems with theirs. The most famous shift was with Procter & Gamble and how it supplied Pampers baby diapers to Wal-Mart stores. The relationship shifted from an arms' length buyer–seller relationship to more of a trusted-partner one. The two shared confidential information, made decisions jointly, and reduced duplicate processes, thereby cutting inventory costs, improving efficiency, and better matching supply and demand.

In conclusion, the reason the link between productivity and IT investments has not been easy to demonstrate is that it depends on three factors: investing in levers that matter, getting the investment sequence and timing right, and pairing new systems with new processes and work practices that take advantage of the new IT capabilities. Furthermore, IT is not the only contributor to increased productivity.

A Tactical View of Making IT Investments

In hindsight, it may be easy to see which IT investments were good and which were not so good. However, at the moment of decision, the choice may not be so clear because of the complex and volatile nature of business. The recent approach to making IT investments is to view all company systems as a portfolio and to make investment decisions from that viewpoint, rather than judging each investment only on its own merits. Investment guidelines, such as those provided by Farrell, can then be used in the decision making.

There are numerous approaches for prioritizing projects. Following is one example, as used by AXA Financial.

CASE EXAMPLE

AXA FINANCIAL

www.axa-financial.com

The AXA Group is a $1.73 trillion global financial services organization with 140,000 employees and headquarters in France. Some 10,000 employees work in the United States at AXA Financial. Its retail businesses include AXA Advisors, LLC; The Equitable Life Assurance Society of the U.S.; Alliance Capital Management; and Sanford C. Bernstein & Co. Its wholesale division (AXA Distributors, LLC) works with brokerage houses, large banks, and independent financial planners that sell Equitable Life products through their own channels. As of December 31, 2006, AXA Financial had approximately $795 billion in assets under management, and its IT group employed 650 people. At AXA, IT has long been seen as a competitive differentiator. In 2000, the company IT budget was $300 million, almost 70 percent of the firm total net income.

Paul Bateman leads the enterprise governance process, which resides within the IT organization yet spans AXA Financial. He spends about half his time working with the business units. He was hired to manage AXA Financial's IT portfolio. Prior to his hire, senior management believed IT provided competitive differentiation and made so many significant investments in IT infrastructure and applications that the company needed to get more control of its growing portfolio. In 2000, some 200 high-priced, significant projects were in development.

Bateman introduced a governance process to instill more efficient management controls. A key principle of the

(*Case Continued*)

process is that all projects and investments are not created equal. Each one's merit depends on its economics, not on an executive's emotional attachment to it or other nonfinancial factors. This new governance process has brought discipline and a way to value projects.

Introducing a New Methodology

Bateman first undid the level playing field by introducing a methodology to help AXA Financial executives define a hierarchy of importance and prioritize projects against that hierarchy. He called on the people at United Management Technologies (UMT)[16] to demonstrate their portfolio prioritization methodology. He had been exposed to it while at Citigroup and found that UMT had since increased the methodology's functionality, making it best in class. He proposed it to senior management, and they agreed to bring the new methodology into AXA Financial.

Bateman held a series of kick-off meetings with the CFO from each area, including retail and wholesale sales, marketing and product development, service delivery, and IT. Needless to say, they were pleased with the financial emphasis of the approach.

Then he introduced it to the executive vice presidents (EVPs)—the business-unit heads—explaining the need to begin managing the portfolio of major IT projects the way fund managers manage their portfolios. Once the EVPs agreed with the concept, Bateman described the UMT tools that could help.

The top-level project review committee is the governance committee, which is co-chaired by the company's CEO and CIO, and includes the CFO and the EVPs. By representing all the lines of business, the committee ensures that approved projects benefit the entire company. This committee helped develop the governance model, which initially was called IT governance, but has since become enterprise governance, because the process is now used to prioritize more than IT projects.

The Prioritization Process

The process begins each year with the EVPs turning in their wish lists of all projects they would like for the coming year, as if they had an unlimited checkbook. Last year, the lists totaled close to 300 projects.

Winnowing the Wish List. Next, the EVPs are asked to split those projects into three categories: must-have (or else AXA Financial would incur revenue or operational risks), should-have, and nice-to-have. Taking out the nice-to-haves still left over 170 projects.

Selecting Business Objectives. To reduce the 170, AXA used the UMT methodology, which begins by having the enterprise state the objectives upon which the projects will be judged. Although the CEO has set out a vision and goals for AXA Financial, the business units are too diverse for a single list of objectives. Therefore, each business unit developed its own objectives with the CEO's strategic goals in mind. Bateman and UMT assisted each business unit to arrive at four to six measurable objectives (such as increase customer satisfaction) that could be tracked and that aligned with the CEO's strategic direction.

Prioritizing the Objectives. Each business unit, led by the EVP and including his or her direct reports, then ranked the

(*Case Continued*)

objectives using UMT's pairwise methodology. One at a time, the business unit decided how one objective compared with each other objective on a scale of importance. They had seven choices: extremely more important, strongly more important, moderately more important, of equal importance, moderately less important, strongly less important, or extremely less important.

As each decision was made, a color-coded choice was recorded by a facilitator on a matrix displayed on a large screen in front of the group. The side benefit of this ranking exercise was the business discussion it elicited among department members. Executives' assumptions and rationale for their decisions often surfaced when they debated how much more or less important, say, increasing customer satisfaction was compared with increasing market share. The pairwise comparison approach made it easy to debate two objectives solely on their own merit. The model took care of the final overall ranking among the objectives.

Ranking Projects Using the Objectives. Given this list of prioritized objectives, the committee moved on to ranking each project against how much that project supported each objective—extremely supports, strongly supports, moderately supports, low support, or no support.

There were several keys to performing this step confidently. One key was understanding what, say, strongly supports meant. Some business units quantified each level of support beforehand to vote from a level playing field.

Another key to success was each staff member's understanding of each project well enough to make these decisions, which meant having well-defined and consistently defined projects.

A third key was not having too many projects and too many objectives, or else the ranking process would take too long.

As in the objective-ranking meeting, a major benefit of this project-ranking meeting was the personal revelations that surfaced when members explained why they voted that a project strongly supports an objective, whereas others voted that the same project provided low support. When done well, these discussions yielded both insights and a group consensus. A high comfort level emerged with the results.

Following these two rankings, each EVP had a prioritized list to present to the enterprise governance committee. By this time, the total number of projects had been culled from the over 170 to approximately 70. One by one, the EVPs defended their own list, explaining why each project was included. The committee then decided which ones would advance to the funding phase.

Funding the Projects. To help the governance committee decide which projects would be funded, a business case application was then filled out for each one. The application asked for financial projections for the current year plus five more. Financial calculations for net present value, rate of return, cash flow, and payback period were then determined using the business case application.

Of course, not all projects are alike. For those that aim to produce income, the committee focuses on payback period. For those that will implement infrastructure improvements, the committee looks at operational efficiencies to be gained or

(*Case Continued*)

extenuating circumstances (such as the vendor no longer supporting a system).

Thus, the process uses four filters: the EVP's wish list filter, the must-have/should-have filter, the UMT prioritization filter, and the business case filter. The result is a list of projects that can be funded.

Throughout the year, the governance committee meets two to three times a month for two hours. It reviews the launch dates for new products and works backward to determine when the support mechanisms, such as the underlying IT system, need to be in place.

Projects costing over $250,000 require the full five-year analysis and approval of the governance committee. Projects requiring less funding need a mini-business case; these are reviewed monthly by the governance committee to ensure that they are strategically linked to company goals. The EVPs have learned to do their own filtering of projects, only taking the ones they know will pass muster at the governance committee meetings.

AXA Financial then uses ProSight portfolio management software to manage its portfolio of ongoing projects. The plan is for the governance committee to begin reviewing these data to keep tabs on the progress of projects, as well as their budgets.

Benefits of the Project Prioritization Process

The UMT-based process provides the enterprise governance committee with a panoramic view of the business, thus discussions of IT projects no long center around budgets. Rather, they center around business strategy, such as looking at the cross-functional nature of a product and how it fits on the roadmap laid out by the CEO. The attendees benefit from these discussions because they have both a view and a say in that future. Knowing the pending projects in the other areas has significantly increased cross-functional communications. Bateman acts as the secretary for the meeting, recording what has been approved and listing follow-up items. "It is a disciplined way of helping AXA Financial manage its future," he notes.

Another benefit is that approved projects are no longer questioned because they have the blessing of the CEO. The group discussions that precede the approvals also create a powerful group-concurrence effect.

Now that AXA Financial has been using the UMT methodology and the ProSight monitoring software for two years, it is turning its attention to comparing planned benefits to actual benefits, because it is beginning to receive actual performance numbers. Bateman is working to refine the estimation techniques so that they are more accurate. Furthermore, once a project has been implemented, its projected savings are being taken out of the appropriate budgets by the CFOs.

This enterprise governance structure is now seen as a best practice throughout the AXA Group. It is now being introduced to and adapted by some of AXA's European and Canadian operations.

Future Plans

Due to the success of the enterprise governance process in funding and tracking new projects, Bateman is always looking at ways to expand the use of governance tools to other areas of the business. The ongoing goal is to continually search for

(*Case Continued*)

ways to increase the value of money spent. AXA Financial has started a zero-based budgeting process (based on activity-based costing) where each business looks at the activities it performs each day and calculates the number of people and the time spent on each activity.

As an example, they could then potentially integrate the discipline of a zero-based budgeting process with the UMT prioritization tool. This approach would give the company a new way to see options to further increase the value of investments.

Another way to improve value throughout the IT organization is to ensure that project proposals list, say, two or three options. For instance, one option could be to deliver 80 percent of the functionality the first year for $1 million; the other option could be to deliver 100 percent in one year for $2 million. Options would yield better business cases and save the company money. In the past two years, the enterprise governance process has deferred approximately $20 million in expenses. The business cases showed the money would have been poorly spent. Bateman and his team are looking at ways to improve the governance process further, to help ensure that the governance committee is making informed investment decisions in support of future growth. ■

Sy Aslan[17] has helped numerous clients in strategic planning, decision making, and IT project prioritization—including clients of UMT. When people talk about prioritizing IT projects, Aslan says the process is really about team decision making; prioritization is just one aspect. He offers the following lessons he has learned over the years in this area.

Realize That the Benefits Come More from the Discussions Than the Prioritizations

A team-based approach to prioritizing projects offers numerous benefits. The foremost benefit is the business-based discussions that take place as people describe their needs and their projects, debate how projects support the business and the extent of that support, and explain the rationale behind their votes.

When the discussions are structured, focused, and well moderated, the participants better understand the business goals, better support others and other business units, and are more committed to the selected portfolio of projects.

Discussions during prioritization lead to healthier teamwork and better decision processes, both of which reduce political maneuvering and simplify future project reviews. They help generate new ideas, surface incorrect assumptions, and create an environment for in-depth discussions of the organization's mission and goals. They lead to better definitions of projects (and even company strategies) and to deeper understanding of the insides of projects. They bring to light what is not needed and crystallize how each project supports specific business needs, if indeed they do.

After a prioritization discussion, the participants can identify which projects can be delayed and how dependent projects are on one another. Discussion also saves time and reduces the amount of noise in prioritization. Low-value and questionable projects are no longer submitted to the group for approval because people know others will scrutinize the submissions.

Put Projects into Categories Where They Are Comparable

Once projects have been defined, it becomes clear that they belong in different categories and thus require different treatment, says Aslan. One category is R&D. These projects cannot produce immediate tangible benefits. Furthermore, there is no certainty they will yield any value in the future. These projects should only compete with each other for some percent of the IT budget.

On the other end of the scale is the volume category. Volume projects are sure things. For example, when a business unit experiences increased demand, it may need to invest in more IT volume to capture the revenue from that demand. Because these projects support sure growth and have a secure return-on-investment (ROI), they should not compete with any other project. All that is needed is the assurance of the capacity planning people that the underlying computer system has indeed reached its capacity limit and the investment and action plan are sound.

Finally, it is also wise to have a minimum consideration level, for example, $25,000. Managers should be able to finance projects below that threshold from their discretionary budget. However, these projects should be reviewed by a higher-level sponsor and project outcomes should be part of the manager's performance evaluation.

Address Project Risks

Project managers should address three types of risk in their proposals:

- Risk that the project will fail
- Risk of not doing the project
- Risk that it is the wrong project for what is trying to be achieved

Every project carries with it a risk of failure. This risk can range from total failure to failure to yield some of the expected benefits. To properly prioritize projects, they all need to be at the same risk level and have the same probability of success. To evaluate risk of failure, project managers should be able to document answers to at least these four questions:

1. What is the probability the project will be completed on time?
2. Will it be completed within budget?
3. Could it be impacted by an internal issue (over which the company has control)?
4. Could it be impacted by an external issue (over which the company has little or no control)?

When a project has a higher risk than is defined as acceptable by the selection process, the project manager should identify mitigation methods, calculate the cost of the risk, and add that cost to the project.

The second type of risk is not doing the project. Here, people need to consider the reason for the project and the problems it will prevent once it is up and running. For example, a project that will introduce virus protection across the network will prevent virus damage. Consider the project as insurance against this damage and use simple actuarial methods to calculate the value of such insurance (probability of the damaging event multiplied by the cost if the event does occur). The calculated insurance value should be added to the project benefits.

The third risk is doing the wrong thing. Three examples are introducing a technology that will be quickly replaced by a superior one, supporting a temporary market trend, and developing a system for a process that is not effective or efficient. These projects may be successful, but they will be deemed useless very quickly.

The best mitigation approach for this risk goes back to the basic tenet of project prioritization: team discussion. The team needs to surface the assumptions that support the project and then play scenario games: Create three scenarios about the business and the project's future. Make one scenario a disaster, the second rosy, and the third an extension of the team's pessimism or optimism by a few degrees. Then have the team ask itself, "What effect will this project have in each scenario?" The ensuing discussion will expose holes in thinking and offer mending approaches. The project may be cancelled, divided into phases, consolidated with another, or re-created in a different version.

The prioritization process takes into consideration costs and benefits. In essence, reviewing the risk is the response to the financial manager saying, "I need proof that this project will achieve its benefits within the stated budget." Many IS researchers advocate the practice of prototyping to make sure that the idea is technically feasible and economically viable. A prototype is a project that is limited to the testing of the most critical features of the systems to be built.

Prioritize Quarterly and Apportion Your Budget Accordingly

In our constantly changing business world, it is not wise to close the list of approved projects for a long period of time. New project requirements arise frequently, and some of these projects may be more important than others already approved. Also, in most cases, the constraints for undertaking projects are not only budgetary, but also people resources and possibly dependencies and timing. If a prioritization team starts the year allocating its entire annual budget, it may find little leeway for change during the year. People will hold onto their budget allocation as if it were an entitlement.

A quarterly prioritization provides more agility. The first option is to allocate part of the budget as reserve to be allocated at a later time. For example, allocate two-thirds of the budget in the first quarter and save the remainder for the following quarters. Another option is to state that any project that gains approval but does not start in the quarter automatically goes into the next quarter's evaluation—and so does its allocation. People are happy with this approach because they know they always have a chance to introduce a new project or reexamine a rejected one. The options are not exclusive. Any combination or variation that allows the team to be flexible in the face of change is a good process.

Once a project starts, it should be tracked by the project life cycle monitoring system. If costs change, say, more than 10 percent, that increase should trigger a reconsideration of the project's cost, risks, and benefits. In doing so, the team should only consider the benefits against what is yet to be spent, even if lots of money has already been poured into the project, because the value of the entire project rests on that unspent portion. During the process, the team should agree on a set of metrics that help measure performance as accurately as possible. It is important for all participating units to monitor the progress of their work. Also, metrics are useful for bringing about credibility, shorter cycle time, and fewer customers complaints.

Be Consistent

The main hindrance to team decision making is lack of consistency. To an individual team member, a group decision-making process seems cumbersome. Individuals have a tendency to find shortcuts and change the process on the run. When a new prioritization process is introduced, people become disenchanted. They do not want to learn the new approach; they secretly revolt and revert to their own old method, which contributes to even more inconsistency.

It is important to have a consistent process and an agreed-upon method for changing the prioritization process. Surprisingly, one of the hardest things to keep consistent is the project definition, says Aslan. Without such consistency, it is difficult to compare projects. To achieve consistency, it is important to introduce principles, such as "a project should be completed within 18 months." Such rules should not be hindrances, but breaking them should require a valid reason.

Consistency comes from understanding the team decision-making process. People need to realize that the process is a balancing act. There is no black and white. For example, they need to see they can either move quickly or scrutinize the details, but not both. If people do not understand how to balance the two, they act as a pendulum. They opt for speed, but fail, so they revert to scrutiny, even when it is not necessary. When they fail again, they go back to speed. The team needs to learn how to balance speed and scrutiny.

Consistency requires patience. Avoid shortcuts. Ensure that the details are well thought-out, recommends Aslan. Some team members will become impatient with the discussion of small, but important points, such as possible future resource conflicts. They need to realize that the value of prioritization comes in such discussions. A well-facilitated session will maximize the team's patience and the discussion value.

Managing: Establishing Credibility and Fostering Change

CIOs are in the change business. Information systems bring about change. But before a CIO and the IS organization will be heard as a voice for change, they must be viewed as being successful and reliable. To foster change, a CIO must establish and then maintain the credibility of the IS organization.

Establishing Credibility

Management consultant Joseph Izzo[18] believes that IS organizations have two missions: to maintain today's systems and to work on tomorrow's systems. These two missions have distinctly different goals and therefore need to be managed separately and specifically. The "today" operation should concentrate on providing service whereas the "tomorrow" operation needs to focus on helping the business operate better. The first job of IS management is to get the "today" operation in shape. Until that task is accomplished, CIOs will have little credibility with top management.

Managing the "Today" Organization Better

Because their main mission is service, the service levels of these various operations need to be measured and used to manage them. To run the "today" operation, Izzo suggests hiring managers for each of these functions who are like supervisors—that is, they are delivery-oriented and demand a high level of service from their people.

An increasing number of companies outsource these IT support functions to companies that specialize in this work. This outsourcing releases in-house staff for higher-value work, generally reduces costs, and should result in gradually increasing levels of service. But reaping these benefits requires negotiating good contracts and managing the suppliers. Chapter 8 discusses running "today" operations further.

Once the "today" organization is in shape, then IS management has the credibility to be heard when talking about the need to change business practices to take advantage of a potential new system.

Fostering Change

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. Not so. Many technically sound systems have turned into implementation failures because the people side of the system was not handled correctly. In essence, 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; thus, 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.[19] 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, which 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

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 projects face and identify what they can do to mitigate those risks.

Working Across Organizational Lines

CIOs now find that the systems they implement affect people outside their firm. The interconnectedness permitted by the Internet, and the desire of supply-chain members to increase their supply-chain efficiency, is pulling some CIOs to working as much with these external members of their supply chain as with their own internal people.

On the supplier side, companies and IS organizations alike are rationalizing their supplier base, depending on fewer, deeper relationships. This trend is causing CIOs to work more closely with suppliers' executives to whom they outsource their help desk, PC acquisition–maintenance–disposal, data center, network management, and other functions. The result is more disclosure of future plans, more joint planning, more joint working, and so forth. Some suppliers are treated more as partners than suppliers. This trend has opened up the need for vendor relationship management techniques. In Chapter 8, we describe what Eastman Kodak has done to develop working procedures with its main outsourcers.

On the customer side, CIOs are being increasingly called upon to describe the company's IT-enabled vision to customer executives to get their buy-in to building interbusiness systems. When dealing with suppliers and customers, CIOs and others on the executive team all become involved in fostering change. Here is an example of a CIO who is working with his peers on his firm's executive team to manage change not only in their own company, but at customer companies as well. It is updated from a Gartner EXP report, *Managing Your Stakeholders*,[4d] written by Andrew Rowsell-Jones, et al.

CASE EXAMPLE

REXAM

www.rexam.com

Rexam PLC is one of the world's top five consumer packaging companies and the world's top beverage can maker. Globally, Rexam has sales of $7.5 billion and only 23,000 employees in more than 20 countries. Rexam's vision is to create more value from its portfolio of businesses. Also, the company seeks to

(*Case Continued*)

capitalize on its economies of scales and the opportunities in the value chain.

The beverage can business is over 100 years old, and the business processes in the industry have been mostly based on lowest cost. To invest in new business processes takes a strong business case. Some processes have been automated, yet many remain manual.

Rethinking Interactions with Customers

When Paul Martin joined Rexam as CIO of Rexam Beverage Can Americas a few years ago, he visited the plants to see how the company did business and he found that most orders were received by phone or fax, keyed into spreadsheets, held for days in anticipation of changes, and then faxed to a plant near the customer, where they were rekeyed into back-office systems. The result: multiple chances for errors and shipments of the wrong products to customers.

"There's a way to leverage the Internet here," Martin told others. Their response, "Our customers will never interact with us via the Internet, or place an order online. You will hit a brick wall." Martin's reply, "If we can demonstrate the value to them, they will." He set about proving his point.

Phase 1: CRM Made Simple

"Our goal is to entangle our customers with e-technology, which means we will deliver incredible value by creating an environment that delivers such exceptional service that our customers will think twice about leaving Rexam for a lower price," said Martin.

Rather than invest in a large Customer Relationship Management (CRM) system, Martin's staff and some consultants built a platform and some applications based on feedback from Rexam's sales group and customers. The system includes online ordering via the Internet and captures customer feedback about quality problems. It also provides customers with a range of reports and business intelligence tools to slice and dice the data in many ways. The system also introduced invoice reporting and put accounts receivable online to reduce billing errors and to expedite payment to Rexam. Every day Rexam can reduce Days Sales Outstanding, its cash flow improves by $4 million. That is a big impact.

The system benefits customers as well. They can inquire about invoice information online—the bill of lading number, filling location, plant making the cans, and so forth. They no longer need to call Rexam's accounts receivable group for this information. Furthermore, when an online order is changed, the system automatically notifies the customer about the change, so both parties stay more in sync. The parties interact more, but the complexity of these interactions is hidden in the system, offloading it from the employees on both sides.

Testing the System with Customers

To test the value of the system to customers, Rexam approached its largest beverage can customer. The director of procurement saw the potential value, so he said, "Let's test it in one bottling location that rarely changes its orders."

After the three-month test, the bottler's response was highly positive. The system did indeed eliminate faxes and phone calls to Rexam, which was a huge plus, and the bottler could get needed information in real time.

(*Case Continued*)

The customer wanted more. In an e-mail, the procurement officer wrote, "I've got some feedback for you. We see benefits, . . . and we'd like some additional features. We'd like to see shipment history for 3 months because that will help our internal forecasting."

In response, Rexam gave them 12 months of shipping history to use in reviewing orders and pull patterns. The customer rolled out the system to 27 U.S. bottling locations the first year, standardizing the ordering system. Rexam has entangled this customer with e-technology in both interactions between the two firms and in assisting the customer with its internal operations.

Phase 2: Knock Customers' Socks Off

The goal in phase 2 is: Knock their socks off, meaning, impress customers so much that they will not leave Rexam. This phase involves redefining "world-class" for the beverage can industry. In part, it involves implementing SAP, reengineering Rexam processes, and using mySAP to create customer portals to leverage the ordering system and permit collaborative online forecasting. This prospect excites customers, because they have learned that Rexam knows more about some aspects of their business than they do. As a service for its customers, Rexam keeps customers' packaging inventory. Rexam's goal is to reduce these inventories through the collaborative forecasting and scheduling system.

Rexam also plans to design new can labels online so that customers can see the artwork in 3D—a significant advance from the digital pictures they now receive via e-mail.

Finally, the CRM system contains pictures and contact information of its employees. In the future, Martin's group will ask customers if they would like PC-based video conferencing. If so, it will install a small video camera on their PCs. By clicking on a Rexam employee's picture, the system dials that person to initiate video conferencing—all part of Rexam's goal to "knock their socks off."

The CIO's Role

Complexity in Martin's job comes from Rexam's suppliers and customers more than from its employees. Martin spends as much time giving presentations to these stakeholders as he does to Rexam employees. The key to gaining their buy-in is the value Rexam brings to them. He demonstrates the value of online ordering using the Internet and interlinking systems.

He is able to spend this much time externally because his IS director has taken over management of key development efforts. "This frees me up to do what the CEO wants me to focus on: strategy and getting our external relationships under control," says Martin.

The beverage can market has flat growth, just 1 to 2 percent a year. Generally, the only way to improve margins is to cut costs. However, last year prices increased for the first time in 25 years. In renegotiating contracts this year, the vice president of sales is adding a new clause to the contracts to leverage the firm's innovative e-business and SAP work. In essence, the clause states, "if we (Rexam) deliver exceptional value in innovation, Six Sigma, and e-business, we can come back to you to collect additional fees."

Obviously, customers have been asking what this new clause means. In response, Martin visits these customers and gives them a presentation about what

(*Case Continued*)

Rexam is doing in these areas and the potential benefits to them. "The CEO sees me as a business person. These are not IT projects; these are company projects. It's my job to translate our systems solutions to their business problems," says Martin.

The Steering Committee's Role

When Martin presented the $11-million business case for the SAP and e-business initiatives, the CEO asked, "How long will this take to deliver?" The answer: three years. "I need it in 18 months," replied the CEO, "It's very important to our strategy. We need this foundation in place."

To meet that aggressive schedule, the work has been guided by the executive steering committee, made up of the CEO; CFO; CIO; and heads of operations, supply chain, and sales. It meets every other week for an hour, not to prioritize projects (everyone agreed on those), but to guide implementation, resolve roadblocks, validate new business process designs, and spur progress. None of the members, including the CEO, has missed a meeting.

The committee first defined Rexam's future state so they would all be "reading from the same page." They have since focused on the vision and achieving behavioral change. "We are transforming our internal business processes and the way customers and suppliers interact with us," notes Martin. "Everyone on the executive team understands the impact of these changes on their own organization. So we divvy up the work. We have all put in the plans and procedures to be ready for the new systems." The executive committee's role has been to lay out the game plan. Phase 2 has been simplified tremendously by the committee members agreeing on the agenda.

Rexam Launches Online Catalogue

Promoted to the rank of Group Information Management Director, Paul Martin continues to focus on how to use IT to create business values. He reaffirms his vision: "We are committed to providing our customers with the latest online tools that facilitate business with Rexam." In 2005, Rexam launched a new online showcase of its packaging solution. The innovative catalogue covers a large spectrum of Rexam's packaging solution. The Web-based catalogue has a simple user-interface with user-friendly search functions. More importantly, it serves as a bridge between the educated customer and the sales teams. This vision is consistent with the cross-functional role of corporate leaders because the economy is moving from an economy of production to one built on consumption. ■

The Rexam case illustrates a number of points about CIOs' current role. One, CIOs are working outside as much as inside these days. Two, they are working in concert with their peers in the company in selling and implementing their visions. Three, to stay ahead, CIOs need to keep their staffs experimenting with new technologies. Four, selling the vision occurs one customer, supplier, or executive at a time. This means CIOs, and others, need to assess how IT-ready a customer, supplier, executive, department, or group is.

The Office of the CIO?

Darwin John, former CIO of the U.S. Federal Bureau of Investigation, Scott Paper, and the Mormon Church, believes that the work of CIOs has become so broad and complex that it should by handled by a team—an office of the CIO—rather than an individual.[20]

When he was CIO, John says he divided his time into thirds: one-third managing the IS organization, one-third working with peers to manage the enterprise, and one-third networking with people outside the enterprise. Today, he says, there are just not enough thirds to go around, because every function has become dependent on IT. Furthermore, CIOs must bring in and integrate new technologies and be highly involved in business planning, because they are part of top management.

One way to divide the job, notes John, is to have an office of the CIO with four positions:

- ***Chief Information Officer (CIO):*** This executive heads IS and works with top management, customers, and suppliers.
- ***Chief Technology Officer (CTO):*** This executive heads IT planning, which involves architecture and exploration of new technologies.
- ***Chief Operations Officer (COO):*** This executive heads day-to-day IS operations.
- ***Chief Project Officer (CPO):*** This executive oversees all projects and project managers.

An alternative two-way split is to have co-CIOs, with one focusing on all things external to the IS organization (such as planning and relationships with the business, customers, and suppliers) and the other focusing on all things internal (such as operations and projects).

With IT so crucial to enterprise success, and the know-how needed to run it so deep and so wide, management needs to become a team effort. A few firms have created such an office of the CIO; others have created such a team without designating it as "the office of the CIO."

CONCLUSION

A key issue in this chapter is how IT leadership can exploit digital technology to deliver growth. We have provided ample examples that IT has become more than a tool for incremental change. IT can be used to achieve quantum leaps. This poses critical and fundamental challenges for leadership. Neil Fligstein,[21] a sociologist at the University of California at Berkeley, makes an interesting observation about the possible future importance of CIOs by looking at history. He notes that different periods of recent history have seen executives with different backgrounds "running the show," depending on the corporate growth driver at the time:

- ***Manufacturing:*** In the early 1900s, manufacturing was the growth driver; thus, manufacturing executives often rose to become CEO.
- ***Sales and marketing:*** In the 1930s through the 1950s, growth came through sales. By 1959, nearly 25 percent of the top American corporations had former sales and marketing executives as CEOs, notes Fligstein.

- ***Finance:*** In the 1970s and 1980s, the large corporations consisted of portfolios of businesses and were best managed by executives who knew how to manage portfolios: chief financial officers (CFOs). They bought and sold businesses like you would buy and sell stock, to get the highest return.
- ***Information technology:*** The financial scandals in the late 1990s and early 2000s, though, have hurt CFOs' reputations. Furthermore, given the revolutionary effects IT is having on the world, perhaps CIOs now have the most appropriate background to be future CEOs, says Fligstein. It's an open question at the moment.

Chris Anderson,[22] author of *The Long Tail* and editor of *Wired* magazine, said in a CIO Conference in June 2007: "CIOs, it turns out are . . . business people who have been given the thankless job of keeping the lights on IT-wise." Today's CIOs must understand technology well, speak the language of senior management, and involve their personnel in finding innovative ways of using IT to effectively and swiftly deploying new business ideas. To achieve this transformation, CIOs must function at the corporate strategy level and work at the detailed operational level. Jeff Wacker, a futurist at Electronic Data Systems, sums up the role of the CIOs as follows: "Their role is part lawyer, technician, mediator, and change agent. No other position requires the executive to excel in so many capacities. It's safe to say that the future CIO should prepare to take on further additional, unexpected responsibilities."[23] Wise and committed IT leadership is required to win in the new economy.

QUESTIONS AND EXERCISES

Review Questions

1. Describe the five waves of innovation from Primozic and colleagues.
2. Describe the three ways American Airlines is reaching the consumer.
3. According to Cox, what are the four areas that make up the overall responsibility of the IS function?
4. What are the two major roles IS departments are likely to play in the future, according to Cox?
5. What is IS Lite?
6. What are the three IT eras and what has been the CIO's job in each, according to Ross and Feeny? (See Figure 2-7.)
7. What are seven ways to understand the business?
8. How is John Leggate selling his Digital Business vision within BP?
9. Describe the needs of champions.
10. How does the corporate technology planning group foster experimentation within Aetna?
11. What is IT governance and why has it become important?
12. What is an IT principle? Give an example.
13. According to Farrell, what three conditions of IT investments yielded the greatest productivity increases in industries dependent on IT and that faced growing competition?
14. What are five lessons Sy Aslan has learned from his work on portfolio prioritization?

15. Describe the three kinds of people involved in change management, as described by ODR. Compare ODR approach with other approaches that you are aware of.
16. What is CIO Martin's role these days at Rexam Beverage Can Americas with respect to customers?

Discussion Questions

1. A vision is not the responsibility of the CIO. It is the responsibility of the CEO or the top management team. Do you agree or disagree? Why?
2. Present both sides of the argument that business-process owners will/will not take over management of IT.
3. What is going to happen to organizations whose senior executives do not appreciate the strategic value of IT?

Exercises

1. There is considerable discussion of the evolving role of the CIO. At one time, the term "CIO" was defined as "career is over." Find at least two articles on the role of CIOs that make conflicting arguments; summarize the differences.
2. There is also much discussion about partnering between IS and line organizations. Find at least two articles that discuss such partnering and summarize the factors they mention that contribute to successful partnering.
3. Contact the CIO in an organization. What is his or her title? How does he or she perceive the leadership role of the job? How do these characteristics relate to those in the text? How is he or she encouraging partnering with business units?
4. Using socialization to win support from other people is too slow a process for our current fast-moving world. Companies really need to either adapt to mandates or have representatives make decisions on others' behalf. Otherwise, a few recalcitrant people could cause the enterprise to move too slowly. Discuss.

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CHAPTER

3

STRATEGIC USES OF INFORMATION TECHNOLOGY

INTRODUCTION

Utilizing the Internet to conduct business has become a mainstream strategic use of IT, where strategic means having a significant, long-term impact on a firm's growth rate, industry, and revenue. In fact, many IT experts would argue that by now, if a company has not aligned its IT with its business, or used IT to create new added value, it will be out of business sooner rather than later. The issue is that no successful business can separate IT from its business strategy. The question is: What now? Does an even larger revolution loom? Does IT still matter? If so, what sorts of strategic uses are companies making of IT (especially the Internet)? How do we link business technology to financial results? These are the topics of this chapter.

HISTORY OF STRATEGIC USES OF IT

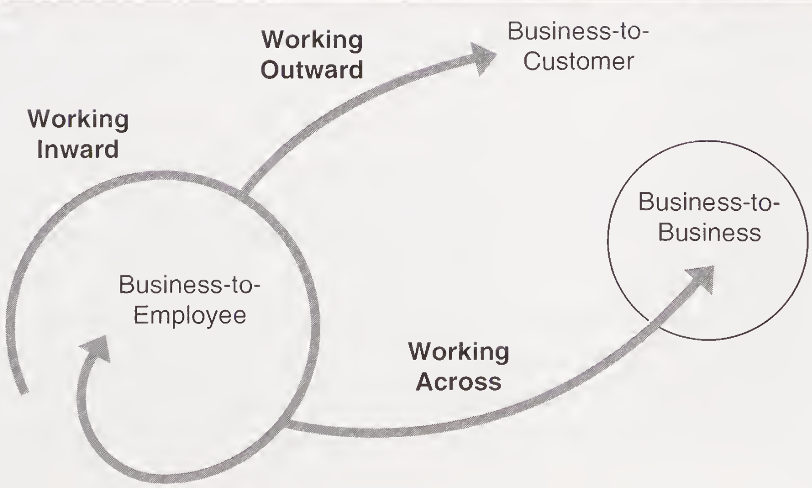
For the past three editions of this book, we have seen three strategic uses of IT in business, as shown in Figure 3-1:

- Working inward: Business-to-employee
- Working outward: Business-to-customer
- Working across: Business-to-business

We believe these types of uses continue today; thus, they form the structure for this chapter. To set the stage, we briefly review strategic uses of IT over the past 25 years by noting the changing emphasis in the strategic use of IT over the lifetime of this book.

In the mid-1980s, the hot topic in the first edition was end-user computing (working inward). IS departments established end-user computing departments to help employees learn about PCs and how to use programming languages, such as BASIC, Focus, and spreadsheets, to write their own computer programs.

FIGURE 3-1 Strategic Uses of Information Systems



Then, during the second edition, strategic use focused outward on using IT to gain competitive advantage. A prime example was Merrill Lynch's cash management account (CMA), which combined a stock account with checking and savings. It was developed in the late 1980s, even through the bleak times following the Black Monday stock market crash in October 1987. When CMA was introduced to the market, it gave Merrill a huge market share boost that other brokerage houses found difficult to take away. This IT-based offering gave Merrill a competitive edge.

In the 1990s, during the third and fourth editions, strategic use turned inward to reengineering business processes. The intent was not to automate existing processes, but to totally redesign how the enterprise operated. The notion had merit, but many efforts failed because they were seen as thinly disguised efforts to lay off staff. The introduction of ERP systems was also aimed at improving internal operations, specifically, providing single sources of data enterprise-wide.

In the mid-1990s, when the Internet's potential started to become evident, dot-coms looked at its outward use to gain a competitive edge. However, most established firms initially used the Internet technology internally, building intranets to improve company processes. Often, the first uses were publishing e-forms on the intranet with accompanying automated workflow processes.

By the late 1990s, the fifth edition showed that use of the Internet for business—e-business—was underway, as established enterprises countered their new, Internet-only dot-com competitors. Then came the bursting of the dot-com bubble, and with it the fervor of e-business slowed down. E-business has become more reality based. Not as many hare-brained ideas are being funded. However, the integration of the Internet into how companies work has proceeded.

In the sixth edition, the inward and outward strategic uses continued, but the strategic use emphasis has been placed on linking to suppliers, customers, and other parties in one's value chain or business ecosystem. The innovation unleashed by the dot-coms, and the competitive challenges they presented for brick-and-mortar firms, initiated a backlash: The Brick-and-Mortar Firms Strike Back (or Return of the Brick-and-Mortars, depending on whose side you are on). That was the theme of the sixth edition: leveraging traditional operations by using the Internet to work more closely with others.

The theme of the seventh edition was on positioning of the role of IT in corporate business and how IT can effect change, especially with regard to the use of IT for competitive advantage. A recent, highly influential article, to be discussed shortly, questions whether IT can be used for competitive advantage at all. It has caused quite a stir. But although some may question IT's ability to give companies a competitive edge, it is absolutely necessary for competitive parity (keeping up with competitors), and more than ever, it is being used strategically—inward, outward, and across.

In this edition, we focus on how IT can "take charge," in an increasingly complex business environment. Recent reports by the *Wall Street Journal* suggest that many companies are spending about 70–80 percent of their IT budget on maintenance. Only a smaller percentage is allocated for developing new strategic projects and carry them out with sound project management. To set the context for discussing these three strategic uses, several opinions follow on just what has changed about the use of IT and where it might be going.

WHITHER THE INTERNET REVOLUTION?

Despite the dot-com burst in 2001, the Internet revolution continues to change the way we live, and the way businesses operates. Wikis, blogs, and instant messaging invade the office. According to a 2006 survey by the American Management Association and the ePolicy Institute, roughly one-third of U.S. employees use instant messaging at work. These new applications have slowly changed the way people work and communicate. Brian Arthur[1] predicts the buildout of the Internet revolution will last 10 to 20 years, and the developments that will matter most will be "arrangements of use," that is, innovations that adapt the Internet to people and their use of it. The interconnection of business will be the revolution. It will be quiet compared to the frenzy of 1999 and 2000, but Arthur predicts it will be a giant revolution.

THE CHEAP AND DISRUPTIVE REVOLUTION

For the past several years, Rich Karlgaard,[2] a publisher of *Forbes* magazine, has been talking about what he calls "the cheap revolution." Karlgaard believes we are in an inflection point in the IT industry where CIOs are shifting from buying expensive proprietary products to buying cheap generic products. He calls it "cheap tech," and he sees the phenomenon occurring in more and more sectors of the IT industry.

E*TRADE, the online trading firm, replaced expensive Unix servers running Sun's proprietary operating system with many cheap generic servers from IBM. Google runs its search engines on more than 350,000 inexpensive Linux-based servers. Furthermore, when one breaks, Google discards it, thereby bypassing expensive service contracts and in-house fix-it staff.

On the supply side, Dell sells generic versions of products at significantly lower prices because its direct-to-customers business model has lower costs. Dell has moved from selling PCs to also selling servers, printers, storage devices, handhelds, and LCD televisions.

The low-cost revolution exemplifies the globalization trend where "cheap" is occurring elsewhere. Companies are constantly looking for cheap labor with offshoring. They look for free open-source software to reduce production costs, and take advantage of VoIP (Voice over Internet Protocol) to cut telecommunications costs. Being on the wrong side of this cheap revolution, in any industry, is not the place to be.

EPISODE TWO: PROFITABILITY STRIKES BACK

The fourth and fifth editions of this text were published during times of "irrational exuberance" (to use Alan Greenspan's noted term) for the Internet; the sixth at a time when people more realistically reviewed its potential. The wild schemes of dot-coms, which became dot-bombs because they could not generate profits, have significantly tempered views.

We would characterize the dot-com euphoria as the Internet's Episode One: The Dot-Com Menace. We would characterize today's leveraging of the Internet as Episode Two: Profitability Strikes Back. Unlike Episode One, which starred companies that only had an Internet presence, the sequel has starred those with a dual physical and Internet presence (initially called bricks-and-clicks firms) and that are profitable. While it took these so-called "old-economy firms" longer to utilize the Web, they realized they had to do so in a profit-making manner. Interlinking the two worlds properly can increase their value proposition to customers.

But, says Michael Porter,[3] the only way to sustain advantage through the Internet is to create a distinct value chain that offers unique value. This chain must be highly integrated, so that potential competitors must replicate the entire system to duplicate the value proposition. Porter recommends: Use the Internet to complement your strategy, not replace your past way of serving customers nor disintermediate your channels. Grainger, as described in the case example, has taken this approach.

EPISODE THREE: INTERNET-ENABLED MASS CUSTOMIZATION

Chris Anderson's provocative and insightful book, *The Long Tail*,[4] describes how the Internet has radically changed the world economy in the most fundamental way. Noting that the Internet is constantly changing our habits and behavior, Anderson shows how buying habits have been shaped by the economics of big business, creating the blockbuster culture. However, citing the success of eBay, Google, Apple's iTunes, and Amazon, he demonstrates that the Internet has changed the culture of mass consumerism, allowing consumers to be more exploratory and specific about what they want and what they buy. In a knowledge economy where information drives reputation and allows niche cultures to blossom, the economy is shifting away from a concentration of a relatively small numbers of "hits" (mainstream products and markets) at the head of the demand curve (for example, most people use Tylenol or drive a Camry) and toward a huge number of niches in the tail (for example, consumers choose their individual songs or movies to download, and select wedding planners based on their unique wishes). There is less need to offer one-size-fit-all products or services. Instead, pervasive technology, in particular with the emergence of mobile computing, makes it possible to sell highly customized goods at attractive prices. As of September 2007, online music stores, in particular Apple's iTunes store, sold more than 2 billion songs for a unique price of 99 cents.

Perhaps a dominant trend of Episode Three is the explosion of niche markets, thanks to the increased capability of search engines and filtering tools that allow consumers to discover and explore what interests them. A particular success of these niche markets is the phenomenal growth of social software services such as YouTube. With YouTube, anyone can create and share any homemade videos; many of them have been watched worldwide. Thus, the Internet revolution continues to change the nature of commerce and provides the consumer with a new sense of place and sense of belonging.

CASE EXAMPLE

GRAINGER

www.grainger.com

Headquartered in Lake Forest, Illinois, Grainger distributes nonproduction products to companies through stocking locations all over the United States. Its business model is to help customers save time and money by providing the right products to keep their facilities operating. As of 2007, Grainger works with more than 1,300 suppliers to give their customers access to more than 800,000 products ranging from adhesives to lighting, electronics, and test instruments. Grainger has a multiple-channel strategy:

- Branch Network: Customers can go to one of the 425 branches in the United States to pick up their order the same day. They have access to knowledgeable customer service associates at the branch, via phone and fax.
- Paper Catalog: The 2007 edition is the 80th edition.
- Grainger.com: Customers can order more than 300,000 products online and have them shipped directly, or to be picked up at the local branch.

"Grainger Internet strategy builds on this physical presence, tightly integrating the two," states Porter.[5] Grainger has found that customers who purchase on its Web site also purchase through its traditional channels, and these customers purchase 9 percent more than those who do not use its Web site.

Grainger has also discovered that its physical sites make its online presence more valuable, especially for customers who want fast delivery. They order online and pick up their order themselves at their nearby Grainger site. This combination cuts Grainger's costs in two ways: online ordering is less expensive than over-the-phone ordering and shipping in bulk to its stocking locations is cheaper than small shipments to individuals.

Grainger also chose to continue publishing its paper catalog after putting its catalog on its Web site. It is pleased to find that it receives a surge of online orders every time it issues its paper catalog. The 2007 catalog offers customers a resource for more than 130,000 facilities maintenance products. The two are synergistic, it turns out. Grainger's sales reached $5.9 billion in 2006. ■

Porter cautions that companies must not only take into account the synergistic effects of conducting business online and off-line, but should also realize that there are secondary effects to having an online presence. For example, although order-taking costs may fall, costs in other areas may increase. For instance, online ordering often results in more requests for quotes and information.

That and other issues revolving around conducting a bricks-and-clicks business are now being debated and tested as old-economy firms e-enable themselves inside, outside, and across. E-enablement means digitizing where possible. The "e" comes from electronic, and it has been attached to all kinds of terms. For example, take the terms "e-business" and "e-commerce." We see e-business as meaning conducting business using telecommunications networks, particularly the Internet. Thus it involves more than buying and selling electronically, which is e-commerce. Not all people agree with these distinctions.

At first, the rapid growth of e-business during Episode One (from 1994 to 2000) seems astounding. However, a closer look reveals some clear reasons for the rapid growth. The Internet provided three key components that accelerated online business:

1. Wide access to a public network
2. Standard communication protocol
3. Standard user interface

Earlier systems that linked firms with their customers or business partners required private networks with proprietary applications. Indeed, the private, proprietary nature of the systems was key to their strategic value. The high cost of implementation, training, and use of these systems locked in customers and created barriers to competitors building similar systems. However, the high cost also limited access to the systems, thus restricting their widespread use; only large firms could afford to build such systems. For example, pre-Internet data estimated that 95 percent of Fortune 500 companies in the United States used EDI, whereas only 2 percent of all U.S. companies used EDI. EDI was the main technology for transacting commerce electronically.

Because e-business applications run over a public network, the Internet, access and communications costs are drastically reduced. Furthermore, with standardized communication protocols and user interfaces, implementation and training costs are far lower. As a result, a much broader set of users and firms has access to the systems, allowing for rapid growth. Indeed, in just a few years, use of the Internet for e-mail and company Web sites became standard business practice in most companies, large and small.

DOES IT STILL MATTER?

Porter's downbeat view of the Internet's value to individual firms (which is explored further in Chapter 4) got attention, and arguments. But it did not generate nearly as much controversy as "IT Doesn't Matter," the provocative article in the May 2003 issue of *Harvard Business Review* by its former editor Nicholas Carr.[4a] His article generated a firestorm of protest. Carr's point is that IT doesn't matter anymore, at least not strategically. He has since expanded his argument into a book.[4b]

According to Carr, IT is an infrastructure technology, like railroads, electricity, and the telephone. Such a technology can create a strategic advantage for an individual firm only at the beginning of its life cycle, when its technology is expensive and risky. That is the only time a firm can create something proprietary that competitors cannot easily copy.

Carr contends that once an infrastructure technology reaches the end of its buildout—that is, when it is neither proprietary nor expensive—it becomes a commodity, available to anyone, and therefore will not yield competitive advantage to any single firm. To Carr, an investment must provide differentiation to give competitive advantage. Investments in commodity technologies cannot provide (nor sustain) such differentiation.

It appears that IT has reached the end of its buildout, says Carr, for five reasons. One, the power of IT now outstrips the needs of businesses. Two, IT prices have dropped; it's affordable. Three, the capacity of the Internet has caught up with demand. In fact, there's more fiber than can be used. Four, many computer vendors want to be seen as utilities (somewhat akin to an electric utility). And five, the investment bubble has burst.

When an infrastructure technology reaches the end of its buildout, it tends to become costly to keep it running. That is when people should care most about mitigating the business risks it poses (phones, electricity, or computer systems not working), rather than pursuing the innovations it makes possible. First-mover advantages cannot last when everyone has access to the same technologies at affordable prices.

Although IT is necessary for competitiveness, it's not sufficient. Competitive advantage comes from a firm's business model, not its use of IT.

IT has become part of the business infrastructure; therefore, its management needs to change, states Carr. Success hinges on defense, not offense. Management of IT should become "boring" and focus on three areas:

1. *Manage the risks.* Focus on vulnerabilities rather than opportunities. There will be plenty of risks because open systems are more risky than proprietary systems.
2. *Keep costs down.* The greatest risk is overspending, so only pay for use and limit upgrading (do not upgrade PCs when it's not needed, for example).
3. *Stay behind the technology leaders,* but not too far behind, because experimentation is expensive. Delay investments until there are standards and best practices and prices drop. Only innovate when risks are low.

Carr's diminutive view of IT's value deals with its innovative use by individual firms. Although they lose the possibility of gaining individual competitive advantage, the infrastructure technology brings its greatest economic and social benefits to all once it has become a shared infrastructure. That is what IT is becoming, he believes.

The Debate Is On

Following are just three of the many insightful pieces that have been written about IT's strategic value that refute Carr's article.[4c] John Seely Brown and John Hagel,[5] two well-known figures in the IT field, state that IT alone has not been a strategic differentiator, but it is "inherently strategic because of its indirect effects." It enables firms to do things they could not do before. Firms that see these possibilities first, and act on them, can differentiate themselves. Although computers are becoming ubiquitous, the insight on how to use them is not, they contend. That's what provides strategic uses of IT.

In fact, Brown and Hagel believe the past has taught three lessons about how to use IT strategically:

1. Value comes from IT only when it is paired with concurrent innovations in business practices. Too many companies do not change their business practices when they implement IT. That is why studies have shown no correlation between IT spending and superior financial results. Executives who think of IT as a commodity have not explored the innovative business practices it makes possible, especially across enterprises.

2. IT's economic impact comes from incremental improvements, not a "big bang" IT project. Waves of short-term IT projects, built on each other and tied to business changes and specific performance metrics, yield value.

3. Strategic differentiation emerges over time. It does not come from specific innovations in business practices. It comes from "the ability to continually innovate around IT's evolving capabilities." The other infrastructure technologies noted by Carr did not sustain continued business-practice innovation as long as IT has. Furthermore, they reached a dominant design fairly quickly (such as standard railway gauges). In IT, innovations in one area (such as storage or bandwidth) combine with innovations in another, unleashing new capabilities and new generations of architectures. New skills are needed for these new architectures. IT does not yet have a dominant design, so there is still potential for individual firms to differentiate themselves using IT—if their short-term initiatives support their long-term goals.

Robert Hof[6] states that although Carr may be right in the long run, he is not right about the current state of IT. In fact, like Brian Arthur,[1] he believes that we are now in the golden age of IT, where innovation is accelerating. IT might not matter strategically in 20 years or so, but now, it is still in flux and can provide differentiation. Witness the new developments in wireless technologies, miniaturization, and IP telephony, to name just three. Carr has jumped the gun in saying that IT has no strategic value, says Hof. And he's wrong in his follow-the-leader advice, because delaying the offering of a technology can lead to losing customers. He notes that hotels that offer wireless Internet access now differentiate themselves. Although that differentiation may not last long, at the moment, these hotels are getting his business, and he might stick with them. Hof believes that firms should both manage IT risks and look for opportunities.

Michael Schrage,[7] co-director of MIT Media Lab's e-Markets Initiative, disputes Carr's underlying premise that scarcity is a resource's attribute that yields sustained competitive advantage. Not so, he says. There is no correlation between scarcity and strategic value. Capital is a commodity, but returns on capital vary significantly. Does capital matter? Of course it does.

It is not a resource's commodity status that matters; it is the way the commodity is managed that determines its impact. Capital matters. Talent Matters. IT matters. Last but not least, management matters. In fact, argues Schrage, the management matters more as IT becomes ubiquitous. IT's ubiquity does not override management quality.

Rather than compare running IT to running an electric utility, Carr should compare running IT to running a factory, suggests Schrage. But that comparison would undermine his premise because the way a factory is designed and run in the future will affect a manufacturer's competitiveness. "What Carr fails to recognize is that IT can profoundly transform the economics of innovation, segmentation, and differentiation for most businesses. And in that recognition lies the CIO's ultimate opportunity," says Schrage.

Is Carr right? Some think so, some think not. Either way, his views have hopefully prompted important discussions in boardrooms, because executives need to understand the underpinnings of IT to know how to guide it. IT is one of their strategic resources, besides money and people, for working inward, outward, and across.

WORKING INWARD: BUSINESS-TO-EMPLOYEE

The essence of using IT strategically inside the enterprise has been, and continues to be, focused on improving business processes. Use of the Internet internally is no exception. It has revolved around building intranets.

Building an Intranet

An intranet is a private company network that uses Internet technologies and protocols, and possibly the Internet itself. The network is intended for employees only, and departments use them to disseminate information and policies, provide needed forms, and even permit online transactions of former paper-based processes (such as filling out an expense requisition or changing a benefit). Applications use the Web interface and are accessed through browsers; communications use several protocols, including Hypertext Transfer Protocol (HTTP) for addressing Web sites, Hypertext Markup Language (HTML) for Web content structuring, and Transmission Control Protocol/Internet Protocol (TCP/IP) for network routing. The result is open systems using low-cost, nonproprietary technologies.

When properly set up, the benefits of intranets have been significant: wider access to company information, more efficient and less expensive system development, and decreased training costs. By using an intranet's open-system architecture, companies can significantly decrease the cost of providing company-wide information and connectivity. One of the most important attributes of intranets is that they support any make or brand of user device—from high-end workstation to PC, to laptop, to handheld device—as well as existing databases and software applications.

Furthermore, investments in a company-wide electronic infrastructure are significantly less than building a proprietary network. Companies only need the servers, browsers, and a TCP/IP network to build an intranet. If, in addition, the company wishes to use the infrastructure of the Internet to geographically extend its intranet, the only additional components needed are firewalls, which keep the public from accessing the intranet, and local access to the Internet. Figure 3-2 shows the basic architecture of an intranet. The link to the Internet allows the company to expand its intranet worldwide easily and inexpensively—a significant benefit that was unthinkable before the Internet.

Finally, because an intranet uses the browser interface, users do not need extensive training on different products. In addition, due to the HTML standard and the availability of easy-to-use Web page authoring tools, employees can easily create their own Web pages for whatever purpose they need. As a result, all employees are potential site

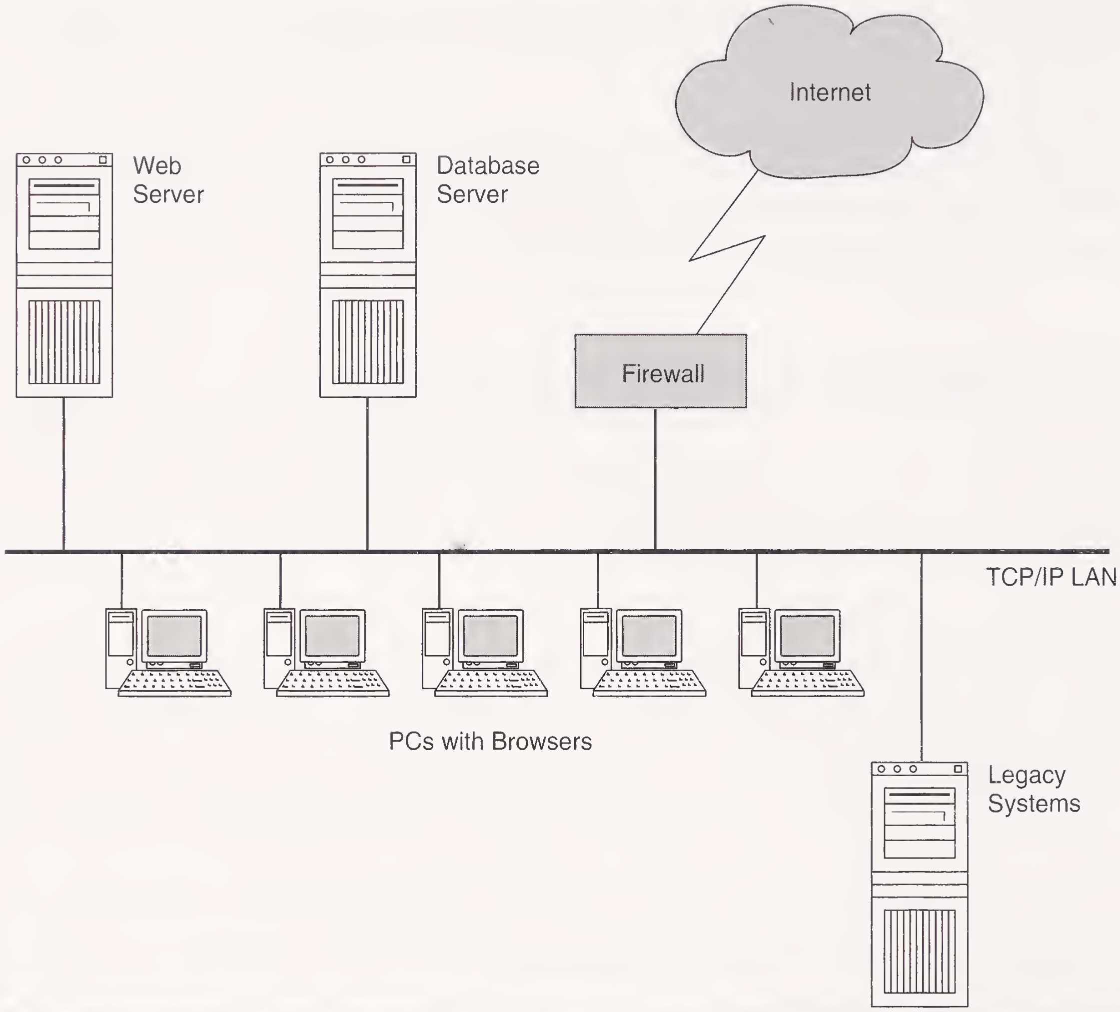


FIGURE 3-2 Intranet Architecture

creators, reducing the IS department's programming bottleneck, while adhering to company-wide standards. An additional benefit is that companies only need to record information in one place, where it can be kept up to date for access by all employees no matter where in the world they are located.

A critical success factor for an intranet is its ability to provide search capability that even external and powerful search engines cannot provide. For a given company, there are unique teams, tasks, products, and services. The intranet development team should use these specific artifacts to define metadata vocabularies so that the company search engines can help employees find them faster than any others. A related feature is shared bookmarking. Coupled with tagging, shared bookmarking allows intranet users to create, manage, and share information.

Below are a few design tips for building an effective intranet:

1. Think about tasks rather than documents. Employees should look at the intranet as a resource guide, a digital assistant that provides standard operating procedures or steps to do to accomplish a specific task. Required forms should be attached to these instructions.

2. Keep the technology simple at first using existing hardware and freeware. Do not do too much at once by starting with a few important features. Pick applications people need (e.g., file sharing, online expense reporting, bulletin board, classifieds) and make them fun to use.
3. Create virtual workgroups organized around the tasks. Provide calendaring features for teams to set up meeting. Use bulletin boards, or chat rooms, to facilitate team discussions. Invest in employee training and solicit feedback.
4. Think outside the box to help identify the unique features that your intranet can bring to the firm. The intranet reflects the company and the company reflects the intranet. Use the intranet to migrate the company, if not done so, to a process-centered organization that encourages collaboration.
5. Create a clear set of fair-use rules so that employees know the company's exact position on information policy. Find ways to encourage intranet use. Put into place effective security policy.
6. Don't expect miracles but do monitor intranet effectiveness. Do not underestimate the needed resources, especially when it comes to maintenance.

Due to the ease with which Web sites can be created and used, many employees have built their own, leading to a proliferation of sites with company information. To control the situation, IS departments have created corporate portals that act as gateways to firms' internal resources, information, and Internet services. This solution brings access to company data and applications together in a single site. Employees simply need a browser. At the same time, the portal provides IS management with a way to monitor and control the growth of internal Web sites, and the portal provides a link to Internet resources external to the company, such as sites for industry news, customers, and business partners.

Building Quality Web Portal

There have been many frameworks to measure the quality of a product, or the use of an IT product, which we will discuss later in this book. From a user's perspective, a Web portal provides information products or services to its users. An information product is a highly interdependent package of information that can be transmitted and distributed in digital forms. In an intranet setting, the company's Web portal can store content-based products (online news, technical documentation, corporate policies, and administrative forms), tools and utilities (application software), and online services (search engines, online consulting, e-mail, chat rooms, bulletin boards). It is important that IT managers identify what to offer through the portal.

The quality of an information product can be assessed from a number of attributes, such as accuracy and applicability of the information content, the timeliness and speed of the physical medium, and the reliability and responsiveness of the product/service provider. It is important that basic quality features should be met when developing an intranet Web portal. Successful portals should be built based on people, not technology. As an intranet application, its design must find the roots from the company employees and the work they undertake during a typical workday. GE Power Systems is a case in point.

CASE EXAMPLE

GE ENERGY POWER SYSTEMS

www.gepower.com

GE is one of the world's largest companies selling products and services ranging from aircraft engines to consumer financing. It has global presence in 160 countries and employs more than 300,000 people worldwide. GE is made up of six major businesses. In 2006, the conglomerate earned $163 billion in revenues. Being a marketing man, when Jeff Immelt became chairman of General Electric (GE) in September 2001, he surveyed the sales force. He found that they were spending more time in the office searching for information that they needed to sell GE products than out with their customers. He challenged all the business units to reverse the ratio, notes Anthes in his review of GE's use of Web servers.[8]

One business unit, GE Energy, is one of the world's leading suppliers of power generation and energy delivery technologies. Its energy solutions include gas, water, nuclear, and wind technologies. By 2006, it earned $19.1 billion in revenues, and employed about 36,000 people in more than 100 countries. GE Energy sells multimillion-dollar turbines and turbine parts and services to energy companies. It answered the challenge by building a Web-based sales portal for its salespeople. In essence, the portal is meant to be their main source of information by linking them to numerous information sources—some inside GE, some outside—without requiring changes to the underlying systems.

- Information Content: The data that are fed to the portal are from the existing Oracle and Siebel databases on sales, parts, pricing, inventory, customers, and such. The portal also has a news feed from the outside.
- Physical Medium: The coordination of all the information is handled by portal software from Vignette. The software assembles dynamic portlets that present salespeople with personalized, up-to-date data views. The portlet might show, for instance, the status of the salesperson's customers' orders, recent news stories that mention the salesperson's customers, price changes, sales performance for the month, and so on.
- Service: Vignette's system manages the content and its presentation to the salespeople; a special Oracle data mart for the portal pulls the appropriate data from the other systems at the appropriate intervals. Some data, such as customer master file updates, are pulled in real time (when the update takes place), whereas other data, such as turbine installations, are updated weekly. The Web server aspects of the system are handled by BEA System's WebLogic Server, and SiteMinder from Netegrity handles security and user sign-ons. When a salesperson wants to access an

(*Case Continued*)

application through the portal, SiteMinder uses an authorization table that has access permissions to determine whether to grant the user access to the system. Formerly, salespeople had to enter a different password for each application. Now, they only enter one password to get into the portal.

Power Systems' IT organization was able to build this portal in just six months' time by following GE's rigorous project management methodology and by using rapid prototyping ("launch and learn," they call it), building incomplete versions of the portal for salespeople to test out and critique at the annual sales conference and elsewhere.

The portal's architecture is flexible enough to be extended to include more types of information and to permit access to more applications. In short, the portal has greatly enhanced the usefulness of GE Power Systems' existing systems to its salespeople by giving them a single port of entry to them all. ■

Fostering a Sense of Belonging

Intranets are evolving into very important enterprise structures. In fact, in some enterprises, the intranet is seen as the enterprise. It houses videos of executives explaining the enterprise's vision and mission. It includes all the internal forms, rules, and processes. Need to file an expense report? Go to the intranet. Need to make travel reservations? Use the intranet. In short, the intranet embodies the company's processes and culture and can be accessed anywhere an employee has a connection to the Web.

Although this convenience can ease the life of employees, it can also feel colder and more impersonal than the traditional office setting. Frances Cairncross,[9] author of *The Company of the Future*, believes the challenge for corporate management of widely dispersed enterprises today is maintaining cohesion, which takes a lot more effort than when employees are co-located. With so many employees working out of their homes, cars, hotel rooms, airports, or customer sites, she believes it is important to create a sense of belonging.

An intranet can provide the foundation for creating a sense of belonging by providing a means of communicating and creating communities. Whether enterprises use intranets to help employees feel part of the culture is up to them. Whether they are successful is yet another issue. Cairncross believes this goal should be a major use of intranets because the care of employees is one of the most important things enterprises do. Dienes and Gurstein[10] reported a successful creation of online community using WebBoard, emails, real-time chat, and online videoconferencing, to support a rural community in Canada. The project using remote management has created a sense of belonging among far-flung remote sites that could not otherwise have been attained at a cost the initiative could afford.[10]

WORKING OUTWARD: BUSINESS-TO-CUSTOMER

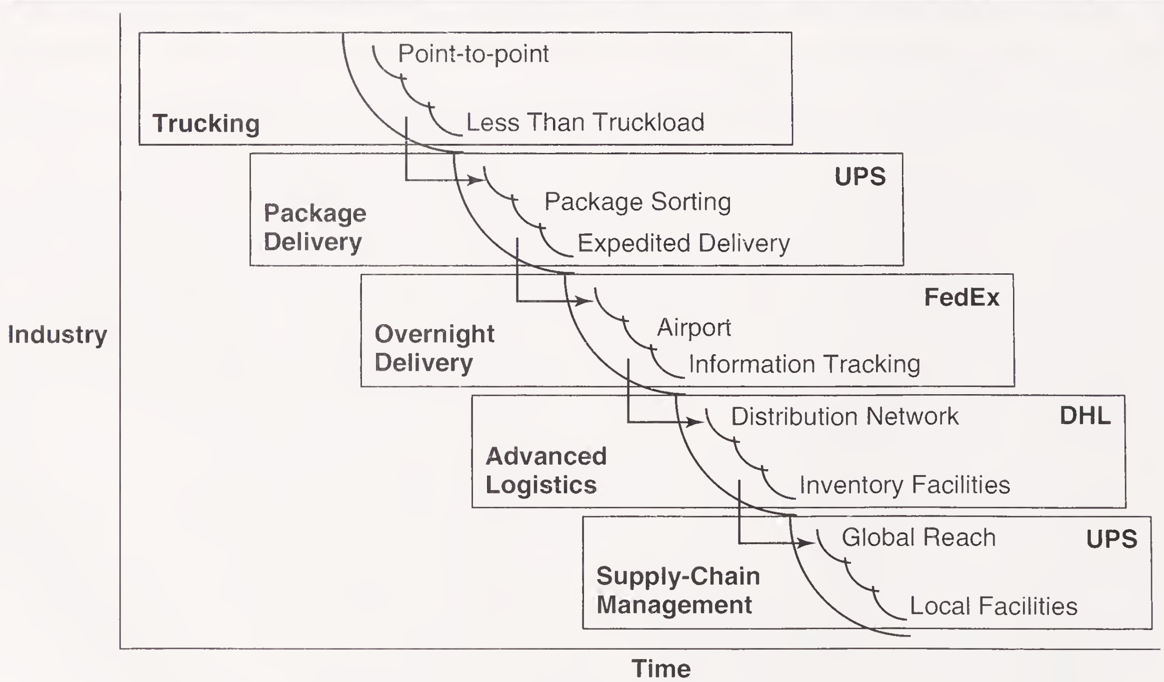
In most industries, companies need sophisticated computer systems to compete. For airlines, hotels, and rental car companies, a computer reservation system—either their own or someone else's—is a must. In the drug and hospital wholesaling industries, those that had automated order entry and distribution systems gobbled up those that did not have such systems. In financial markets, computerized trading and settlement systems are replacing open-outcry systems. And the list goes on.

As industry leaders increase the sophistication of their systems to concurrently address the four hallmarks of competitiveness—quality, service, innovation, and speed—their competitors must do the same or find themselves at a disadvantage. Using IT (or any technology) as the basis for a product or a service can, in some cases, be viewed as moving up a series of experience curves.

Jumping to a New Experience Curve

The traditional view of an experience curve is that the cost of using a new technology decreases as the firm gains more experience with it. However, in *Strategic Choices*[11] Kenneth Primozic, Edward Primozic, and Joe Leben present the view that more experience leads to a set of connected curves, rather than one continuous learning curve, as shown in Figure 3-3.

FIGURE 3-3 The Shipping Industry



Source: Based on Kenneth Primozic, Edward Primozic, and Joe Leben, *Strategic Choices: Supremacy, Survival, or Sayonara* (New York: McGraw-Hill, 1991).

Each curve represents a different technology or a new combination of technologies in a product or service as well as in the product's manufacturing or the service's support. Moving to a new curve requires substantial investment in a new technology, and the company often must choose from among competing technologies, none of which is yet the clear winner. A firm that correctly identifies a new market and the technologies to exploit it can shift to the new experience curve and successfully open up a new industry segment. However, management sometimes has such an emotional attachment to the current experience curve that it fails to see the next one and thus loses its market share to swifter competitors. This has repeatedly happened in the computer field. Mainframe manufacturers ignored mini-computer firms. Then mini-computer firms ignored PC manufacturers (considering PCs to be toys). Then PC manufacturers ignored operating system firms, that is, Microsoft. And they, in turn, initially ignored the Internet.

To demonstrate this principle of experience curves and the need to keep up or lose out, consider the authors' example of the shipping industry.

CASE EXAMPLE

THE SHIPPING INDUSTRY

Primozic et al.[11] present an intriguing discussion of the shipping industry (which we have extended) to illustrate their concept of experience curves.

The Original Industry: Trucking

The trucking industry initially shipped two types of truckloads of goods: full point-to-point truckloads and less than truckloads (LTLs), as shown in the upper left of Figure 3-3.

New Industry 1: Package Delivery. Once United Parcel Service (UPS) based its entire business on LTL shipping, a new industry segment was born: package delivery. As a result of this new experience curve, the shipping industry changed, and UPS actually became much larger than the trucking companies because it served a market with far more customers. The new technology that was key to UPS's success—and thus represented this particular experience curve—was the efficient sorting of packages at distribution centers in order to maximize use of its trucks.

New Industry 2: Overnight Delivery. UPS, however, did not guarantee a delivery time nor did it track packages. FedEx capitalized on these two missing functions, jumped to a new experience curve, and started yet another new industry segment:

(*Case Continued*)

overnight delivery. FedEx became larger than UPS because it tapped an even larger market. And for UPS and other package carriers to compete, they, too, had to invest in the technologies to guarantee delivery and track packages.

Needless to say, IT played a crucial role in this experience curve. In fact, the Internet began playing a role when UPS allowed customers to order package pickup online and when FedEx created a Web page that enabled customers to query the whereabouts of a package directly from its package-tracking database. That Web site, which went live in November 1994, had 12,000 customers a day doing their own package tracking, saving FedEx $2 million just that first year.

New Industry 3: Advanced Logistics. In the late 1990s, a third industry emerged: advanced logistics. Due to their distribution networks and inventory facilities, overnight delivery services could handle inventory for large corporate clients and guarantee overnight delivery of these inventoried items. On this experience curve, client companies outsource not only their inventory, but also distribution to FedEx, Airborne Express, UPS, and other carriers. Clients include computer manufacturers, auto parts suppliers (to handle after-sales service), health care diagnostic labs, retailers, even movie studios (to ship film to and from theaters). IT continues to play an integral role in the offered services.

New Industry 4: Supply-Chain Management. The industry has morphed again. Major players are becoming clients' supply-chain partners, providing all the services needed to get a client's product from the loading dock to the customer's premises. These companies have extended beyond advanced logistics by having the global reach and local presence (in far-flung locations) that their clients need to move their goods. In essence, these players become their clients distribution function, which requires all of the parties involved to work even more closely with each other.

New Industry 5: Global Positioning. The Global Positioning System (GPS) is increasingly becoming a tool to help businesses track in real time the location of the products or employees that want to monitor. This inexpensive navigation technology has facilitated the transportation logistics of the shipping industry. Equally important, it provides real-time feedback to the customers, allowing them to track the location of their order during shipment. ■

The following case example of Cisco and UPS illustrates this latest industry. Notice how Cisco taps UPS's global reach and experience with European carriers to complete its supply chain. Also notice how closely linked the companies are becoming, with UPS employees responsible for some of Cisco's inventory and for some of the data in Cisco's ERP system, thereby giving Cisco more visibility into its downstream supply chain.

CASE EXAMPLE

CISCO SYSTEMS AND UPS SUPPLY CHAIN SOLUTIONS

www.cisco.com; www.ups.com

In the late 1990s, Cisco committed itself to manufacturing products within two weeks of receiving an order, but it could not guarantee delivery. Cisco's shipping area in San Jose, California, typically suffered congestion with more than 150 transportation providers picking up finished goods. Customers were responsible for getting their products shipped from San Jose to their own premises. Shipping to Europe was especially taxing on customers.

To improve the situation, Cisco turned over its European supply chain to UPS Supply Chain Solutions (UPS SCS), a division of UPS, for reengineering and management.[12]

Some 90 percent of Cisco's products are configured and ordered over the Web. Within 24 hours of receiving an order, Cisco sends the customer an e-mail that states that the order has been accepted and that indicates when it will be produced.

When the product for a European customer is ready, Cisco notifies UPS SCS. Within 24 hours, UPS SCS picks up the order and books cargo space to move it to its European distribution center in the Netherlands, where it arrives two to three days later. In this shipping process, SCS handles customs clearance, documentation, billing, and carrier selection.

Once at the European distribution center, the order is shipped to the customer in one of two ways. If it is a complete order or if the customer chooses to receive the order in several shipments, UPS SCS ships the product directly using its cross-docking facility. If the product is only part of an order, it is held until the rest of the order is received, then shipped. In some cases, fast-moving products are inventoried at the Netherlands site. UPS SCS personnel manage the site's inventory levels (meeting Cisco's specifications) and handle the last bill-of-material update in Cisco's ERP system once a product has been ordered for dispatch.

UPS SCS uses its own system to find the best shipper to move the package from the Netherlands center to the customer site. In essence, the system issues an electronic request for quotes to all approved shippers in the system. The system uses the information they supply to calculate the price, transit time, and service level for the shipment and then places a shipping order. The UPS SCS system also updates Cisco's system so that customers can find out their order status via Cisco's Web site. Until an order is filled, customers can even make changes, such as changing the delivery address.

The systems of the two companies have become increasingly linked. Each movement of a product is recorded in both systems.

(*Case Continued*)

UPS now handles over one million boxes a year for Cisco through its Netherlands distribution center. Because UPS can ensure reliable transit times, Cisco is able to now promise delivery times for its European customers. In addition, these customers have only one point of contact for their shipments: the UPS SCS distribution center. And Cisco has online visibility into its downstream supply chain—to customer delivery in Europe—which it did not have before. ■

The Emergence of Electronic Tenders

An important development is occurring in the working-outward arena. Initially, IT was embedded in products and services because of its computational capabilities. For example, cars and elevators have computers that make them operate more efficiently. Toys have computers to make them more fun. Now, due to the Internet and wireless networks, the communication capabilities of computers are being extended and emphasized, often in these same products and services. These additions are literally transforming these goods. In essence, we would characterize these additions as adding electronic tenders.

An electronic tender is 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 another computer. Electronic tenders open a seemingly unlimited set of possibilities for using IT in the working-outward arena. For example, consider a vehicle and its computers. Those computers can be programmed to perform diagnostics while the vehicle is running. Those diagnostics could be monitored by the car dealer (or an intermediary service provider), in real time, as a service to the owner. If something seems out of kilter, the owner could be notified, perhaps in real time. Likewise, packages and luggage with bar codes or other forms of identification can be tracked and found (if lost). The list of the uses of electronic tenders is endless.

Electronic tenders are occurring with services as well. A growing number of enterprises keep track of their customer interactions, culling them to understand clusters of customers and their buying patterns. Again, the options are endless. The goal is to get closer to the customer.

Getting Closer to Customers

The first wave of using the Internet in the working-outward arena involved the use of Web sites to sell products and services and manage customer relations. Many types of products can now be purchased online, from books, CDs, and flowers to automobiles, legal services, and wine. The advantages of selling online are numerous and seem obvious. Figure 3-4 lists some of these advantages. Indeed, it is not difficult to find success stories, such as Dell, E*TRADE, and Cheap Tickets. However, the potential problems are also numerous and have become more obvious since the dot-com bust. Figure 3-5 lists some of the potential problems faced in creating a B2C system.

Use of the Internet has now become much more sophisticated. CRM systems are used to learn more about customers (and perhaps noncustomers). Whether you visit a firm's Web site; call it from your home, office, or cell phone; or buy something from

Global accessibility: The Internet reduces the constraints related to geographic boundaries.

Reduced order processing: Automated order processing improves efficiency.

Greater availability: The company is available online 24 hours a day, 7 days a week.

Closer customer relationships: With a direct link to customers, the company can quickly address concerns and customize responses.

Increased customer loyalty: With improved customer service and personalized attention comes greater customer loyalty.

New products and services: With direct links to customers, the company can provide information-based products and services.

Direct marketing: Manufacturers can bypass retailers and distributors, selling directly to customers.

FIGURE 3-4 Advantages of B2C E-Business

it, the firm is keeping track and combining that information to create a profile of you. CRM systems for managing these profiles are the next wave of enterprise systems, following on the heels of ERP. ERP focused on internal data. CRM focuses on customer data.

Examples of CRM are scattered throughout this text. CRM systems are both a boon and a bane, depending on how intrusive you think they are. You may be pleased when companies e-mail you offers that you want to take advantage of, such as a reduced-fare flight to a city you want to visit on the weekend. Or, you may see them as invading your privacy. In response to privacy concerns, some countries have passed privacy-protection laws to require companies to inform customers of whether and under what circumstances customer information is shared with others.

On the other side of the coin, IT and the Internet have changed what customers value. They now expect service to be fast; the key term is "on-demand"—personalization and instant gratification. Online business enables firms to respond quickly by drastically reducing the time needed to respond to customer requests for company, product, and price information; to process an order; and to get products to customers.

Customers also now expect convenience. They want more than one-stop shopping; they want a single point of contact in the company. CRM allows the gathering and

FIGURE 3-5 Potential B2C Problems

Technical: Information systems are not always reliable or may be poorly designed.

Logistics: Getting physical products to customers around the world in a timely manner brings physical barriers to the virtual business.

Personnel: Few people have expertise in dealing with the new environment, both in technical and business arenas.

Legal: Doing business across geographic boundaries means dealing with multiple legal systems.

Competitive response: The ease of creating a Web presence brings low barriers to entry for competitors.

Transparent prices: Customers can compare prices across Web sites, reducing profit margins.

Greater competition: The elimination of geographic boundaries means a firm must compete with competitors from around the world.

Instant gratification: Customers demand immediate satisfaction.

managing of customer information so that whoever interacts with the customer has all the relevant customer information at hand.

Customers further expect personalization of service. Online business allows direct, ongoing communication with customers; thus, preferences and buying patterns can be tracked and analyzed to provide individual service. By reducing the time to process orders, online business allows firms to customize products to individual customers. Thus, products from music CDs to PCs to bicycles to automobiles can be made to order online.

Online business forces companies to rethink their pricing of products and services. Customers now have access to a wide range of competitive prices and sellers for products, driving down profit margins and the price of products. Some observers have speculated that online business will drive profit margins to miniscule levels. Although some initial studies have confirmed the lower prices for goods purchased online, the highest-volume sellers do not always have the lowest prices. Prices are offset by branding, awareness, and customer trust.

The Internet is not used only to sell to customers online. It is also used to provide services to customers. In fact, sometimes it can be difficult to know which is more valuable, the product or the service. For instance, what is more valuable, a piece of machinery or the ongoing monitoring of that machinery and receiving an alert before it malfunctions?

The increasingly important focus is on staying in closer contact with customers, understanding them better, and eventually, becoming customer driven by delivering personalized products and services. As Frances Cairncross[9] notes, the shift is taking place from running a company to keeping customers happy. This shift is having a profound effect on company structure and offerings.

To demonstrate a completely different side of the working-outward arena, we turn to the other side of the coin, from being a seller to being a buyer.

Being an Online Customer

Companies large and small are transacting business via the Internet. Some use it as their main means of business. Here is an example of one entrepreneur—Terence Channon, CEO of TerenceNet—who is a heavy user of the Internet as both a buyer and seller of services. The story comes from Gartner EXP.[13a]

CASE EXAMPLE

A DAY IN THE LIFE OF AN E-LANCER

www.elance.com

TerenceNet is an online consulting, development, and research firm that delivers solutions to small and medium-sized businesses. A fair amount of its work is procured from Elance (www.elance.com), a Web site that puts freelancers in touch with firms seeking bids for projects. Elance charges a commission

(*Case Continued*)

of 10 percent of the value of jobs set up through the service. The following is a typical day's journal for Channon's use of Elance.

8:15 A.M. My working day starts with e-mail and checking Elance. I signed up with Elance a few years ago to see what kinds of online work were being offered for freelancers. I think I was one of Elance's first customers. The site's first postings were mainly for online work—Web development and the like—just what my firm does. Recently, I have noticed engineers advertising for AutoCAD drawings, so the site seems to be broadening.

There are lots of freelance Web sites and online marketplaces, but I like Elance because it's where I got my first paid job. I won a job through another site—but never got paid. Elance is a very active site, with 30 to 40 new postings a day; others only have three to four.

This morning I bid on 10 projects.

11:05 A.M. I check Elance several times a day or when I get an e-mail notification that I have received a message, like right now. I've logged onto My-Elance—my own personal Elance Web page—that shows all the work I have bid on, which bids are open and which are closed, and all the projects where my bids have been declined or accepted. It also shows all the projects I have offered, the number of bids I have received, and so on.

A company is considering me for a job I bid on, so its new message to me is flagged. This company tells me it has set up a private message board on Elance for us to talk privately about the work.

At first, I used Elance to supplement my company's income. Now I can pretty much count on the site as a revenue source. It may not be steady revenue, but there are enough postings on it, and I win enough of my bids that I can rely on it for work.

I put considerable thought into the bids I make. Some people just cut-and-paste a generic statement of what they do. I don't do that; I respond to a request by setting out exactly what we can do and pointing to examples of similar work. I think this shows commitment and knowledge.

3:00 P.M. When you sign up on Elance, it's like joining a community. Everything is very open. I can see who is bidding on a job, read their experience, look at the work they have done (such as Web sites they have developed), and see how they have responded to a posting. I can also see who has won a bid.

There's a lot of trust involved on both sides because we don't have contracts. I have to trust that the client will pay me. The client has to trust that I will do the work. Elance has a feedback board where I can see that I have a top rating from the companies I have worked for and from the people who have worked for me. Everyone can see these ratings.

I have found everyone to be very professional on Elance, cordial in fact. The bidders all feel as if we are in this together; we don't feel or act like competitors. Naturally, we promote ourselves and our work—but we do not talk down others. I've made some wonderful contacts on Elance. Some short jobs have turned into relationships. TerenceNet is now on retainer with one company because it liked our initial work.

Another company liked our development work and wanted more functionality on its Web site. We were busy at the time so I put a posting on Elance. I got

(*Case Continued*)

30 bids in five days. When I whittled them down to the bid with the best example of the kind of work I wanted, it was from a company in Bulgaria. This company did the work at a fair price and delivered on time, and I have since given it other work. I had to pay via Western Union, but Elance has a payment system where you can transfer funds between bank accounts.

7:30 P.M. One last check on Elance. Usually, there are not many new job postings in the evening, but I want to make sure I have responded to all my messages. There are 10 new postings tonight—one for designing a business card, two for company logos, one for 1 million Web site addresses, one for writing a press release, and one for programming in Dreamweaver. None of them interests me.

I put out a posting for some Palm work a few days ago and gave it a five-day bid period. I'm surprised I have received nine bids so far. I did not know there were so many wireless developers out there.

There are not many job postings on the weekends, so I'm taking this weekend off to spend with my family. ■

A major point of the Semco and TerenceNet case examples is that both are very customer-centric. They keep themselves attuned to the market by continually asking what customers need. This customer-centricity is also changing the strategic use of IT in the working-across arena.

WORKING ACROSS: BUSINESS-TO-BUSINESS

Streamlining processes that cross company boundaries is the next big management challenge, notes Michael Hammer,[14] a well-known consultant in the IT field. Companies have spent a lot of time and effort streamlining their internal processes, but their efficiencies generally stop at their corporate walls. The winners will be those that change their processes to mesh with others they deal with so that they have chains of activities performed by different organizations, notes Hammer. This is not a technical challenge, as most have viewed supply-chain management (SCM), but a process and management challenge, he believes.

Working across businesses takes numerous forms. Here are three. One involves working with co-suppliers; a second is working with customers in a close, mutually dependent relationship; and the third is building a virtual enterprise, in fact, one that might evolve into an e-marketplace.

Coordinating with Co-suppliers

Collaborating with noncompetitors is a type of working across. For example, two food manufacturers might have the same customers (supermarkets and other retailers) but not compete with each other. Hammer calls such companies "co-suppliers." Their form of working across is illustrated in this example.

CASE EXAMPLE

GENERAL MILLS AND LAND O' LAKES

www.generalmills.com; www.landolakesinc.com

The seven-largest U.S. food manufacturers have about 40 percent of the supermarket shelf space for dry goods. That volume is high enough to support their own fleet of delivery trucks, notes Michael Hammer.[14] However, they have only 15 percent of the refrigerated goods business, which is not enough volume to fill up their refrigerated trucks for one supermarket. Thus, they use one truck to deliver to several supermarkets, which is less efficient because of traffic delays.

To address this problem, General Mills (maker of Yoplait yogurt) teamed up with Land O' Lakes to combine their deliveries on General Mills trucks. The result is better use of the trucks and higher supermarket satisfaction (due to fewer late shipments). Land O' Lakes ships its butter to General Mills' warehouse, either for delivery on the same truck or for pickup by the customer. In fact, notes Hammer, the coordination has been so beneficial that the two are looking into integrating their order-taking and billing processes, again, because they have duplicate processes where they might be able to only have one. To fill their trucks even further, they are creating joint initiatives for customers to order more from both companies at the same time. ■

What has deterred co-suppliers from working together has been the lack of convenient ways to share information quickly and easily. The Internet takes away that deterrent. In fact, companies can reduce costs through sharing anywhere they use similar resources, such as warehouse space in the same city or shipping between the same two cities.

Hammer recommends companies begin working with co-suppliers by first making their own processes efficient, then collaborating on new joint processes (which is new territory for many companies). Eliminate duplicate activities, focus on customer needs, and let the work be done by the company in the best position, he suggests.

Deciding what type of relationship two enterprises want with each other in many ways determines factors regarding their relationship. Do they want a loose, close, or tight relationship?

Establishing Close and Tight Relationships

As noted earlier, the action in strategic use of IT and the Internet has moved to the most difficult area, working across companies. This means having relationships with various players in one's business ecosystem—investment banks, advertising agencies, specialist providers, suppliers, distributors, retailers, even competitors. Such relationships often have accompanying linking information systems. As Marcus Blosch and Roger

Woolfe point out, in the Gartner EXP report *Linking Chains: Emerging Interbusiness Processes*,[13b] companies need to determine what level of system integration they want in each case: loose, close, or tight.

- In loose integration, one party provides another party with ad hoc access to its internal information. The information may or may not be confidential, and it is accessed when it is needed. An example might be a builder of small power units that lets suppliers and customers check specifications on its Web site. The business processes remain distinct. Such limited integration requires little risk or cost.
- In close integration, two parties exchange information in a formal manner. Some of that information is probably confidential, and although the two parties' processes are distinct, they do handle some tasks jointly. For instance, they jointly manage the sharing. An example is airlines sharing pricing data with each other so that they can provide more seamless service to customers using several airlines on one trip. This level of integration leads to greater benefits, so there is greater impetus to make the relationship succeed. However, risks do increase because confidentialities are shared. Costs of integration are also higher than in loose integration.
- In tight integration, two parties share at least one business process, as partners, in a business area that is important to them. Generally, high volumes of data are exchanged; the data can be highly confidential; and the data include key events, such as price changes. An example could be a supplier and retailer sharing a common inventory process. The intent is to synchronize operations to reduce costs and speed response time. Tight integration is the most risky because it is business critical and the most costly to integrate. In some cases, it may be difficult to identify where one organizational boundary ends and the other begins because the two become so intermeshed.

The point to note is that due to the high costs and risks, companies can only have a few tight relationships. Those would be where the benefits outweigh the costs and risks. That implies that tight relationships are the ones that encompass genuinely critical processes and where working tightly with another party adds significant value. Blosch and Woolfe thus see companies having a pyramid of inter-business relationships, as shown in Figure 3-6: a few tight ones, some close ones, and many loose ones. The loose ones have basic conformance to integration requirements (such as a negotiated agreement

FIGURE 3-6 The Integration Pyramid

	Numbers of Relationships	Potential Benefit	Cost of Integration	Risk
Tight	Few	•••	•••	•••
Close	Some	••	••	••
Loose	Many	•	•	•
• Basic conformance	**•• Intermediate conformance**		**••• Advanced conformance with significant detail and ongoing maintenance**	

Source: Marcus Blosch and Roger Woolfe, *Linking Chains: Emerging Interbusiness Processes,* Gartner EXP, August 2001.

and shared information). Tight ones have advanced conformance as well as significant detail and ongoing maintenance in their agreements.

To illustrate a close relationship that is becoming a tight one, consider the case of the Sara Lee Bakery Group, one of the first food manufacturers to use a specific information technology to establish close relationships with supermarket chains. Based on that experience, it has more recently moved to establish some tight relationships. The case comes from Blosch and Woolfe.

CASE EXAMPLE

SARA LEE BAKERY GROUP

www.saralee.com

Sara Lee Bakery Group (SLBG), formerly Earthgrains, with headquarters in St. Louis, Missouri, is the second-largest bakery in North America. It specializes in fresh-baked branded goods and private-label refrigerated dough and toaster pastries. Worldwide, SLBG has 26,000 employees.

Fresh-baked goods are delivered to retailers by direct store delivery. Delivery people stand in line at the retailer's back door to have their deliveries counted. To reduce labor costs, retailers have reduced the number of hours their back door is open. SLBG requires more trucks to accommodate the reduced hours. The lines become longer and more time is wasted.

Dealing with the Backdoor Bottleneck

SLBG was one of the first food manufacturers to introduce scan-based trading (SBT), selling bread on consignment. On the first day of the new arrangement, SLBG buys back the bread on the retailer's shelf, which moves the inventory value to the bakery group's balance sheet.

At the end of each day, the store sends the scan data from its point-of-sale checkout system for all SLBG products sold that day to its retail headquarters, which then transmits the data to SLBG via EDI or the Internet. The retailer also uses that scan data to post sales to its accounts payable system, and SLBG posts to its accounts receivable system. The retailer pays SLBG electronically, based on the scan data.

More recently, SLBG has established a shared database with 100 stores, hosted by a third party, viaLink. This database facilitates price and item synchronization. Once SLBG has created an electronic connection to viaLink, it can easily expand to other trading relationships because viaLink handles translations between trading partners' systems.

Benefits of SBT

SLBG now has 2,143 stores at seven retailers across the United States on SBT. The retailers like SBT because they no longer have money tied up in inventory and they pay for bread after it is sold. SLBG likes the arrangement because it receives the scan data, which it uses to improve its merchandizing. SBT also saves time. Delivery people no longer line up at the back door to hand over

(*Case Continued*)

goods during the back door hours. They stock the shelves themselves.

SLBG uses the saved time to improve the quality of work for its delivery people (less stress in making deliveries), to reduce the number of delivery routes, and to reinvest the time in callbacks in the afternoon to restock the shelves to make the store look better for the before-dinner rush of shoppers.

The shared database eliminates "chasing deductions," which is a huge non-value-added activity in the industry.

Seven Prerequisites for SBT

Over the years, SLBG has learned seven prerequisites for creating SBT relationships.

The first is to deal with the major point of contention—shrinkage—right up front. Shrinkage is the amount of product "lost" at the retail store due to theft, misplacement, or other reasons. SLBG deals with shrinkage by agreeing to split the loss 50-50 up to a maximum amount; thus, accountability is shared with the retailer.

Second, SLBG requires the retailer to have an SBT executive sponsor—an executive from headquarters who makes SBT a priority for the retailer. Individual stores cannot initiate SBT on their own because they do not have the authority or the money to create the necessary systems or interfaces.

Third, SLBG requires the retailer to assign a point person. SBT projects touch many people on both sides. SLBG has a project manager as its point person for the retailer. It only wants to have to contact one person at the retailer as well.

Fourth, to plan the relationship, SLBG asks the retailer to create a cross-functional group—the executive sponsor along with people from purchasing (merchandising), finance, accounting, security, operations, and IS. IS is involved because converting existing systems costs a retailer between $50,000 and $100,000. One required change is the creation of a path between scan data and accounts payable, which is not a natural path. If the retailer has not been using EDI, SLBG provides a package for transmitting data securely over the Internet.

Fifth, SLBG asks the retailer to create an as-is process map of how its process currently works and a to-be process map of how it will work in the future. The two processes are vastly different. The data and money move on different paths, and in-store processes need to change. For example, the vice president of operations needs to allow SLBG staff in the retail store after noon.

Sixth, SLBG only works with retailers that have invested in achieving almost 100 percent accuracy in their point-of-sale system, because that system determines how much money SLBG is paid. A system that is only 95 percent accurate gives SLBG a 5-percent shrinkage from the outset, which SLBG will not accept.

Seventh, SLBG does not initiate SBT until prices have been synchronized with the retailer.

Managing SBT Relationships

SBT is managed by a 10-person team that is headed by a vice president. The group includes EDI coordinators who handle the technical aspects of receiving SBT data. Project managers integrate customer-driven projects, such as SBT. An analysis group monitors SBT data to ensure that each store is staying within its agreed shrink limits. The analysis

(*Case Continued*)

group also sends out quarterly invoices to reconcile shrink differences.

Rolling out SBT to a retailer's stores requires lots of coordination. Store employees need to know, "Next Monday everything is going to change." The SBT team works with SLBG's account manager for the retailer to make sure store employees understand the new routine. Store receivers need to understand that SLBG will no longer be standing in line. Store management needs to know delivery people may be tending shelves in the afternoon. SLBG delivery people need to be much more careful about their record keeping—SLBG's income depends on those records.

SLBG's ordering process, in which counting items every day is an integral part, allowed it to move fairly easily to SBT. Manufacturers that do not count individual items, such as soft drink and snack food companies, have a more difficult time making the switch. This is one reason that SBT has not spread more quickly in the industry; it has not yet touched the 85 percent of the grocery items stocked from retailer warehouses. ■

Becoming a Customer-Centric Value Chain

A company's value chain consists of its upstream supply chain (i.e., working with its suppliers of raw materials and parts) and its downstream demand chain (i.e., working with its distributors and retailers to sell its products and services to end customers). Traditionally, most companies make-to-stock. They build vehicles or package mutual funds and then push them to customers. This is the supply-push world.

We are seeing the rise of the reverse—a demand-pull world—where a customer's order triggers creation of the customized product or service the customer has defined. The chain of events is reversed from supply-push to demand-pull, from running a company to keeping customers satisfied. Dell is a prime example of this customer-centric, demand-pull business model. In fact, it has become the model that many companies admire and would like to emulate. The case also illustrates the benefits of having a tightly integrated value chain.

CASE EXAMPLE

DELL VERSUS HP

www.dell.com; www.hp.com

Dell sells PCs, servers, handhelds, and other electronic equipment directly to customers, either individuals or organizations worldwide. It is the largest seller of PCs in the world, mainly because of its prices, which are a

(*Case Continued*)

direct result of its customer-centric business model.

When a customer custom configures a PC online on Dell's Web site, the order information is fed into Dell's production schedule and an e-mail is sent to the customer stating when the computer will be shipped.

However, Dell does not make most of its product; its suppliers do. Some 30 of its 200 suppliers get close to 80 percent of Dell's business. That is very few suppliers, notes Cairncross;[9] most PC manufacturers have thousands of suppliers. Dell created an extranet for its suppliers so that they can see order information and Dell's production schedule. In fact, they can grab this information and feed it into their own production systems.

In essence, Dell's extranet is moving toward becoming a private marketplace, where orders arrive from customers and are distributed to suppliers. In fact, Dell is working toward making the information available to suppliers of its suppliers—two tiers down. Its goal, says Cairncross, is transparency, giving the entire industry a clearer view of supply and demand so that they can see what is selling, and perhaps what buyers are paying, all the while maintaining the privacy of suppliers.

Because suppliers can see through this demand chain, and find out which of their components are being ordered and for what kinds of computers closer to real time, they can forecast better. The result is less inventory in the supply chain. Reduced inventory is very important in the PC business, notes Cairncross, because some 80 percent of the cost of a PC is in its components. Prices have dropped quickly in the industry; at least 1 percent every two weeks is not uncommon. So the fewer days they need to keep inventory, the less money they tie up in it, and the less money they lose.

Dell has a reverse physical value chain from other PC manufacturers. They have supply-push; Dell has demand-pull. Dell also has a demand-pull financial value chain. In the supply-push model, the manufacturer borrows money from a bank to build-to-stock. It then repays the bank, with interest, after the stock has been sold. In Dell's demand-pull financial model, customers pay for their PC when they place their order. Thus, Dell gets paid before it builds the computers. Hence, it borrows less money and pays less interest, lowering its costs and its prices.

Hewlett-Packard (HP) is another leading technology solution provider and one of Dell's most aggressive competitors. In 2006, HP leapfrogged over Dell to recapture the lead as the number-one PC maker worldwide for the first time in almost three years, according to Gartner. To counter Dell, HP adopts a different customer-centric model. On the technological side, HP develops a number of unique features that are highly demanded by consumers. HP computers are equipped with hardware that provides useful functions (such the LaserScribe DVD/CD drive allowing the user to engrave permanent and attractive labels on the disks), and are loaded with popular applications software such as multimedia applications. Furthermore, HP works with major retailers to sell its desktop and laptop computers. The use of distributors allows HP to deliver its products to the consumers immediately at the stores, after they have had a chance

TW

(*Case Continued*)

to try them out. As such, the strategy to counter Dell's short delivery cycle with local store availability has worked for HP. The fight for the top position is fierce, and we expect these two giants to continue to come up with innovative supply-chain strategies. Both companies seek to restructure their businesses to further streamline costs—one leadership position in which Dell is no longer ahead—and to look for new business models to remain in this ferociously competitive world of PC sales. This duel is certainly worthwhile keeping an eye on. ■

Pros and Cons of Demand-Pull

Value chain transparency is a much-talked-about concept. It should, for instance, reduce the number of duplicate orders. During the late 1990s, for instance, when a component was in short supply, manufacturers sometimes duplicated an order for the component with several suppliers just to ensure a steady supply. An order for 10,000 memory chips might appear as 30,000, greatly exaggerating the true demand. In late 2000, when both the dot-com and telecommunications bubbles burst, large amounts of back orders disappeared just about overnight, partly because of this duplicate ordering phenomenon, catching manufacturers unaware. Transparency about orders might prevent such drastic downswings.

Creating private exchanges, such as Dell is doing, changes the level of cooperation among firms as well. Information passes through the chain in a burst and is available to all parties at the same time, rather than sequentially over time. The result is that suppliers and even customers become collaborators in improving efficiency throughout the process. Working closely also introduces technological changes more rapidly. Suppliers would be hard-pressed to keep up without a close working relationship and electronic ties. In fact, some have implemented software that automatically notifies every relevant supplier when a change is made so that they are working from the latest specifications.

One disadvantage to demand-pull is the infrastructure. The manufacturer's infrastructure becomes its suppliers' infrastructure as well, binding them more tightly together. If the infrastructure is not robust, crashes can affect the entire ecosystem dependent on the exchange. Another drawback is that such close working requires trust. Divulging confidential information to suppliers, such as canceled orders, could hurt the company if it is passed to competitors or Wall Street (perhaps causing the stock price to fall). Furthermore, suppliers that provide parts to competing PC manufacturers must ensure that information from one does not leak to another. This containment of information within a company is often referred to as building "Chinese walls" between the groups that work for competing customers. However, no such containment can be absolute, notes Cairncross. Innovations that employees learn from one customer can naturally seep to another.

Becoming customer-centric is not straightforward, especially for supply-push companies. Their computer systems, processes, and people follow that model, essentially casting the organization in electronic concrete. That is why the promise of Customer Relationship Management (CRM) is so alluring. It helps companies shift their attention from managing their operations to satisfying their customers.

Getting Back-End Systems in Shape

To have a hope of working across, internal back-end systems need to be fully operational. Most, if not all, B2B systems must integrate with these existing back-end systems, which has proven particularly challenging. Back-end systems cover a wide range of applications, including accounting, finance, sales, marketing, manufacturing, planning, and logistics. Most of these systems have been around for years, operate on a variety of platforms, and were not designed to integrate with other systems. Modifying these systems entails many risks, particularly when the integration must cross organizations. Luckily, most organizations have a head start on inter-organizational integration because they have been working for a number of years on internally integrating their systems.

Understanding the need for internal integration, many companies replaced, or are currently replacing, their old back-end systems with newer ones using database management systems (DBMS) and Entreprise Resource Planning (ERP) systems. The benefits of DBMS and ERP systems have always stemmed from their ability to provide integration. Recognizing the importance of online business, DBMS and ERP vendors have modified their products to integrate with Internet-based applications. In doing so, the vendors provide platforms for building B2B systems.

Another approach to establishing B2B integration is to create an extranet, as Dell has done. An extranet is a private network that uses Internet protocols and the public telecommunication system to share part of a business' information or operations with suppliers, vendors, partners, customers, or other businesses in a secure manner. An extranet is created by extending the company's intranet to users outside the company. The same benefits that Internet technologies have brought to corporate intranets have accelerated business between businesses.

Whatever the approach, the goal is to extend the company's back-end systems to reengineer business processes external to the company. Example activities include sharing product catalogs, exchanging news with trading partners, collaborating with other companies on joint development efforts, jointly developing and using training programs, and sharing software applications between companies. Initially, the benefits come in the form of greater cost and time efficiencies. Ultimately, the systems will change the structure of industries, and marketing strategies.

Mobile Computing as a Strategic Advantage

Mobility matters. The advent of wireless devices—from notebooks to smart phones, and from Wi-Fi connectivity to RFID—has enabled businesses to move data to where it is needed in real time. The idea here is that the processed intelligence follows the user, and not vice versa. This mobile business intelligence is critical in a competitive environment that requires timely decisions. The use of mobile computing for business is another case of the virtuous circle of the "new" economy shown in Figure 2-10. The use of innovative IT products leads to increased industry productivity and fiercer competition. The potential for mobile computing is virtually limitless, going beyond mobile e-mail and messaging. However, to take advantage of mobile technologies, an

10. What is the next big management challenge, according to Michael Hammer? Who will be the winners?
11. How do General Mills and Land O' Lakes cooperate?
12. Explain loose, close, and tight relationships.
13. According to SLBG, what are the prerequisites for it to implement SBT with a retailer?
14. What is a demand-pull value chain? How does Dell exemplify this concept?
15. Identify three potential applications of mobile computing. Highlight the benefits, and identify the challenges.

Discussion Questions

1. The British railway and canal revolutions are nothing like today's Internet revolution. For one thing, those were just machines that only augmented muscle power. Computers augment brain power. Brian Arthur is wrong in his predictions about the future. Argue both sides of this issue.
2. There have been so few instances of companies gaining competitive advantage from IT that Carr must be right; IT really does not matter strategically anymore. Carr is not right, and will not be right, because IT is not one technology (like electricity or railroading); it is many different technologies. New ones are constantly appearing. Choose a side and defend it.
3. Companies are using online applications to build profiles of customers. Privacy advocates consider this practice to be dangerous. Do you agree? Where do you draw the line? Discuss.
4. The prospect of electronic tenders is promising. The prospect of electronic tenders is frightening. Discuss both statements and state where you draw the line and why.

Exercises

1. Learn more about the debate Nicholas Carr has unleashed by finding seven arguments not in the text that convincingly argue that "IT does matter." Present these to the class.
2. Visit a local company and talk to a manager about the firm's intranet. What sorts of functions do they currently have on it? What do they plan for the future? Is it creating a sense of belonging among dispersed employees? If so, give some examples.
3. Describe your personal use of a product or service that has an electronic tender. What do you think of the electronic tender? How valuable is it to you? How could the vendor extend the tender in a way that would help you? How has the vendor stepped over the line in invading your privacy, if you think it has?
4. Visit a local company and talk to a manager about an inter-business system. Is it loose, close, or tight? Why was it built, what challenges did it present, and what benefits is it producing?

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CHAPTER

4

STRATEGIC INFORMATION SYSTEMS PLANNING

INTRODUCTION

We noted in Chapter 1 that IS management is becoming both more challenging and more critical, especially in strategic systems planning. On the one hand, the technology is changing so fast that it is tempting to say, "Why bother?" On the other hand, most organizations' survival depends on IT, so planning its effective use is a matter of organizational life and death.

How can this apparent paradox be resolved? The good news is that a variety of approaches and tools have been developed to assist in systems planning. The bad news is that there is no universal solution. Thus, most organizations use more than one approach or tool to empirically uncover which approach that would best fit its organizational context or culture.

It is important to establish the appropriate mind-set for planning. Although some managers believe planning means determining what decisions to make in the future, this view is untenable today because the business environment is so turbulent, making the future unpredictable. A practical view is that planning is

developing a view of the future that guides decision making today.

This seemingly subtle difference significantly changes how managers approach and execute planning. In turbulent times, some executives think in terms of strategy making rather than planning. Our definition of strategy is

stating the direction we want to go and how we intend to get there.

The result of strategy making is a plan.

This chapter first describes the traditional view of planning, and then offers a current version of strategic systems planning, that is, strategy making, which is intended to synchronize with today's faster-paced business world. Finally, some approaches that are used in strategic systems planning are presented.

WHY PLANNING IS SO DIFFICULT?

Planning is usually defined in three forms—strategic, tactical, and operational—which correspond to three planning horizons. Figure 4-1 summarizes these three planning types and some of their characteristics. This chapter emphasizes strategic planning—the top row. In Chapter 3, strategic was defined as "having a significant, long-term impact on the growth rate, industry, and revenue" of an organization. Strategic systems

FIGURE 4-1 Three Types of Planning

TARGET HORIZON	FOCUS	ISSUES	PRIMARY RESPONSIBILITY
3–5 years	Strategic	Strategic planning, business process reengineering	Senior management CIO
1–2 years	Tactical	Resource allocation, project selection	Middle managers IS line partners Steering committee
6 months–1 year	Operational	Project management, meeting time, and budget targets	IS professionals Line managers Partners

planning deals with planning for the use of IT for strategic purposes. It attempts to form a view of the future to help determine what should be done now.

Some fundamental reasons explain why systems planning is so difficult. Here are a few of them.

Business Goals and Systems Plans Need to Align

Strategic systems plans need to align with business goals and support them. Unfortunately, if top management believes the firm's business goals are extremely sensitive, the CIO is often excluded in major strategic meetings by top management. The IS department can be left out of the inner circle that develops these plans. Fortunately, more and more CIOs are being made part of senior management. In addition, systems planning is becoming a shared responsibility among the CIO, CTO, and other members of senior management. The emergence of e-commerce and globalization caused CEOs and CFOs to realize they need to be involved in systems planning.

Technologies Are Rapidly Changing

How can executives plan when IT is changing so rapidly? One answer is continuous monitoring and planning the changes of technologies and how the industry would adopt this technology. Gone are the days of an annual planning cycle done the last few months of the year and then put aside until the following year. Rather, the planning process first needs to form a best-available vision of the future on which to base current decisions. Then the technology needs to be monitored to see whether that future vision needs alteration. When it does, adjustments in current decisions are made. Some organizations have an advanced technology group charged with watching and evaluating new technologies. It is important for organizations to pay particular attention to the impact of disruptive technologies or disruptive innovation. Sometimes, an emerging and inexpensive technology emerges and swiftly displaces incumbent technologies. A classic example is the Linux Operating System (OS). When it was introduced, its capability was inferior to other existing OSs like Unix and Windows NT. Linux was inexpensive, and thanks to continuous improvements, it has earned a significant market share for computer servers. In 2007, IBM announced it would use Linux with its new servers. The USB memory stick is another instance of disruptive technologies. This inexpensive storage medium has changed the way people share files, displacing disk storage. Many forecasters have predicted that Voice-over-IP will replace decades-old land-based telephony.

The planning issue here is for management to foresee the upcoming of innovation with superior technology potential and viable business applications. These new technologies can be a cost-effective addition to the existing technological infrastructure. Or, they can be a potential replacement that needs a carefully migration strategy.

Companies Need Portfolios Rather Than Projects

Another planning issue is the shift in emphasis from project selection to portfolio development. Businesses need a set of integrated and seamless technologies that work together. Project developments have had a history of building "stove-pipe" systems that result in applications that are not compatible with each other. A portfolio approach requires a more sophisticated form of planning because projects must be evaluated on more than their individual merits. How they fit with other projects and how they balance the portfolio of projects become important. The Internet Value Matrix described later is an example of this approach.

Infrastructure Development Is Difficult to Fund

People understand intuitively that developing an infrastructure is crucial. However, it is extremely difficult to determine how much funding is needed to develop or improve infrastructure. Often, such funding must be done under the auspices of large application projects. The challenge then is to develop improved applications over time so that the infrastructure improves over time.

Since the mid-1980s, companies have faced a continual succession of large infrastructure investments. First, they needed to convert from a mainframe to a client-server architecture to share corporate and desktop computing. Then they implemented ERP to centralize and standardize data so that everyone had the same information. Then they needed to create a Web presence and give users access to back-end systems. Now they are under pressure to implement Web Services–oriented architectures to work inter-company and draw on best-of-breed processes. Boards of directors have realized that they have to fund these huge multiyear projects just to remain competitive. Making these large-stakes bets increases the difficulty of systems planning.

Responsibilities Needs to Be Joint

It used to be easier to do something yourself than gather a coalition to do it. This is no longer the case. Systems planning initiated by and driven by the CIO has not proven as effective as systems planning done by a full partnership among C-level officers (CEO, CFO, CIO, COO) and other top executives. Systems planning has become business planning; it is no longer just a technology issue. Many large organizations set up an Information Systems Council (ISC) or committee to periodically review the effectiveness of the current strategic plan, assess the current technological environment, and develop an IT strategy based on the institution's mission and goals.

Other Planning Issues

Several other characteristics of planning make strategic systems planning difficult. There is always tension between top-down and bottom-up approaches, thus the planning process must strike a balance between radical change and continuous improvement. Furthermore, systems planning does not exist in a vacuum. Most organizations have a planning culture into which systems planning must fit. This sampling of issues illustrates why systems planning is a difficult but crucial task.

THE CHANGING WORLD OF PLANNING

This section discusses how strategic planning has evolved along with the rapid change of Internet-driven technologies.

Traditional Strategy Making

In its Tactical Strategies[1a] report, Gartner EXP states that traditional strategy making followed the progression shown in Figure 4-2:

1. Business executives created a strategic business plan that described where the business wanted to go.
2. From that plan, IS executives created an IS strategic plan to describe how IT would support that business plan.

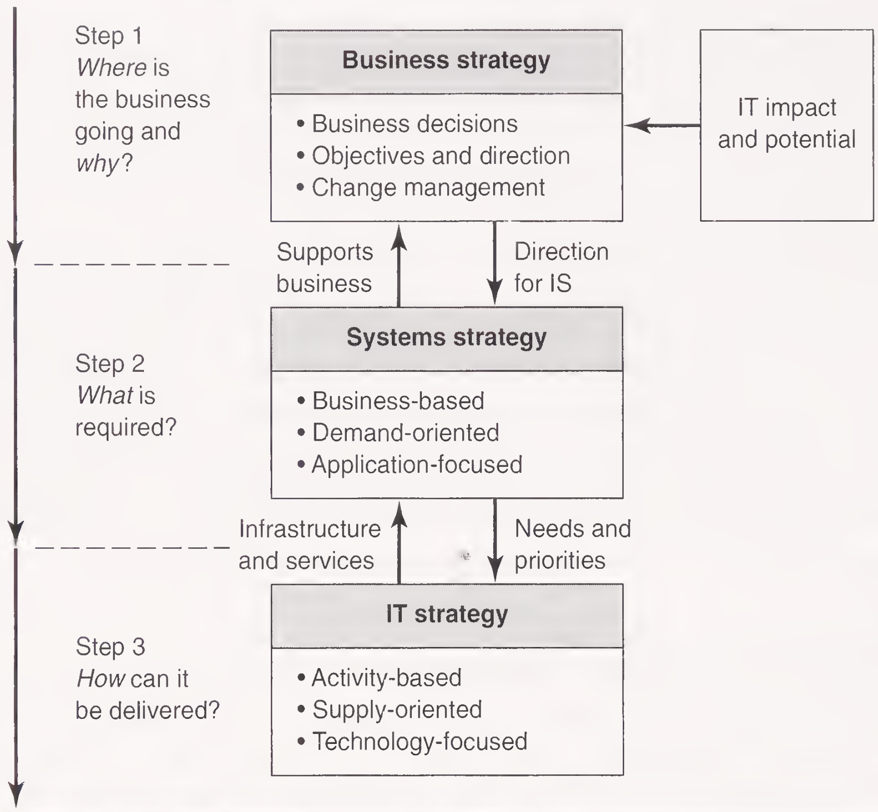


FIGURE 4-2 Traditional Strategy Making

Source: Adapted from and reprinted with permission from Roger Woolfe, Barbara McNurlin, and Phil Taylor, *Tactical Strategy*, Wentworth Research Program (now part of Gartner EXP, 56 Top Gallant, Stamford, CT 06904), November 1999.

3. An IT implementation plan was created to describe exactly how the IS strategic plan would be implemented.

Companies felt comfortable spending quite a bit of time, often a full year, creating a single strategic plan that they would implement over, say, the coming five years. That plan was created by top management. If the CIO was part of that group, then IS was involved in the planning; otherwise, IT considerations may or may not have been taken into account.

From the corporate strategy, IS staff developed the systems strategy, which described what was required to support the business plan. Finally, from that systems strategy, IS staff developed the technology-based IT strategy, which described how the company could deliver the needed capabilities.

This traditional planning stance was based on the following assumptions:

- The future can be predicted.
- Time is available to progress through this three-part sequence.
- IS supports and follows the business.
- Top management knows best, because they have the broadest view of the firm.
- The company can be viewed as an army: Leaders issue the orders and the troops follow.

Today, due to the Internet, these assumptions no longer hold true.

The Future Is Less Predictable

The Internet has caused discontinuous change, that is, change that can occur in unexpected ways. Industry leaders may not be able to use the same strategies they used in the past to maintain their superior market position. Unexpected and powerful competitors can emerge out of nowhere. For example, in the mid-1990s, how many booksellers predicted Amazon.com's business model of selling only on the Web or the success it would have? Not very many. Likewise, how many top executives seriously considered eBay's online auction model as one that could transform the way they would buy and sell? Not very many. As firms incorporate the Internet into their business, even newer Internet-based business models will appear. Industry after industry is encountering discontinuous changes to the way they have traditionally operated.

Time Is Running Out

Due to the Internet, time is of the essence. Companies no longer have the luxury of taking a year to plan and several years to implement. Worse yet, the most time-consuming phase of the sequence—IT implementation—is at the end, which means the IS department is late in supporting the business' strategic plan from the outset. To move quickly, IT implementation planning actually needs to be ahead of business strategizing. Furthermore, it needs to be faster than it has been in the past.

IS Does Not Just Support the Business Anymore

IT has become the platform of business; it makes e-business possible. Marilyn Parker, Bob Benson, and Ed Trainor[2] have pointed out that IT can serve lines of business in two ways. As shown in Figure 2-8 on page 77, one is by supporting current or planned operations, which they call "alignment." The second is by using systems to influence future ways of working, which they call "impact." To fulfill this second role, IS needs to get ahead of the business to demonstrate IT-based possibilities. At the very least, IS and the business need to strategize together, not follow the old model of business first, IS second.

Top Management May Not Know Best

When change occurs rapidly and when top management is distant from the front lines of the business (i.e., those interacting with customers, partners, and suppliers), having strategy formulated by top management limits it to what these few members of the firm can distill. Today's trend of customizing products and services to smaller and smaller niche markets, even to markets of one, requires diversity in strategy making. It may be best performed by those closest to customers—if not customers themselves—because they know their local environment. Hence, the former inside-out approach to strategy making needs to be shifted to be outside-in, as illustrated in Figure 4-3.

An Organization Is Not Like an Army

Industrial-era planning implicitly viewed companies as an army: Top management edicts rippled down through the organization to be implemented by the troops on the front line who dealt with customers. This metaphor is not holding true. Take, for example, the business process reengineering failures of the early 1990s. Executives learned

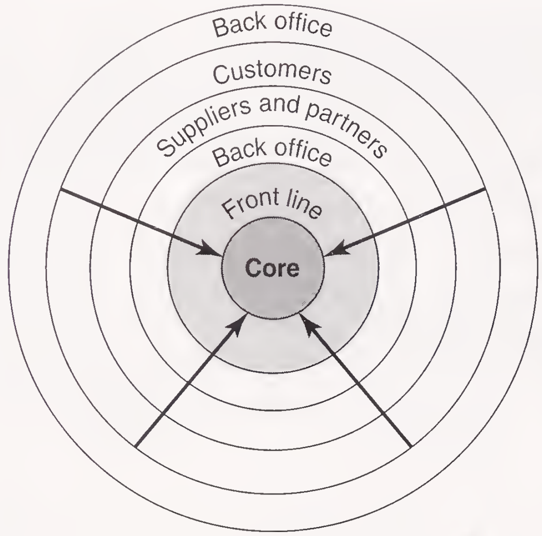


FIGURE 4-3 Outside-In Strategy Development

Source: Adapted from and reprinted with permission from Roger Woolfe, Barbara McNurlin, and Phil Taylor, *Tactical Strategy*, Wentworth Research Program (now part of Gartner EXP, 56 Top Gallant, Stamford, CT 06904), November 1999.

that their mandates to institute major changes in business processes, imposed from the top, often ended in disaster. Not only did the projects fail, but they ate up resources, burned out employees, created animosity, and even destroyed valuable company knowledge assets because experienced employees left.

A socio-biological view of information systems is to see systems as living entities that evolve, with self-interest, capable of mutation. They are not commanded; they can only be nurtured or tended. Means should be given to these entities so that they can improve themselves and their world. This new paradigm, if believed, obviously requires a different form of leadership, one that cultivates a context for knowledge to lead to innovations. Many futurists see the sense-and-respond approach as the "next big thing" to community-wide quality improvement.

Today's Sense-and-Respond Approach to IT Planning

If yesterday's assumptions no longer hold true, thus making yesterday's approach to strategy making less effective, what is appearing to take its place? The answer is a kind of sense-and-respond strategy making, as reported in Gartner EXP's Tactical Strategy Report.[1a]

Let Strategies Unfold Rather Than Plan Them

In the past, top management took the time to articulate one enterprise-wide strategy. In times of rapid change and uncertainty about the future, such as we are now experiencing, this approach is risky. If a bet proves wrong, it could be disastrous.

When predictions are risky, the way to move into the future is step by step, using a sense-and-respond approach. It means sensing a new opportunity or possibility and quickly responding by testing it via an experiment. The result is a myriad of small experiments going on in parallel, each testing its own hypothesis of the future, as illustrated in Figure 4-4.

A company that illustrates this sense-and-respond approach to developing strategy in the Internet space is Microsoft, say Shona Brown and Kathy Eisenhardt in their book, *Competing on the Edge: Strategy as Structured Chaos.*[3]

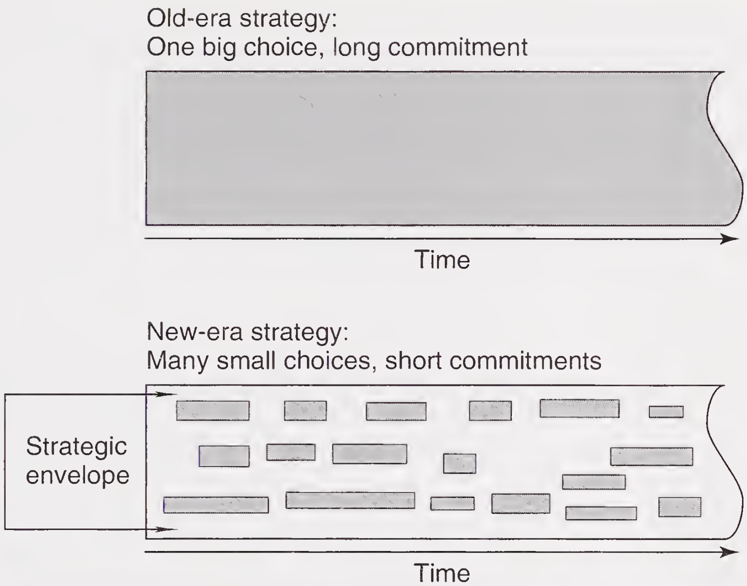


FIGURE 4-4 Sense-and-Respond Strategy Making

Source: Reprinted with permission from Roger Woolfe, Barbara McNurlin, and Phil Taylor, *Tactical Strategy*, Wentworth Research Program (now part of Gartner EXP, 56 Top Gallant, Stamford, CT 06904), November 1999.

CASE EXAMPLE

MICROSOFT

www.microsoft.com

Microsoft, the software giant in Redmond, Washington, has taken a sense-and-respond approach to creating its Internet strategy. Throughout its history, Microsoft has been slow to embrace some of the computer industry's most significant technology shifts and business chances. To adopt innovation, the company has often succeeded in using its financial might to acquire successful leaders (e.g., Lotus Development Corp. for office automation and Netscape Communications Corps for Web browsers). Microsoft moved on to buying Internet companies, aligning with Sun to promote Java (and create a proprietary version of Java), and even forging an alliance with AOL. This catch-up-and-strive approach has worked rather successfully for Microsoft.

Over time, the software giant moved into a variety of technologies:

- BASIC programming language for PC
- MS-DOS (Microsoft Disk Operating System)
- MS Mouse
- MS Word
- MS Windows
- MS Office

(*Case Continued*)

- Internet Explorer
- MSN Web Portal and ISP (Internet Service Provider)
- Visual BASIC
- MS Windows XP
- MS Business Solutions (Financial Management, CRM, SCM)
- Tablet PC
- Windows Mobile OS
- Visual Studio .Net Enterprise Developer
- Xbox 360 and the multiplayer broadband gaming service, Xbox Live
- Vista Operating System

In parallel with these core products, Microsoft diversifies in a number of related sectors, to include:

Web-only magazine, Slate, Web News site with NBC, Cable news channel with NBA, digital movie production via Dreamworks, mobile application, .NET platform for Web Services, and search engines to compete with Google. As the company celebrates its 30^th^ year anniversary, it is moving even more to applications areas (e.g., healthcare) while continuing to explore new software technologies (e.g., multi-core programming technology called "F-Sharp" to manage massive server computers).

Bill Gates has made defining announcements, to be sure, focusing the company on the Internet, security, and Web Services. Each announcement has fostered even more explorations. However, the strategies have not always come from top management. The company's first server came from a rebel working on an unofficial project. In addition, management mistakenly passed up some cheap acquisitions that later cost them much more via licensing agreements. Some of these moves could have been predicted, but others are surprising. In short, Microsoft has been sensing and responding to the moves in several industries, getting its fingers into every pie that might become important. Craig Mundle, Microsoft's chief research-and-strategy officer, is designated to replace Bill Gates, who relinquishes his chairmanship in 2008, as the new long-term strategic thinker. In his quest to position the company in the post-Gates era, Mundle flies around the globe, nurturing dialogues with employees working at far-flung research facilities. He seeks to change the company culture so Microsoft no longer is missing on emerging technologies and businesses. He travels around the world to hear the opinions from entities whose work might be overlooked by top product executives who set the agenda. In a report to the *Wall Street Journal* (July 30, 2007), Mr. Mundle wants Microsoft units to constantly search for innovation: "This is something that should be stuck in the face of the people who still think this is science fiction." ■

Formulate Strategy Closest to the Action

The major change introduced by the Internet is faster communication, not only within organizations but, more importantly, with others—customers, suppliers, and partners. Aligning corporate strategy with the marketplace in fast-paced times requires staying in close contact with that marketplace. Hence, strategy development needs to take place at these organizational edges, with the people who interact daily with outsiders.

Furthermore, employees who are closest to the future should become prime strategizers as well. Today, this means including younger employees because they have grown up in an era of the Internet, PDAS, and cell phones. They take all three for granted; they wear them like clothing. One company that is taking this premise of downside-up strategizing to heart is Skandia Future Centers.[1a]

CASE EXAMPLE

SKANDIA FUTURE CENTERS

www.skandia.com

Skandia Future Centers (SFC), located in Stockholm, Sweden, is an incubator for testing ideas on IT, social relationships, and networking for the Skandia Group, the 150-year old giant Swedish financial services company. The center acts as an inspirer and advisor to those who do the strategy making within Skandia.

The center was created in 1996 by Leif Edvinsson to give Skandia a laboratory to break out of its current ways of thinking and to provide a place where different generations can collaborate on on-the-edge projects. The mission is to explore five key driving forces of the business environment: the European insurance market, demographics, technology the world economy, and organization and leadership. The goal is to devise a vision of the company's future.

3-Generation Teams

One of the first concepts used at the center was 3G teams, getting three generations (25+, 35+, 45+) to work together. The teams were part-time and cross-cultural; coming from Venezuela, Germany, Sweden, and the United States. The participants were chosen by peers as well as nominated from different parts of the company.

To get the generations to actually talk to each other, their mandate was to focus on questions rather than answers. "When you ask for answers, you get a debate. When you focus on questions, you get a dialog," says Edvinsson.

Based on their questions, participants arrived at a number of interesting contexts for the questions, such as the evolution of the financial community around the world and the evolution of IT. These contexts were presented to 150 Skandia senior executives, not through a report, but through scenarios of these five future environments performed by professional actors in a theater play.

Knowledge Café

The play led to the first knowledge café among the 150 executives. The café was created by one of the 3G teams and a few of the executives. At the café, the 150 gathered for one hour around stand-up tables at different Skandia sites. Each table had coffee and a laptop loaded with

(*Case Continued*)

groupware software from Ventana Software. During the hour, they discussed the questions presented in the play through anonymous entries. The discussion was spiked by the drama they had seen, then nourished and cultivated through the exchange.

The entire project was videotaped and sent to a larger community, along with the questions and a video of the play and the café. The goal of this project was to show the power of collective intelligence. The knowledge café accelerated innovation at Skandia, transforming it into an innovation company. The effect has been demonstrated by Skandia's growth, to become a global innovative financial service company.

Nurturing the Project Portfolio

Edvinsson thinks of the center as a garden, where some of the projects are growing and some are not. He tends them by looking at the level of interest surrounding each one and at the progress each has made, which he equates with gardening.

Ten years after the creation of the center, the head of the FSC was appointed as Chair Professor of Intellectual Capital at the University of Lund, Sweden. Looking at the future, Edvinsson reckons that the success of the firm of the future lies in its ability to create intangible value creation, through intense exchange of knowledge at the global scale. ■

Guide Strategy Making with a Strategic Envelope

Having a myriad of potential corporate strategies being tested in parallel could lead to anarchy without a central guiding mechanism. That mechanism is a strategic envelope, as shown in Figure 4-4. Creating and maintaining this envelope is the job of top management. Rather than devise strategy, they define its context by setting the parameters for the experiments (the strategic envelope) and then continually manage that context. Thus, they need to meet often to discuss the shifts in the marketplace, how well each of the experiments is proceeding, and whether one is gaining followership or showing waning interest.

They may perform this work by defining a territory, as Microsoft did. Or they may hold strategic conversations, as espoused by Brown and Eisenhardt.[3] A strategic conversation is a regular, frequent meeting at which executives share the workload of monitoring the business environment and responding to it. Perhaps the vice president of operations might be charged with reporting on "today," such as the size of the company's mobile workforce. The emerging technologies director might be charged with reporting on "tomorrow," such as recent developments in Web Services or mobile or fixed wireless services. The HR vice president might be the team's eyes and ears on outsourcing. The purposes of each meeting are to stay in tempo with the marketplace (which may mean setting new priorities), spot trends in their infancy, launch new projects, add resources to promising ones, cut funding for others, and so forth.

Another way to create a strategic envelope is to meet regularly with the experimenters, as in the case of Shell Oil, described by Richard Pascale in an issue of *Sloan Management Review*.[4]

CASE EXAMPLE

SHELL OIL

www.shell.com

Steve Miller, then incoming general manager of oil products at Royal Dutch/Shell Group, believed change would only occur if he went directly to his front lines—employees at Shell gas stations around the world. He felt he had to reach around the middle of the company to tap the ingenuity of frontline employees at the gas stations, encouraging them to devise strategies that were best for their local markets.

He set aside 50 percent of his own time for this work and required his direct reports to do the same. His goal was not to drive strategy from corporate, as had been tried and failed, but to interact directly with the grass roots and support their new initiatives, thus overwhelming the old order in the middle of the company.

Action Labs. His technique was to use action labs. He invited six teams, each with six to eight people from gas stations in one country, to a week-long "retailing boot camp" at which they learned how to identify local opportunities and capitalize on them. The teams were then sent home for 60 days, each to develop a proposal of how to double their net income or triple their market share.

The following week, a fresh set of six teams came to headquarters.

After 60 days, the first six teams returned for a "peer challenge" at which they critiqued each others plans. They then returned home for another 60 days to hone their plans for the third action lab: approval or disapproval.

At this third lab, each team took turns sitting in "the hot seat" facing Miller and his direct reports, who grilled them for three hours on their plan. The teams, in turn, described what they needed from Miller as the other teams watched. The plans were approved, denied, or modified. If funded, the promised results were factored into an operating company's goals. The teams then had 60 days to implement their plans, after which they would return for a fourth session with Miller and his reports.

The Results. These action labs had a powerful effect. They caused stress on Shell's way of doing business, in effect, unfreezing the status quo. The corporate middle, which had not formerly seen good results from corporate efforts, saw solid plans and energized subordinates. In turn, they became energized. In addition, the labs led to much more informal communications up, down, and across Shell. The teams, for instance, felt comfortable calling up Miller and his staff—a significant departure from the past.

The labs also affected the way Miller and his staff made decisions. In the labs, these executives had to make on-the-spot decisions in front of the frontline teams rather than behind closed doors. They found they had to be consistent and straight with the teams. It was a difficult and trying experience for all, but humanizing for the teams.

(Case Continued)

In the various countries, "guerilla leaders" emerged and initiated innovative experiments. One, for example, was "the soft drink challenge." Whenever a customer was not offered the full gamut of services at a Malaysian gas station, they received a free soft drink. The result: a 15 percent increase in business.

The projects spawned many more projects, and Miller learned that small local projects can have large effects. The focus was to tap the intelligence at the front lines, with controls and rewards supporting that goal. "We're not going to tell you what to do. Pick a big-ticket business challenge you don't know how to solve. Let's see if we can do things a little differently," told Miller to teams from Malaysia, Chile, Brazil, South Africa, Austria, France and Norway.

Formerly, top management had the illusion of being in control via their directives. Through the action labs, they learned as their staff learned, they received much more feedback, and they knew far more about their customers and the marketplace. Guidance and nurturing came from the top, so there was not complete chaos. In fact, Miller believes the key is to get the right tension between chaos (at the team level) and order (at the managing director level). He sees it as treating the company as if it were a living system. Having retired from Shell, Miller reflects on his experience at Shell: "Top-down strategies don't win many ball games today. Experimentation, rapid learning, seizing the momentum of success works better. The leader becomes the context setter, the designer of a learning experience, not an authority figure with solutions. Once the folks at the grassroots realize they own the problem, they also discover that they can help create the answer." ■

Be at the Table

As noted earlier, IS executives have not always been involved in business strategizing. That situation is untenable today because IT is intrinsic to business. However, to have a rightful place in the strategizing process, the IS function needs to be strategy oriented. Many have been tactical and operational, reacting to strategies formulated by the business. To become strategy oriented, CIOs must first make their departments credible, and second, outsource most operational work to release remaining staff to help their business partners strategize and experiment.

Test the Future

To get a running start, as well as contribute ideas about the future, IS departments need to test potential futures before the business is ready for them. One mechanism for testing the future is to provide funding for experiments. Another is to work with research organizations. Yet another is to have an emerging technologies group.

Put the Infrastructure in Place

Internet commerce requires having the right IT infrastructure in place. Hence, the most critical IT decisions are infrastructure decisions. Roger Woolfe and his colleagues[1a] recommend that IT experiments include those that test painful infrastructure issues, such as how to create and maintain common, consistent data definitions; how to create and instill mobile commerce standards among handheld devices; how to implement e-commerce security and privacy measures; and how to determine operational platforms, such as ERP and SCM.

Experimentation is the new sense-and-respond approach to IS strategy making. It differs markedly from the traditional planning described at the outset of this chapter. In fact, it represents a revolution in planning. The following section describes some tools and approaches that can be used to both focus and broaden thinking during planning and strategy making.

EIGHT PLANNING TECHNIQUES

Due to the importance and the difficulty of systems planning, it is valuable to use a framework or methodology. Over the years, a number of techniques have been proposed to help IS executives do a better job of planning. The seven presented here take different views of IS planning, including looking at the assimilation of IT in organizations, defining information needs, understanding the competitive market, categorizing applications into a portfolio, mapping relationships, and surmising about the future. The eight planning techniques discussed are:

1. Stages of growth
2. Critical success factors
3. Competitive forces model
4. Three emerging forces
5. Value chain analysis
6. Internet value matrix
7. Linkage analysis planning
8. Scenario planning

Stages of Growth

Richard Nolan and Chuck Gibson[5] observed that many organizations go through four stages in the introduction and assimilation of a new technology.

- ***Stage 1: Early Successes.*** The first stage is the beginning use of a new technology. Although stumbling occurs, early successes lead to increased interest and experimentation.
- ***Stage 2: Contagion.*** Based on the early successes, interest grows rapidly as new products and/or services based on the technology come to the marketplace. They are tried out in a variety of applications; growth is uncontrolled and therefore rises rapidly. This proliferation stage is the learning period for the field, both for uses and for new products and services.
- ***Stage 3: Control.*** Eventually it becomes apparent that the proliferation must be controlled. Management begins to believe the costs of using the new technology are too high and the variety of approaches generates waste. The integration of systems is attempted but proves difficult, and suppliers begin efforts toward standardization.

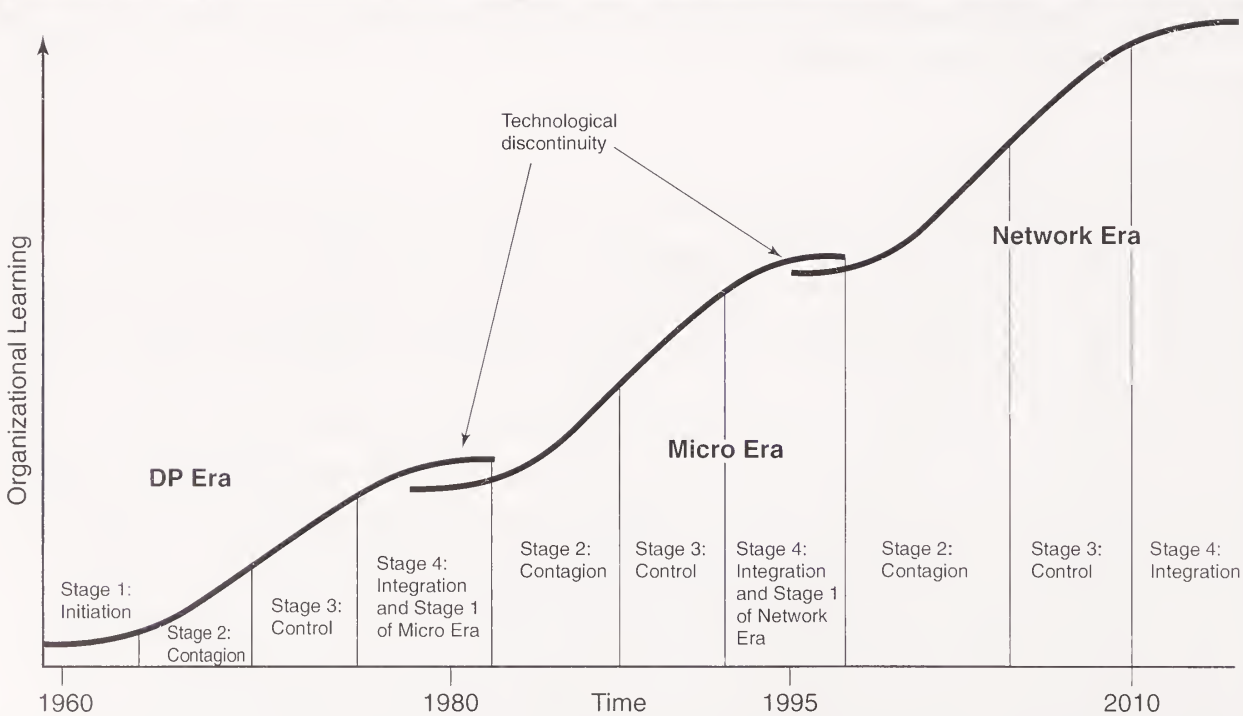
- ***Stage 4: Integration.*** At this stage, the use of the particular new technology might be considered mature. The dominant design of the technology has been mastered, setting the stage for newer technologies, wherein the pattern is repeated. An organization can be in several stages simultaneously for different technologies.

Nolan has since used the Stages of Growth theory to describe three eras, as shown in Figure 4-5.[6] Underlying the three organizational learning curves pictured is the dominant design of each era. The DP (Data Processing) Era's dominant design was the mainframe, the Micro Era's design was the PC, and the Network Era's is the Internet. The eras overlap each other slightly at points of "technological discontinuity," states Nolan, which occur when proponents of the proven old dominant design struggle with the proponents of alternative new and unproven designs. Inevitably, one new dominant design wins out.

The importance of the theory to IS management is in understanding where a technology or a company currently resides on the organizational learning curve. If, for example, use of Web Services is in the trial-and-error Stage 2, where experimentation and learning take place, then exerting too much control too soon can kill off important new uses of the technology. Management needs to tolerate, even encourage, experimentation.

Because the management principles differ from one stage to another, and because different technologies are in different stages at any point in time, the Stages of Growth model continues to be an important aid to the systems planning process.

FIGURE 4-5 Stages of Growth



Source: Reprinted with permission from R. L. Nolan, "Information Technology Management from 1960–2000," in *A Nation Transformed by Information*, Alfred D. Chandler and James W. Cortad (eds.), Oxford, 2000.

Critical Success Factors

In 1977, Jack Rockart[7] and his colleagues at the Center for Information Systems Research (CISR), Sloan School of Management, at the Massachusetts Institute of Technology (MIT), began developing a method for defining executive information needs. The result of their work is the Critical Success Factors (CSF) method. It focuses on individual managers and their current information needs, whether factual or opinion information. The CSF method has become a popular planning approach and can be used to help companies identify information systems they need to develop.

For each executive, critical success factors (CSFs) are the few key areas of the job where things must go right for the organization to flourish. Executives usually have fewer than 10 of these factors that they each should monitor. Furthermore, CSFs are both time sensitive and time dependent, so they should be reexamined as often as necessary to keep abreast of the current business climate. These key areas should receive constant attention from executives, yet CISR research found that most managers had not explicitly identified these crucial factors.

Rockart finds four sources for these factors. One source is the industry that the business is in. Each industry has CSFs relevant to any company in it. A second source is the company itself and its situation within the industry. Actions by a few large, dominant companies in an industry most likely provide one or more CSFs for small companies in that industry. Furthermore, several companies may have the same CSFs but, at the same time, have different priorities for those factors.

A third source of CSFs is the environment, such as consumer trends, the economy, and political factors of the country (or countries) in which the company operates. A prime example is that prior to, say, 1998, few chief executives would have listed "leveraging the Internet" as a CSF. Today, most do.

The fourth source is temporal organizational factors, or areas of company activity that normally do not warrant concern but are currently unacceptable and need attention. A case of far too much or far too little inventory might qualify as a CSF for a short time.

In addition to these four sources, Rockart has found two types of CSFs. One he calls monitoring, or keeping abreast of ongoing operations. The second he calls building, which involves tracking the progress of "programs for change" initiated by the executive. The higher an executive is in the organization, the more building CSFs are usually on his or her list.

One way to use the CSF method is to use current corporate objectives and goals to determine which factors are critical for accomplishing the objectives, along with two or three prime measures for each factor. Discovering the measures is time consuming. Some measures use hard, factual data; they are the ones most quickly identified. Others use softer measures, such as opinions, perceptions, and hunches; these measures take more analysis to uncover their appropriate sources. CSFs vary from organization to organization, from time period to time period, and from executive to executive. IS plans can then be developed based on these CSFs.

Competitive Forces Model

The most widely quoted framework for thinking about the strategic use of IT is the competitive forces model proposed by Michael Porter[8] of the Harvard Business School, in his book *Competitive Strategy*. Porter believes companies must contend with five competitive forces, as shown in Figure 4-6.

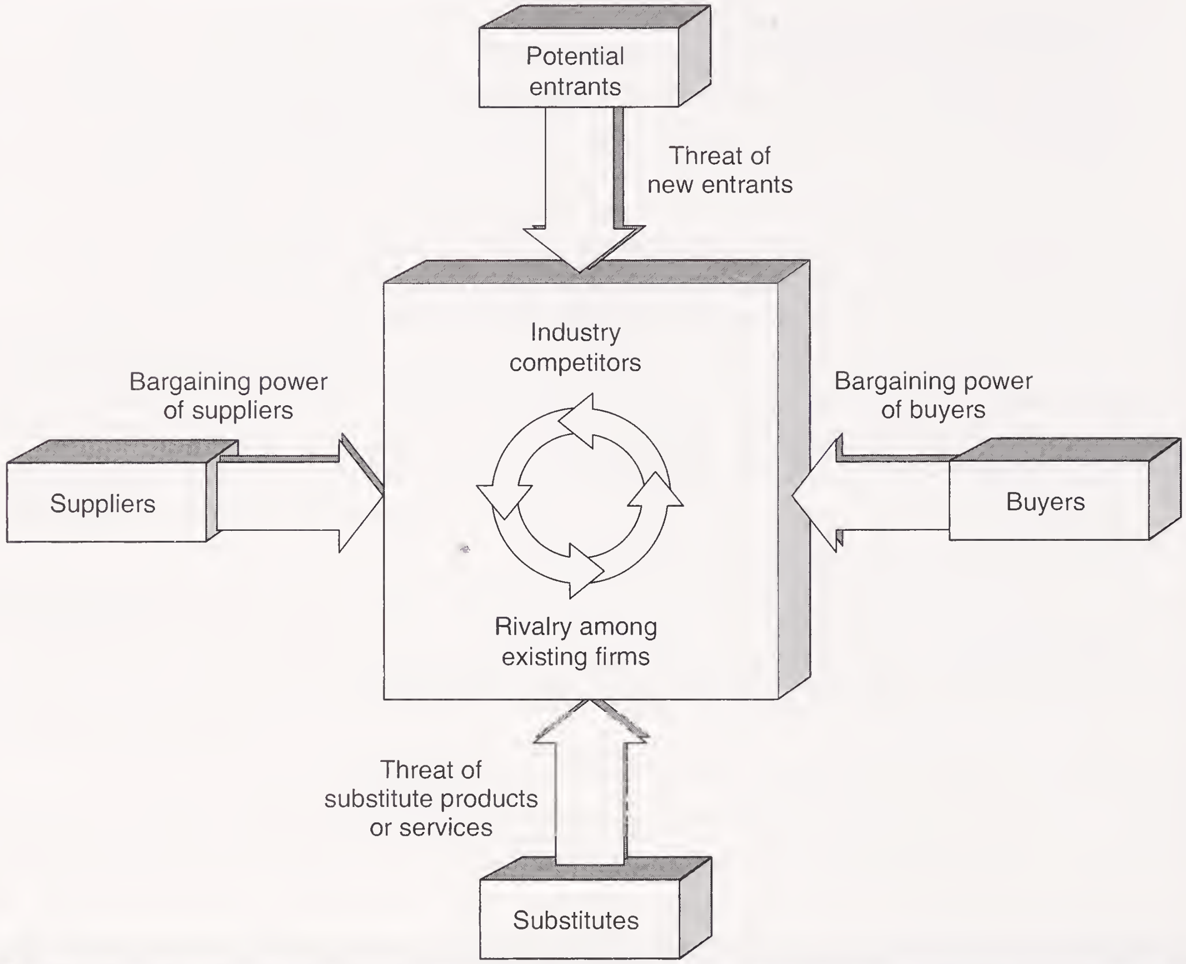


FIGURE 4-6 Michael Porter's Competitive Analysis Model

Source: Michael E. Porter, "The Five Competitive Forces That Shape Strategy," *Harvard Business Review*, January 2008.

One force is the threat of new entrants into one's industry. For instance, the Internet has opened up a new channel of marketing and distribution, which, in turn, has allowed all kinds of unexpected new entrants into numerous markets. Travel Web sites, for example, are threats to travel agencies.

The second force is the bargaining power of buyers. Buyers seek lower prices and bargain for higher quality. Web-based auction sites, shopping bots, and intelligent agents are all giving buyers more shopping options and more information about potential suppliers, thus increasing their bargaining power. In fact, much of the power of the Internet has to do with this force.

A third force is the bargaining power of suppliers. For example, the Internet enables small companies to compete against large ones in uncovering requests for bids and bidding on them—leveling the playing field.

The fourth force is substitute products or services. The Internet provides a myriad of examples here. E-mail is a substitute for paper mail. Music downloads are substitutes for CDs. Book and music Web sites are substitutes for book and music stores.

The fifth force is the intensity of rivalry among competitors. IT-based alliances can change rivalries by, for instance, extending them into value-chain-versus-value-chain competition rather than just company-versus-company competition.

Porter presents three strategies for dealing with these competitive forces. His first is to differentiate products and services. By making them different—that is, better in the eyes of customers—firms may be able to charge higher prices or perhaps deter customers from moving to another product, lower the bargaining power of buyers, and so on. It is probably the most popular of his three strategies.

Porter's second strategy is to be the lowest-cost producer. He warns that simply being one of the low-cost producers is not enough. Not being the lowest causes a company to be stuck in the middle, with no real competitive advantage.

His third strategy is to find a niche, such as focusing on a segment of a product line or a geographical market. Companies that use this strategy can often serve their target market effectively and efficiently, at times being both the low-cost producer and having a highly differentiated product as well.

This framework guides IS planning because all five forces and all three strategies can be enabled by or implemented by technology. Once management analyzes the forces and determines company strategy, the necessary information systems can be included in the plan. In a widely referenced 2001 article in the *Harvard Business Review*, Porter[9] analyzes the Internet using this framework. Here are his main points.

FRAMEWORK EXAMPLE

FIVE FORCES ANALYSIS OF THE INTERNET

In the main, the Internet tends to dampen the profitability of industries and reduce firms' ability to create sustainable operational advantages, argues Michael Porter, because it has "a leveling effect on business practices." He reaches this sobering conclusion by looking at the effect the Internet can have on industry profitability using his five forces framework.[8] Here are his points.

The Bargaining Power of Buyers Increases. On the demand side of the value chain, the Internet opens up new channels for companies to deal directly with customers, rather than through intermediaries. Thus, the Internet can decrease the bargaining power of the other channels and their intermediaries, thereby potentially increasing profitability.

However, the Internet gives buyers more information, both about competitors and products, strengthening their bargaining power and lowering industry profitability. The Internet can also decrease switching costs—the cost a buyer pays to switch from buying from one firm to buying from someone else.

(*Case Continued*)

This also increases buyer bargaining power. In total, the increase in buyer bargaining power decreases industry profitability.

Barriers to Entry Decrease. Due to the Internet's new channel to buyers, industries may not be so reliant on building up sales forces to sell their goods, making it easier for others to enter the industry because they can compete without having these high fixed costs. Furthermore, location need not be as much of a limiting factor. Small companies can sell to the world via a Web site.

On the other hand, network effects, which increase barriers to entry, are difficult to garner, argues Porter. A network effect occurs when the value of a product or service increases as the number of users increases. eBay illustrates this effect: the more buyers, the more eBay is a desirable marketplace for sellers. And the more sellers, the more eBay attracts buyers.

It is a virtuous circle. However, Porter argues that a self-limiting mechanism is at work. A company first attracts customers whose needs it meets well. The needs of later customers may be less well met—presenting an opening for other competitors. Thus, the network effect limits itself. Yet, where it exists, it presents a formidable barrier to entry.

The Bargaining Power of Suppliers Increases. On the supply side, the Internet can make it far easier for a company to purchase goods and services, which reduces the bargaining power of suppliers. This trend would seem to increase industry profitability. But, at the same time, suppliers can more easily expand their market, finding new customers, thereby increasing supplier bargaining power. Lower barriers to entry also erode the former advantage of a company over its suppliers.

Electronic exchanges, which expand marketplaces, can benefit both buyers and suppliers. However, they can reduce the leverage of former intermediaries between suppliers and end users. This decrease gives companies new competitors (their former suppliers), which can reduce industry profitability.

Finally, in giving equal access to all suppliers, the Internet tends to diminish differentiation among competitors—again reducing industry profitability.

The Threat of Substitute Products and Services Increases. An industry can increase its efficiency by using the Internet, thereby expanding its market and improving its position over substitutes. For example, online auctions can decrease the power of classified ads and physical marketplaces because the online auctions may be more convenient to buyers. Online exchanges, especially those with many buyers and sellers, can thus discourage substitutes.

On the other hand, the Internet has opened up entirely new ways to meet customer needs. Thus, the threat of substitutes can increase significantly, probably greater than its ability to ward them off through increased efficiencies.

Rivalry Among Competitors Intensifies. Proprietary offerings are more difficult to sustain in the Internet's open-system environment, states Porter, because products and services are easier to duplicate. Hence, there can be more intense rivalry among competitors. Furthermore, due to the Internet's global nature, companies can extend their range of

(*Case Continued*)

competition, so there can be more competitors in a marketspace.

Also, the Internet can change the cost structure, emphasizing fixed costs (Web sites rather than call centers, for example) and reducing variable costs (serving one more customer can be much less expensive via a Web site rather than a call center). This change in cost structure can lead companies to compete on price (which hurts industry profitability) rather than on convenience, customization, specialization, quality, and service (all of which can increase industry profitability).

Even partnering with complementary products and services, while seeming to increase a market, may instead decrease profitability if it leads to standardized offerings. Microsoft's operating systems has had that effect on the PC industry. The industry now competes on price; its profitability has decreased.

Outsourcing, another form of partnering, can also depress industry profitability if the companies outsource to the same providers and their products thereby become more alike.

Overall, states Porter, the Internet tends to decrease industry profitability. But not all industries need to see this happen to them. It depends on how their companies react. They can react destructively by competing on price or compete constructively by competing on differentiating factors. It will be harder for them to distinguish themselves on operational efficiencies alone because the Internet can make duplication easier. Instead, firms should focus on their strategic position in an industry and how they will maintain profitability (not growth, market share, or revenue). Success depends on offering distinct value. ■

Beyond Porter—Downes' Three Emerging Forces

Porter's Five Forces Analysis is strongly rooted in applied microeconomics, taking into consideration the theories of supply and demand, production theory, and market structures. Developed late in the 1970s, the model reflects an era of strong competition with rather predictable developments. Larry Downes,[10] of UC Berkeley, argues that the "new" economy needs to be considered in the analysis. The "old" economy looked at IT as a tool for implementing change. In the new economy, technology has become the most important driver of change. Focusing on the critical role of IT, Downes suggests three new forces:

1. **Digitalization:** As technological innovation is accelerating, and as we have seen throughout the various case examples in this text, new business models continue to emerge, disrupting the basis of competition in a market. With its online bookstore supported by a computer networked-supported supply chain, Amazon.com did dramatically change the bookstore market, forcing Barnes and Nobles to alter its century-old business. Skype is another example of using a new technology (VoIP) to disrupt the telecommunications industry. Apple's 99-cent iTunes songs has contributed to the exit of Tower Records. Downes recommends

that those who use Porter's Five Forces model should think beyond today's industry structure, and embrace digital technologies as their key strategic tools.

2. **Globalization:** Cheaper telecommunications costs and faster transportation logistics make it possible for companies—large and small—to conduct cross-border trade. Outsourcing is now offshoring. Market dimension is no longer local but global. A local travel agent who does not do import-export himself is indirectly affected by Travelocity.com or Expedia.com. In addition to the quality and pricing strategies, analysts should look at the network effect at the global scale. A firm could achieve significant considerable competitive advantages if it can reach far-reaching networks of partners for mutual benefits. Sabre Holdings is a good example of using Travelocity.com to partner with similar online reservation systems around the globe.
3. **Deregulation:** Under the auspices of the World Trade Organization (WTO), governmental influence on trade has diminished in many industries—telecommunications, banking, transportation, and utilities. Local monopolies are losing their market power. Thanks to IT and a deregulated market, geographically remote firms can impose anytime, anywhere presence, therefore forcing local businesses to revisit their strategy.

If anything, Downes' three forces should remind us that any strategy planning in the new economy is going to be less stable, less predictable, and more complex. In the information economy, certain products do defy the old theory of price elasticity. How can one estimate the demand of an iTunes song that is sold for a small and unique price of 99 cents? Likewise, Amazon.com sells digital books in a condensed version and in Acrobat's PDF format for 49 cents. The price is small and unique. There must be other factors that drive demand other than price for these microproducts, such as reputation or instant gratification.

If Porter's model was developed in the 1970s and popularized in the 1980s, and Downes formulated his digital strategies in the 1990s, the three emerging forces do mirror the context of this era. One should, however, expect that with the rapid rate of globalization and deregulation, the impact of these two forces will somehow fade away in the future. However, less can be said about the digitization trend.

Value Chain Analysis

Five years after proposing the Five Forces Model in 1980, Porter presented the value chain in *Competitive Advantage* in 1985; it, too, became a popular strategic planning tool. As shown in Figure 4-7, a value chain for a product or service consists of major activities that add value during its creation, development, sale, and after-sale service. According to Porter, primary activities and support activities take place in every value chain.

The five primary activities deal with creating a product or service, getting it to buyers, and servicing it afterward. These activities form the sequence of the value chain:

1. ***Inbound logistics:*** Receive and handle inputs
2. ***Operations:*** Convert inputs to the product or service
3. ***Outbound logistics:*** Collect, store, and distribute the product or service to buyers
4. ***Marketing and sales:*** Provide incentive to buyers to buy the product or service
5. ***Service:*** Enhance or maintain the value of the product or service

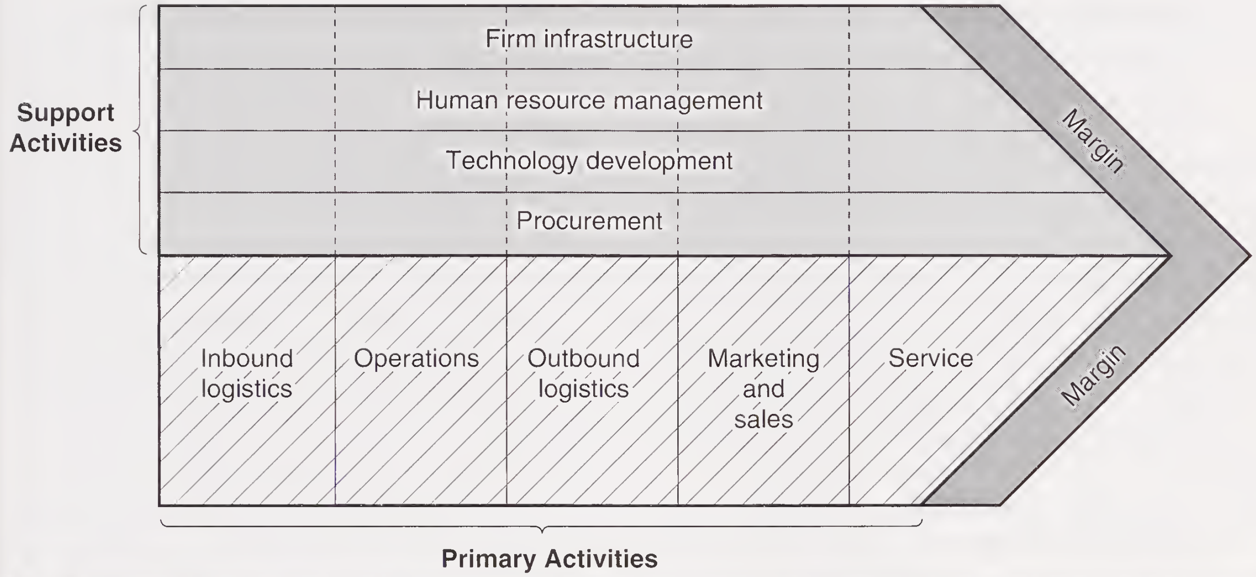


FIGURE 4-7 The Value Chain

Source: Michael E. Porter, *Competitive Advantage* (New York: The Free Press, 1985).

The four supporting activities underlie the entire value chain:

1. Organizational infrastructure
2. HR management
3. Technology development
4. Procurement

By studying how a firm performs the primary and support activities for a product or service, a firm can explore how it might add more value at every activity. Alternatively, it could determine where another company could add more value, and team up with that firm, outsourcing that activity to that partner.

Virtual Value Chains

Jeff Rayport and John Sviokla[11] distinguish between marketplaces, where physical products and physical location are important, and marketspaces, where information substitutes for physical products and physical location. In the world of Internet commerce, they ask, "How can companies create value in marketspace?" or "How can they create value in marketspace and marketplace concurrently, leveraging off each other?" They draw on Porter's value chain in their answer.

In the traditional value chain, companies treat information as a support element, not as a source of value itself. To compete in marketspace, companies need to use information to create new value for customers (such as FedEx and UPS did in opening up their tracking systems to consumers via their Web sites). Creating value in the marketspace also involves a value chain, but it is a virtual value chain, because the steps are performed with information and through information. At every step, value via information can be added in five ways: gather it, organize it, select it, synthesize it, or distribute it. The IS organization should therefore play a major role in marketspace.

Making operations visible. Firms seem to follow an evolution in using information to add value: first by making operations visible, then by putting in place mirroring capabilities, and finally by creating space-based customer relationships. Companies first create ways to see their physical operations through information. That is, they foster visibility of operations, generally through their production systems, allowing employees to coordinate activities across the physical value chain, sometimes in ways that lead to competitive advantage. Frito-Lay's field employees input information on store-by-store sales as well as information about competitors' promotions and new competitive products. With all this field data, managers can better schedule production to match demand, route trucks most efficiently, and tailor promotions to suit local buying patterns. Frito-Lay can more quickly react to marketplace changes. Visible flows of information lay the foundation for a virtual value chain.

Mirroring capabilities. Second, companies begin to substitute virtual activities for physical ones. Here is a case in point from a report by Roger Woolfe.[1b]

CASE EXAMPLE

AN AUTOMOBILE MANUFACTURER

This auto manufacturer has dealerships around the United States. Many of the dealerships have satellite dishes, as do headquarters. In addition to other uses, these dishes are used by the manufacturer's rental car subsidiary to auction off good, clean used vehicles (with fewer than 10,000 miles) to dealers to sell.

For 30 minutes at a specified time, an auctioneer is able to sell 60 vehicles online. As a car comes up for bid, the dealers view it on a monitor at their premises. They can see it from several directions, read its ratings (on cleanliness and condition), and use a mouse to bid against the other dealers online. Headquarters staff monitors the progress of the auction and advises the auctioneer on, say, lowering minimum bids to ensure that every vehicle is sold. The auctions are held once or twice a month.

The dealers have been extremely satisfied with this system because it saves them from having to travel to auctions, and they can get good-quality used cars without much effort. In addition, the manufacturer guarantees satisfaction. If, after taking delivery of a vehicle, the dealer decides he does not want it, he can send it back. ■

Another example is virtual worldwide teams, such as design teams in the United States, Europe, and Asia that work on designs and prototypes in a virtual information space. Time and space are no longer limitations. The teams can be located anywhere, work can progress 24 hours a day, and many more virtual designs can be created and tested in a shorter time and for less cost than in the physical world. This mirroring of capabilities, note Rayport and Sviokla, marks the beginning of creating a parallel virtual value chain.

Space-based customer relationships. Third, companies draw on their flow of information to deliver value to customers in new ways. In essence, they create new space-based customer relationships. USAA, the insurance company for military officers, exemplifies this third step, note Rayport and Sviokla. For many years, USAA collected information about customers and made it available company-wide so that employees could provide advice and answer questions anytime a customer called (visibility). The company then discovered it could create customer risk profiles and customize policies. From that point, it created new product lines, such as insurance for boat owners (mirroring capabilities). From there, USAA expanded to new areas, such as offering financing to boat purchasers. In fact, it even offers to replace stolen items in a theft claim, rather than send the insured a check, a service many seem to prefer. USAA is managing its information to create new value for customers.

When searching for strategic uses of information, Rayport and Sviokla point out that many of the rules differ from those of the physical marketplace. Digital assets are not used up in consumption; therefore information can be reused in many forms at a low cost. New economies of scale are present, so small companies can effectively compete against large ones, due to lower overhead, while still covering large geographic areas. New economies of scope allow insurance companies to offer financing and even discount buying programs to policyholders, as USAA is doing, for example. Finally, transaction costs are lower in marketspace; thus, companies can capture information that they were not able to capture in the past, as Frito-Lay is doing.

To take advantage of these four changes, though, a significant mind shift is required from supply-side thinking to demand-side thinking. That is, companies need to sense and respond to needs rather than make and sell products and services. That shift appears to be a significant strategic opportunity for companies, and IS should play a role in identifying and helping the company take advantage of it.

E-Business Value Matrix

It can be difficult for executives to prioritize projects, said Peter Alexander,[12] because of the wealth of opportunities. Alexander describes a portfolio planning technique used at Cisco to ensure it develops a well-rounded portfolio of Internet-centric IT projects. The approach is further described in Hartman et al.'s *Net Ready*.[13]

A portfolio management approach is of great value to senior and functional executives to ensure that they are working on a broad front that will lead to success in the Internet economy.

The portfolio management approach Cisco uses is called the e-business value matrix, and every IT project is meant to be placed in one of four categories to assess its value to the company. As shown in Figure 4-8, the value of each project is assessed as high or low in two categories: criticality to the business and newness of the idea (newness not just to the company, but to the world). The result is four categories of projects: new fundamentals, operational excellence, rational experimentation, and breakthrough strategy.

	Criticality to Business	Newness of Idea
New fundamentals	Low	Low
Operational excellence	High	Low
Rational experimentation	Low	High
Breakthrough strategy	High	High

FIGURE 4-8 E-Business Value Matrix

Source: Adapted from a speech by Peter Alexander and *Net Ready: Strategies for Success in the E-conomy* by Amir Hartman, John Sifonis, and John Kador (New York: McGraw-Hill, 2000).

New Fundamentals

These projects provide a fundamentally new way of working in overhead areas, not business-critical areas. They are low risk and focus on increasing productivity. They can provide significant cost savings by measurably improving operations. An example is Web-based expense reporting, described in the Cisco case example on pages 157–159.

These projects should be managed as quick hits: Implement a project to increase productivity in finance within three to six months, said Alexander, then move on to another area. Often, such projects can be implemented by IS with little user involvement during development. However, an important point to remember is that these systems aim at the grass roots of the company. Thus, they can lead to a cultural shift, such as shifting to working via an intranet.

Operational Excellence

These projects are of medium risk because they may involve reengineering work processes. They do not aim for immediate returns, but rather intend to increase such areas as customer satisfaction and corporate agility. In essence, they revolve around providing faster access to information. These projects can be important in improving IS credibility because of their high visibility. An example is an executive dashboard for quickly viewing operational metrics. Such a system is highly visible to executives.

These projects have about a 12-month horizon. They should involve cross-functional teams (to ensure that the reengineering does indeed take place), and they should use tested technology.

Rational Experimentation

These projects test new technologies and new ideas. Hence, they are risky. However, every company needs some of these projects to hope to move ahead of competitors. When described as experiments, they set the realistic expectation that they may fail. The goal is to prove the concept in, say, several months' time or less. One example could be Web Services; another could be desktop video conferencing. When treated as experiments, these projects will not hurt the company if they fail. If they do pan out, however, they could prove a new business or IT model and thus become one of the other three types.

These incubator-type projects should be managed as experiments with short time frames and incremental funding. The team may be full-time, but it does not need to move out of IT. Participants should not be penalized if one of these projects fails.

Breakthrough Strategy

These projects potentially have a huge impact on the company, and perhaps even on the industry, if they succeed. They capture the imagination, but they are high risk. The typical response, once someone sees the potential, is, "If this works, it would change. . . ." An example of a breakthrough strategy is eBay. Its auction business model altered people's thinking about global buying and selling. Another example is extranets for customers. When successful, they move to the operational excellence cell.

Breakthrough strategy projects require strong functional buy-in. One way to get this commitment is to brainstorm with functional partners on the possibilities. Because they are generally bet-the-farm types of projects, they need to be managed like start-ups. They need venture-capital-like funding, not month-to-month milestones. For example, the project may request $10 million with the possibility of failure, but also offer the possibility of huge upside returns.

Key steps of a breakthrough strategy consist of the following:

- Brainstorming on markets and services: Identify as many fundamental changes as possible that occur in the industry—changes in product types, manufacturing, distribution, customer services, regulations, and the like; discuss the extent to which the company can fit in these trends.
- Create a list of creative marketing ideas: Make a list of services that the company has not provided and search for clever ideas.
- Break the rules: List all the existing rules that govern the marketing of existing goods and services that the company currently sells, and try to envision a new world without these rules.

To attract top talent and foster the intense communication and collaboration needed among the team members, they probably need to be housed in a "skunk works" setting by being set apart organizationally and reporting to the CEO or CFO, who protects them from corporate politics and from the "but this is the way we've always done it" mind-set. Finally, the skunk works team needs to be given financial incentives if the project succeeds. To practice a breakthrough strategy, management should encourage risk and accept failure of the right kind. Because C-level involvement is key, executives may need to be educated on their roles.

To illustrate this portfolio approach, here are examples of Cisco IT projects.

CASE EXAMPLE

CISCO SYSTEMS

www.cisco.com

Cisco Systems Inc. is a global leader that designs and sells networking and communications technology and services under four brands: Cisco, Linksys, WebEx, and Scientific Atlanta. Cisco uses the e-business value matrix described by Alexander[12] to manage its portfolio of IT projects, placing a value on each project

(*Case Continued*)

based on the newness of the idea it employs and the criticality of the system to the company.

Here are examples of systems in each of the four cells in the matrix: new fundamentals, operational excellence, rational experimentation, and breakthrough strategies.

New Fundamentals

Completing a travel expense report is a chore for many business executives. Cisco assembled a team of 15 employees to include eight from the IT department to build an easy-to-use Management Expense Travel Reports Online, or Metro for short. Metro is a fundamentally new way of handling expense reporting.

To submit an expense report, an employee goes to a Web page to build the report online. As the report is filled in, the system checks to see whether the employee has adhered to company policy, and consults with the company's treasury department for exchange rates and payroll to find the employee's bank information for electronic reimbursement transfers. When submitted, the system routes the report to the employee's manager and explains the purpose of the expense report, the total expenses, and whether any policies were violated. If the manager does nothing, the employee's credit card account and personal account are credited in two days' time.

This system quickly earned employees' adoption (more than 86 percent right after the system went live in 1997). In addition, the system delivered major cost savings, since Cisco now only needs three employees to manage expense reports for more than 56,000 employees. Although abuse is possible, the cost of potential losses from questionable charges is a fraction of the cost of having a larger administrative staff.

Operational Excellence

Cisco's executive dashboards for each functional area are seen as operationally differentiating the company from its competitors. In fact, Cisco executives have claimed, "I cannot live without this system because . . . it allows me to model sales programs, . . . it allows me to manage the supply chain, . . . it allows me to do trend analysis on component availability, and so on."

Each dashboard is a Web front end to the company's data warehouse. The dashboard provides just enough and instant data to meet the information needs of the busy executive. It is an executive information system that allows executives to drill down into the data to pull up a snapshot of, say, the company's revenues, bookings, or margins (the fundamentals of the company) at a point in time by business unit, region, entire enterprise, product line, and so on. For example, executives can see how well a division is progressing in meeting its forecasts.

Furthermore, the system allows the CFO to close the company's books within one day of the end of each quarter, and the company expects to reduce this lag to just two to three hours.

Such a system is not excellence in product, it is excellence in IT; and it is operational excellence, said Alexander.

Rational Experimentation

To keep information flowing and strategic skills sharp within the company, CEO John Chambers and his CIO and vice president of the Internet Learning Solutions teamed up to create a Delta Force. The triangular model seeks to apply more expertise to

(*Case Continued*)

serving business. The idea is to avoid having businesspeople come up with a sound business application, but IT engineers cannot develop an information system to support this application. Conversely, there are situations where the IT department can build technically sound solutions but they might not be adequate for business use. In search for a winning application, the approach is to start experimenting. Cisco has a continual stream of such experiments going on in IT. One experiment has been multicast streaming video. Executives are watching to see the business value of this new technology to the various functional areas. For example, they have made all-company meetings available online to employees through IP TV. If this technology proves useful, it could be used for new-product training.

Breakthrough Strategy

Cisco views its development of a virtual supply chain as a breakthrough strategy. Of the 26 factories that build Cisco products, only 5 are owned by Cisco. Thus, the company's ability to sense and respond is not tied to capital assets. It is a function of their building an effective supply chain. Although not easy, they believe it is critical to their business. If their gamble on virtual manufacturing goes awry, it would present an enormous problem. However, they see it as worth the effort because the returns will be extremely high if they succeed.

Cisco takes its portfolio of IT projects and Internet initiatives so seriously that CEO John Chambers holds a review of leading Internet capabilities each quarter. At these reviews, each functional area describes how it is implementing Internet capabilities that are ahead of its peers in the industry. Most company CEOs do not make this effort, said Alexander. If they did, they would see spectacular returns, he believes. ■

Linkage Analysis Planning

Linkage analysis planning examines the links organizations have with one another with the goal of creating a strategy for utilizing electronic channels. This approach to strategic systems planning is espoused by Kenneth Primozic, Edward Primozic, and Joe Leben, in their book *Strategic Choices*.[14] The methodology includes the following three steps:

1. Define power relationships among the various players and stakeholders.
2. Map out the extended enterprise to include suppliers, buyers, and strategic partners.
3. Plan electronic channels to deliver the information component of products and services.

Define Power Relationships

To create a strategy for building electronic links among enterprises, Primozic's team believes that management must first understand the power relationships that currently exist among these various players. For this analysis, they begin with Michael Porter's[8] classic model of competitive forces. To this model, they add technology, demographics, global competition, government regulations, and "whatever is important in your environment." The goals of this step are to identify who has the power and determine future threats and opportunities for the company.

The analysis begins by identifying linkages, which are relationships the organization has with other entities. Figure 4-10 on page 163 is a good illustration. The links are represented by lines between organizations (shown in boxes). Once identified, management needs to determine who is managing each link. Oftentimes, no one is, which should be of concern. From here, the team picks the most important link and decides how the firm can control that link. The authors believe that successful organizations will be those that control the electronic channels or the electronic linkages among enterprises.

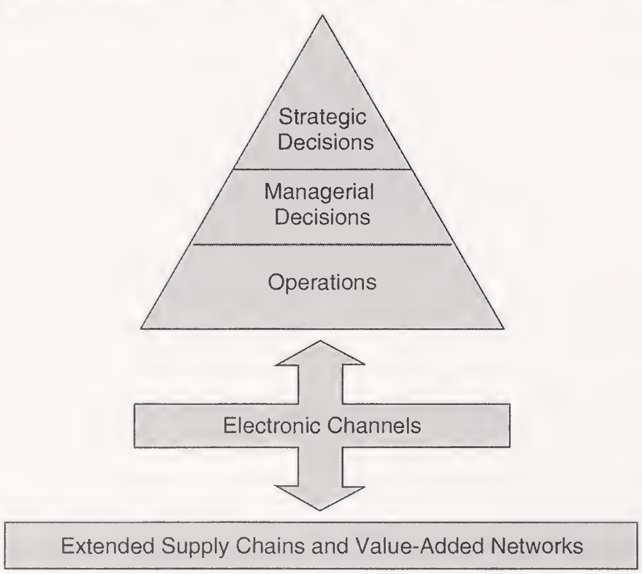
The discussion of how to gain power within one's world of linkages brings up a host of questions. Two important ones are: How might alliances with other firms across industries or even with competitors help us? How do we need to restructure ourselves to seize an opportunity or ward off a threat?

Map Out Your Extended Enterprise

These questions lead to the second step in this approach to planning—mapping the extended enterprise. An extended enterprise includes all of one's own organization plus those organizations with which one interacts, such as suppliers, buyers, government agencies, and so forth in the extended supply chains and value added networks (see Figure 4-9).

The purpose of this step is to get management to recognize the existence of this extended enterprise and then begin to manage the relationships in it. Primozic and

FIGURE 4-9 The Extended Enterprise



Source: Adapted from K. I. Primozic, E. A. Primozic, and J. F. Leben, *Strategic Choices: Supremacy, Survival, or Sayonara* (New York: McGraw-Hill, 1991).

colleagues believe successful managers will focus on extended enterprises. They see two fundamental principles to managing these relationships:

1. The enterprise's success depends on the relationships among everyone involved, which includes employees, managers, suppliers, alliances, distribution channels, and so forth.
2. Managing information as a strategic tool is crucial because some 70 percent of the final cost of goods and services is in their information content.

An extended enterprise diagram might deal only with external players, such as the government, stockholders, traditional competitors, the financial community, and so forth. Such a chart includes everyone whose decisions affect the organization or who are affected by its decisions. The analysis then moves to discussing how the links might change and how each link should be managed.

In the extended enterprise, each relationship will prosper only when it is win-win, say the authors. For example, in return for maintaining a buyer's parts inventory and providing just-in-time delivery, a supplier should be paid electronically upon delivery of goods. Such an arrangement profits both parties.

Competitive advantage will depend increasingly on being able to exploit the collective resources of one's extended enterprise, say Primozic and colleagues. Such enterprises often require electronic channels to execute business transactions, which leads to the third step in their planning approach—planning the electronic channels.

Plan Your Electronic Channels

An electronic channel is an electronic link used to create, distribute, and present information and knowledge as part of a product or service or as an ancillary good. These channels focus on the information component of products. The authors believe that those who control the electronic channels will be the winners because they will be able to address new niche markets as they arise. Furthermore, as use of IT leads to a faster-paced world, organizations with the longest electronic reach into their extended enterprise will have the advantage.

The authors use linkage analysis charts to help executives conceptualize the key issues they face in an extended enterprise and focus on the factors that are critical to their future success. This methodology has been used by the Electric Power Research Institute, whose story is told next.

CASE EXAMPLE

ELECTRIC POWER RESEARCH INSTITUTE

www.epri.com

Founded in 1973, the Electric Power Research Institute (EPRI), with headquarters in Palo Alto, California, is a large, private research firm serving members that collectively provides more than 90 percent of the electricity generated in the

(*Case Continued*)

United States. EPRI's 350 staff scientists and engineers manage some 1,600 R&D projects at any one time. The projects, which study such subjects as power generation, superconductivity, electronic and magnetic fields, and acid rain, are conducted by more than 400 utility, university, commercial, government, and other R&D contractors on behalf of the members.

The Challenge

EPRI's mission is to deliver the information and knowledge from its research projects to the 400,000 employees in the 768 member utilities to help them be more competitive. Management realized EPRI had to compress the "information float," the elapsed time from the availability of research findings to the use of those results in industry.

The institute was suffering from "info-sclerosis," the hardening and clogging of its information arteries. Due to the volume of research findings—gigabytes of information—moving information in and out of EPRI was extremely difficult. In addition, because of the documentation and publishing process, the results often were unavailable for up to 24 months, so the reports were not as timely as they could be. Nor were the results accessible, because they were in massive reports. Solving this information delivery challenge was critical to EPRI's survival.

The Vision

The vision was to assist members in exploiting EPRI's product—knowledge—as a strategic business resource, whenever and from wherever they choose. To accomplish this vision, EPRI built an electronic information and communication service.

As described by Marina Mann and her colleagues,[15] their delivery vehicle is EPRINET, an online channel that includes

- A natural-language front end for accessing online information
- Expert system-based products that contain the knowledge of their energy experts
- E-mail facilities for person-to-person communications
- Video conferencing to foster small-group communications

Using Linkage Analysis Planning

To focus the EPRINET effort and to identify the services and products that would offer strategic business advantages to members, EPRI used linkage analysis in a three-day workshop led by Kenneth Primozic. The workshop began with management stating that (1) EPRI was both an R&D organization and a knowledge provider and (2) the goal was to leverage knowledge as a strategic asset.

From this starting point, Primozic asked, "Who is linked to EPRI in creating and distributing knowledge?" The participants identified the co-creators as contractors, research firms, universities, the government, and technology firms. They identified the recipients as the utility industry, universities, research labs, government policies, and knowledge as capital—as shown in Figure 4-10. Each represented a link to EPRI; therefore, the group then studied the present and future power relationships in each buyer–seller link. During these discussions, they saw how some current customers, such as universities or research labs, could become future competitors and change the power relationship in a link.

Management's goal was to leverage knowledge, so the group listed all the

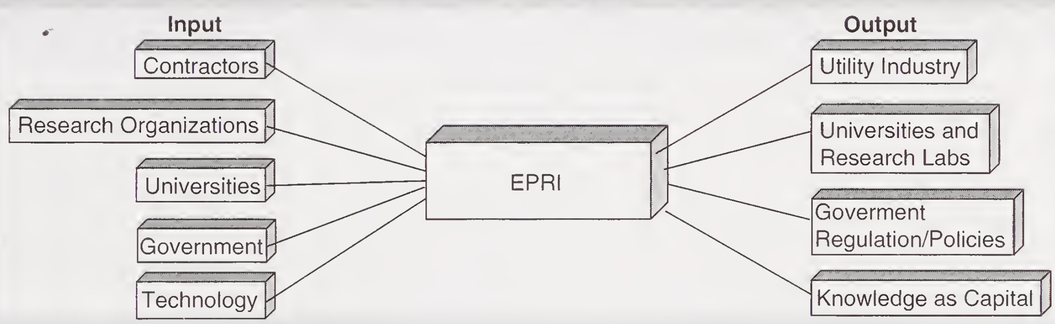
(*Case Continued*)

ways leverage could be achieved. Then they focused on the most important way, which turned out to be treating knowledge as capital. During this analysis, management defined the following CSFs for giving EPRINET a sustainable competitive advantage:

- Establish the right mix of product offerings, a mix that allows people to pick, choose, and combine at the lowest possible cost.
- Keep all customers in mind, including utility executives, research engineers, and operations people.
- Use IT—specifically expert systems and natural language—to make the system easy to use and access.
- Create a range of "knowledge packages" targeted to specific audiences.
- Establish a timely, reliable, secure global distribution channel.

Once EPRINET was made available, a marketing campaign began. The number of users has climbed steadily since. Frequent users report that the system is indeed broadening the number of people they can stay in contact with and allowing them to uncover EPRI research findings that they would not have found otherwise. ■

FIGURE 4-10 EPRI's Linkage Analysis



Source: M. M. Mann et al., "EPRINET: Leveraging Knowledge in the Electric Utility Industry," *MIS Quarterly*, September 1991, pp. 403–421.

Scenario Planning

The final strategic planning approach is scenario planning. Peter Schwartz, who has written the definitive book on scenario planning, *The Art of the Long View*,[16] states that scenarios, which get their name from the theatrical term for a script or a play, are stories about the way the world might be in the future. Such stories can help people spot and adapt to aspects of their lives that are actually changing today. They help people find appropriate paths to each of the plausible futures described in the scenarios.

The goal of scenario planning is not to predict the future (because that is hard to do), but to explore the forces that could cause different futures to take place and then decide on actions to take if those forces begin to materialize.

M. Lynne Markus[17] points out that long-term planning has traditionally extrapolated from the past and has not factored in low-probability events that could significantly alter trends. Thus, these straight-line projections have provided little help.

Markus identifies four steps in scenario planning:

1. ***Define a decision problem and time frame to bound the analysis.*** In thinking about the future of IS, for instance, IS management might ask, "How will IS be managed 10 years from now?" An individual IS employee might then ask, "What skills would I need to succeed in that organization, and what do I need to do to get those skills?"
2. ***Identify the major known trends that will affect the decision problem.*** Generally, scenario planners think about trends in categories: the business environment, government and regulations, societies and their concerns, technologies, financial considerations, the global environment, and such. Each trend is then judged by asking, "What impacts will this trend have on the decision problem?" "What are the directions of each impact?" Trends with unknown impacts or contradictory impacts are classified as "uncertain."
3. ***Identify just a few driving uncertainties.*** Driving uncertainties are those around which others tend to cluster. Often scenario analysts choose just two, with two possible states for each, leading to four scenarios. The goal is to explore quite different futures, not the most likely future, notes Markus.
4. ***Construct the scenarios.*** Each scenario, based on a driving uncertainty, needs to be plausible. To create this plausibility, scenario writers include a "triggering event," something that redirects the future into the desired space. For example, a triggering event could be a world event (the September 11, 2001, tragedy certainly qualifies), an action by a group (a major court decision), or a business event (the collapse of a large company). The scenarios depict the end state (at the selected point in time) and how that path was taken.

With these scenarios in hand, executives and planners then decide how well their current strategies would fare in each case. Then they ask, "Is there a better strategy, perhaps one that would cover more bases?" Also, they should determine what factors they should monitor closely to quickly spot changes in trends.

To give a brief glimpse of a scenario effort, here are four scenarios Markus created around the question, "What will in-house IS management look like in 10 years?"

CASE EXAMPLE

SCENARIOS ON THE FUTURE OF IS MANAGEMENT

The question M. Lynne Markus[17] pondered in developing her scenarios was, "What will IS management look like in 10 years?" In studying IT and IT industry trends, business management trends, and societal trends, she noted that a straight-line extrapolation of the trends would have all organizations acquiring their

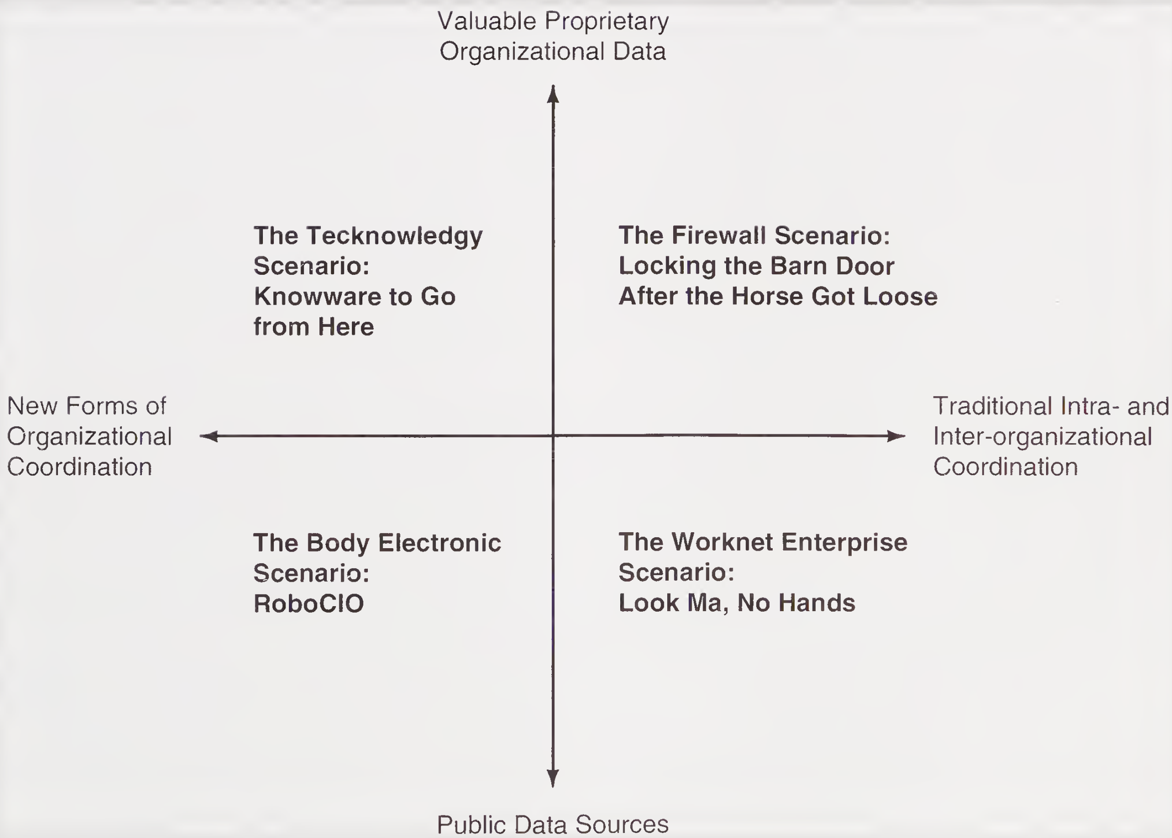
(*Case Continued*)

IT-enabled products and services from external providers through a variety of arrangements, including partnerships, long-term contracts, and spot transactions. To explore the future of IS management, she settled on two driving uncertainties:

- How will companies coordinate IT? Will they use traditional hierarchical coordination mechanisms or pooled organizational forms?
- How will companies manage their data or content? Will they benefit from managing their own proprietary data or will content be managed by fee-charging external service providers? These lead to four possible scenarios, as shown in Figure 4-11.

Scenario 1: The Firewall Scenario—Locking the Barn Door After the Horse Got Loose. Organizations maintain traditional arm's-length relationships with suppliers and customers, and they believe data is proprietary. After a defining event, in which several companies go out of business from crashes in their computer systems that bring their business to a standstill, corporate managements take a concerned look at their IT operations. Many take on a bunker mentality; their main concerns are security and control. If they outsource their infrastructure to

FIGURE 4-11 Four Scenarios on the Future of IS Management



Source: M. Lynne Markus, "The Futures of IT Management," *The Data Base for Advances in Information Systems*, Vol. 27, No. 4, 1996, pp. 68–84.

(*Case Continued*)

highly regarded outsourcers, they retain tight control over the vendors. All software is off-the-shelf and integrated by professional services firms. All data is housed in virtual bomb shelters. In essence, IS staff become general contractors and enforcement agencies.

Scenario 2: The Worknet Enterprise Scenario—Look Ma, No Hands. In this scenario, tough privacy legislation is enacted following highly publicized information leaks. Most companies then outsource data management to specialist service providers who comply with the new laws. However, the promised global network does not materialize, so companies cannot turn over their entire IT infrastructures to providers.

Companies continue their traditional arm's-length relationships with other firms, but they use IT to mediate workflows between organizations. The result is that competition shifts to networked value chains, called worknets. Within these worknets, data are shared, generally through service providers that run inter-enterprise software packages for the worknet. Thus most IS organizations have handed over their IT work to their worknet's technology consortium, significantly reducing the costs of interworking with these partners. These consortia, themselves, are like self-managing virtual IS departments, so the IS staff in the contracting firms are mainly either change agents or information brokers tasked with helping the business uncover new uses of IT and implementing them.

Scenario 3: The Body Electric Scenario—RoboCIO. The triggering events in this scenario are availability of cheap, integrated networking services, plug-and-play computing devices, and portable health and pension plans (due to new legislation). As a result, new forms of organizations flower and data are more likely shared than guarded. In general, people own parts of the small, independent work units (cells) in which they work. Some work under a corporate umbrella; but many are autonomous, combining to deliver goods or services and then disbanding.

The standards for the global IT infrastructure that allow this interworking were created by a global consortium, and vendors adhere to the recommendations. The result is a highly flexible plug-and-play network of interconnected service providers and their services, called Technoos. Cells do virtually no IT work themselves, but they do need to find appropriate IT products and services. This searching is fairly automated and is called "value questing." The other piece of IT work is "IT facilitation," which involves helping cells change how they work when they either form a new alliance or adapt to a new type of software that changes their processes. Specialists can offer both services or they can be handled in-house as part of other jobs.

Scenario 4: The Tecknowledgy Scenario—Knowware to Go from Here. The growth of the Internet and the Web lead to an open information society. Any kind of information is available, for a price. People specialize in having (or knowing how to get) certain kinds of knowledge. Various kinds of intellectual capital have different, well-publicized value. Companies organize themselves to best develop and share knowledge. Those that learn fastest and share best are the most successful.

Knowware (advanced groupware) flourishes because it helps people and

(*Case Continued*)

organizations share knowledge. In fact, knowware is the information technology most people use. It is part of organizational processes; it is how they work. Vendors maintain knowware, which handles administrative work as well, so few companies have IS departments. They rely fully on external providers. The downside is that changing knowware packages is unthinkable because the one that a company adopts forms the foundation of its business. Many jobs even require prior knowledge of the knowware product in use in a company. Thus, the main IS job within companies is facilitation, ensuring that knowledge processes are maintained and employees understand them. ■

CONCLUSION

Based on the successes and failures of past IS planning efforts, we see two necessary ingredients for good strategic planning efforts. One is that the plans must look toward the future. This point may seem obvious, but in turbulent times, the future is not likely to be an extrapolation of the past. Therefore, a successful planning effort needs to support "peering into an unknown future"—most likely in a sense-and-respond fashion. This future will undoubtedly impact us.

A second necessary ingredient is that IS planning must be intrinsic to business planning. This point may also seem obvious, but, again, unless the planning process specifically requires joint development, the systems plans may not be relevant because they do not align with corporate strategy. A misalignment is not so likely with the advent of Internet commerce, but it is also not yet natural in many companies.

In this chapter, we have described an approach to strategic systems planning and a number of the most popular techniques. No single technique is best, and no single one is the most widely used in business. In fact, many companies use a combination of tools because each deals with different aspects of planning. The main goal these days is to meld speed with flexibility. That goal can best be achieved by creating an overall strategic envelope and conducting short experiments within that envelope, moving quickly to broaden an experiment that proves successful. Sense-and-respond is the new strategy-making mode.

QUESTIONS AND EXERCISES

Review Questions

1. What are the primary differences between operational planning, tactical planning, and strategic planning?
2. Identify and describe several reasons why strategic systems planning is so difficult.
3. What assumptions in traditional strategy making no longer hold true?
4. What is a sense-and-respond approach to planning?

5. Describe Skandia Future Centers' 3G teams.
6. What is a strategic envelope?
7. Describe Shell Oil's action labs.
8. What is the main contribution of the stages of growth theory to IS planning?
9. What are critical success factors (CSFs)? How do they contribute to the systems planning process?
10. Describe Porter's five competitive forces.
11. Describe the components of Porter's value chain.
12. What is the evolution of ways companies use information to add value, according to Rayport and Sviokla?
13. Describe the four types of applications in the e-business value matrix.
14. Briefly describe the goal of linkage analysis planning. List the three steps involved in conducting such an analysis.
15. Briefly describe the four steps in scenario planning, as described by Markus.

Discussion Questions

1. Which of the frameworks for systems planning seem most useful to you? Why?
2. If you were in charge of systems planning for a small firm, what questions would you ask company officers to determine which planning approach(es) would be most appropriate?
3. In Chapter 2, we stated that strategies are out and visioning is in because no one can plan in turbulent times. This chapter states that planning is crucial. How would you reconcile these two viewpoints?

Exercises

1. Survey the current literature on systems planning. What other approaches or frameworks are not mentioned in this text? What automated products are available on the market to assist IS executives in the planning process?
2. Visit the CIO of a local organization. What planning process is used? What is the planning horizon? To what degree do the systems plans and the business plans relate to each other?
3. Create a simple information linkage analysis chart of your current personal relationships. Put yourself in the middle box and each relationship in its own box around you, with a line from you to each of them. Who has the power in each link? How might that power shift in the future? Which is the most important relationship to you? How could you make it more win-win?
4. Ask the CIO of a nearby company what electronic channels his or her firm has in place. Ask about the benefits both parties receive in each link.

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PART II

MANAGING THE ESSENTIAL TECHNOLOGIES IN THE DIGITAL ECONOMY

Part II—Chapters 5 through 8—focuses on infrastructure management, as shown in Figure P2-1. The purpose of this part is to present the technological underpinnings of a corporate IS operation and point out the major issues that must be addressed in order for it to be well managed.

Virtually all of today's business computer systems are distributed. Chapter 5 briefly describes the basic forms of distributed systems architectures and highlights key concepts of IT architecture and infrastructure from a management point of view.

Chapter 6 is about telecommunications, including the new infrastructure being built, how the telecommunications industry is transforming itself, the underpinnings of today's networks, the Internet, and the new frontier of wireless Internet access.

Whereas Chapters 5 and 6 deal with the structure of distributed systems, Chapter 7 deals with the content, or the information resources. These resources have been referred to as data. Increasingly, this content has context (making it information), intelligence, and actionability (making it knowledge), and is housed on the Web (content). Chapter 7 deals with three of these areas: data, information, and content. Knowledge is discussed in Chapter 13.

Finally, Chapter 8 explores operations, the day-to-day concerns of keeping elaborate, far-flung corporate distributed systems up and running. Back in the old days of centralized systems with mainframes and "dump" terminals, operations

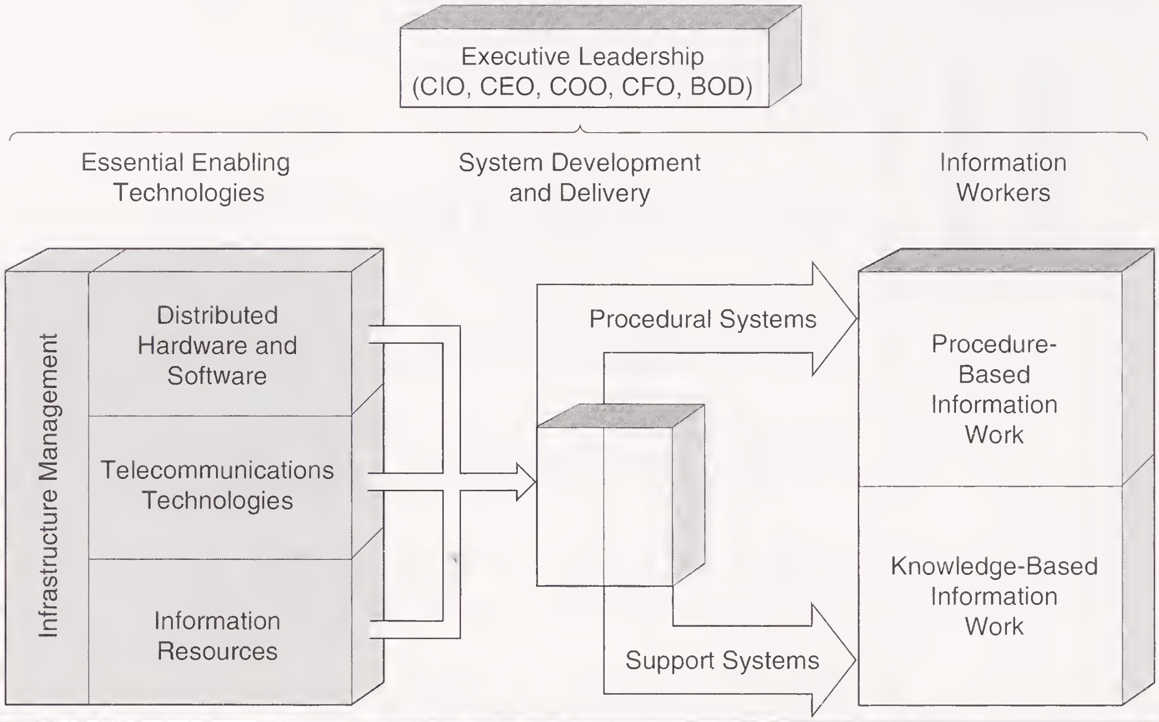


FIGURE P2-1 A Framework for IS Management

were pretty much taken for granted by non-IT people and housed in "the glass room." Today, corporate executives have major operational concerns around their IT infrastructure, including outsourcing, security, business continuity, and shrinking budgets.

CHAPTER

5

DESIGNING CORPORATE IT ARCHITECTURE

INTRODUCTION

Way back in 1964, Paul Baran at the Rand Corporation wrote a paper about distributed systems. At the time, computing meant mainframes and hardwired terminals; distributed systems were just theory. Driven by sophisticated computing needs of business users, distributed systems have today become the corporate architecture of choice, and oftentimes, by necessity, in an increasingly interconnected world. Thus, we begin this part—Part II, which deals with the essential technologies of computing—with a brief discussion of this important computing framework.

To start, we need to point out that the two terms, "architecture" and "infrastructure," are often used interchangeably, which can make discussions of distributed systems confusing. In this book, we make the following distinction:

> *An IT architecture is a blueprint. A blueprint shows how a system, house, vehicle, or product will look and how the parts interrelate. The more complex an item, the more important its architecture, so that the interrelationships among the components are well defined and understood.*
>
> *An IT infrastructure is the implementation of an architecture. In a city, the infrastructure includes its streets and street lighting, hospitals and schools, utilities, police and fire departments, and so on. In a corporation, the IT infrastructure includes the processors, software, databases, electronic links, and data centers, as well as the standards that ensure that the components seamlessly work together; the skills for managing the operation, and even some of the automatic electronic processes themselves.*

At the end of this chapter, we delve into both architecture and infrastructure in a bit more depth, after looking at the various kinds of distributed systems.

The Evolution of Distributed Systems

In the first IT architecture—mainframes doing batch processing—some data get inputted into "dumb" terminals and, after some remote processing, some output is sent to these "dumb" terminals. These "slave" user devices had no processing capabilities. All the processing was done by the "master" (the mainframe), and most were for corporate needs, such as payroll and billing. With the advent of minicomputers (a scaled-down version of the large mainframe), computers moved into departments, but the master–slave model persisted. Processing was centralized, although gradually distribution or sharing of processing among mainframes and minicomputers began to occur.

With the microcomputer, though, the model changed significantly because processing power moved first onto desktops, then into notebooks, and now into handhelds, game consoles, cell phones, and so on.

Throughout this evolution, stand-alone processors were gradually linked to other computers. As that happened, the notion of a distributed architecture developed. Thus, distributed systems are systems where the processing is spread over several computers. All large computer systems are typically distributed. This configuration brings many advantages:

- Increased processing power: Running many processors concurrently provides more computing power, with some processing used for managing them (e.g., grid computing, seti@home)

- Increasing access to large and geographically dispersed databases
- Resource sharing (e.g., e-mail servers, databases, high-performing printers)
- Scalability: The system can be upgraded or downgraded whenever needed (e.g., the World Wide Web)
- Fault tolerance: Errors in one part of the system do not necessarily affect other parts of the same system

The Internet has become the center of a worldwide distributed system. It is because of this global electronic infrastructure that the e-business revolution is taking place. The client-server concept of requesting services continues today and will be more important in the future as Web Services continue to develop, allowing a large number of service providers and an equally large number of service users to sell and buy processing and data over the Internet (as discussed later in this chapter).

To get a grounding in this important notion in computing, we now delve into the basic concepts of distributed systems.

ATTRIBUTES OF ENTERPRISE DISTRIBUTED SYSTEMS

The degree to which a system is distributed can be determined by answering four questions:

1. Where is the processing done?
2. How are the processors and other devices interconnected?
3. Where is the information stored?
4. What rules or standards are used?

Distributed Processing

This is a method to run a computer program with more than one processor located at different locations. The goal in distributed processing is to move the appropriate processing as close to the user as possible and to let other machines handle the work they do best. For example, when a travel agent uses his computer to book a flight that requires more than one airline, the ticket reservation system connects different airline computers together to set up the itinerary. The reservation process is made possible thanks to the simultaneous execution of the computers, likely with separate databases, according to a specific requirement of the customer.

Distributed processing requires interoperability, which is the capability for different machines using different operating systems on different networks to work together on tasks. Interoperability allows exchange of data and processes in standard ways without requiring changes in functionality or physical intervention.

Charlie Bachman, a pioneer in the database and distributed systems fields, pointed out that two major forms of interoperability are possible. One is the transparent communication between systems using system protocols. In this form, the systems decide when to interoperate. To use the Internet, companies have developed protocols for standard file and job transfers to permit this form of interoperability. The second form of interoperability is the interactive or two-way flow of messages between user applications. In this form, user applications can be activated by receiving messages; this activity, of course, is supported on the Internet.

Connectivity Among Processors

This type of connectivity means that each processor in a distributed system can send data and messages to any other processor through electronic communication links. A desirable structure for reliable distributed systems has at least two independent paths between any two nodes, enabling automatic alternate routing in case one node goes down. Planned redundancy of this type is critical for reliable operation. Such redundancy has not been implemented in many LANs, which is one reason they have been so fragile. It is, however, a major feature of the Internet as well as most corporate WANs.

Distributed Databases

In many situations, a central database might not be possible (e.g., proprietary data are owned by different organizations) or desired (e.g., maintenance and security). A distributed database is a database that is stored in more than one physical location. There are at least two ways to set up a distributed database. One divides a database and distributes its portions throughout a system without duplicating the data. Any portion is accessible from any node, subject to access authorization. Users do not need to know where a piece of data is located to access it, because the system knows where all data are stored.

The second type of distributed database stores the same data at several locations with one site containing the master file. Up-to-date synchronization of data is a significant problem in this approach, which is why it has not been the preferred way to distribute data.

An interesting development in this area is edge servers on the Web. An edge server is defined as being on the edge of the Internet, which means it is close to a set of users (such as a city). It holds a copy of an organization's Web site. Many edge servers, located strategically around the world, hold the same information. The edge server concept arose to accelerate Web page downloads to site visitors so they would not leave the site because they had to wait too long to see a page appear on their screen. Edge servers—essentially distributed databases—have become an integral part of the Internet.

Systemwide Rules

These rules mean that an operating discipline for the distributed system has been developed and is enforced at all times. These rules govern how distributed computing units communicate between them: How do processes get distributed between computers? What and how can data be exchanged? What are the operating procedures to ensure proper business processes or to warrant an acceptable level of security? Since the 1990s, these systemwide rules have been increasingly based on the open-system concept. Products using open standards can operate together in one or more distributed systems, such as the Internet. The initial idea was to avoid being locked into the proprietary products of one vendor or a few vendors. Generally speaking, the more complex the distributed system, the more complicated the rules.

In the 1980s, open systems referred mainly to telecommunication and meant that a company intended to implement products that followed the OSI (Open Systems Interconnection) Reference Model whenever they became available. At that time, OSI implementation was not a reality, just a target.

About 1990, the definition of open systems expanded to include operating systems, specifically UNIX, because it runs on more platforms than any other operating system and is not owned by any one company. At that time, UNIX was tentatively seen as appropriate for mainline business computing. Today, it is an important operating system for servers on the Internet. In business computing, it has gained a foothold, but it has not displaced proprietary operating systems, such as Microsoft's Windows.

At the same time, in the data world, open meant structured query language (SQL), the standard intermediary language for accessing relational databases. SQL remains the standard today.

In the early 1990s, the definition shifted to the interfaces between applications. Open meant standardized interfaces that would allow products to interoperate across multivendor networks, operating systems, and databases. Application Program Interfaces (APIs) came into being. They define the way data are presented to another component of a system—a machine, a database, even an e-mail system. APIs allow individual products to be innovative, yet connectable, and they have made writing distributed systems far easier.

Today, the term "open" includes the already mentioned definitions and stresses interconnectivity. In this realm, the OSI reference model remains the definition of open. Most people, however, are only familiar with its widest implementation: the network protocol used in the Internet, TCP/IP. Corporate networks, both LANs and WANs, now use TCP/IP to ease interconnection to the Internet.

An interesting twist on the term "open" hit critical mass not long ago. At the beginning, an open system allowed programmers to offer software for free (or for a small donation), which many did. This freeware has come to be called "open source," which means the source code can be downloaded by anyone and can be modified. (In purchased software, the code is compiled, thus undecipherable.) The open-source movement led to developers taking some freeware, improving it, and reposting it to the Internet. In the 1990s, Linus Torvalds offered his operating system, Linux, as open source; he has since gained a huge following. Developers around the world have contributed to it, improved it, and extended it. Because it is free, it is being used in a growing number of companies.

The term "open systems" keeps expanding because it truly is the crux of distributed systems, allowing products from multiple vendors to work together.

Although some people see the main reason for distributing systems as improving the use of computer resources, that is just technical interoperability, portability, and open software standards. The organizational impetus behind distributed systems is to move responsibility for computing resources to those who use them in an interconnected world.

Recently, many major vendors such as IBM and Hewlett-Packard have begun to adopt Linux as part of their overall sales strategy. With open-source software, these vendors pass on the savings to their customers, and concentrate on developing specific business solutions. This movement is critical to the computing world. First, it helps connect business computers faster and more cost effectively. Second, it will likely help speed up the necessity of finally having a "standardized" open source.

The next section briefly addresses the business reasons for distributing applications and the responsibilities that go with them.

CORPORATE POLICY FOR DISTRIBUTED COMPUTING

IS management needs a corporate policy for deciding when the development, operation, and maintenance of an application should be distributed. Individual end users and departments should not be left on their own to make these decisions, especially when enterprise connectivity and inter-enterprise connectivity are important. Although technical considerations are critical, the major reason for choosing a particular distributed system architecture hinges on: Who should make the key management operating decisions?

Decision-making responsibilities are being pushed down and out in organizations, with local sites and teams being given more autonomy and responsibility for the resources they use. Teamwork between IS management and business management is important in designing a distributed processing architecture that supports the business's goals.

Francis Wagner, a computing pioneer, once said he believes people perform best when they are responsible for their own mistakes. If they have no one to blame but themselves, then the quality of their performance increases. The result is a more effective use of corporate resources. Therefore, a driving force behind distributed processing is the desire to give more people more control over their work. This autonomy can happen at any of seven levels: ecosystem, company, division, site, department, team, or individual.

James Wetherbe[1] suggested asking the following three business questions before distributing IT functions and the responsibilities that go with them. Systems responsibilities can be distributed unless the following are true.

Are the Operations Interdependent?

When it is important for one operation to know what another is doing, those operations are interdependent; thus, their planning, software development, machine resources, and operations need to be centrally coordinated to synchronize their operation. Two industries in which interdependency is mission-critical are manufacturing and airlines, which is why they have continued to have large centralized systems even in this era of distributed systems.

Are the Businesses Really Homogeneous?

If the operations do not need to know what the others are doing, then many systems functions can be decentralized, unless the operations truly have a lot in common.

For example, in the fast-food business, each franchise has the same information-processing needs, which makes them homogeneous. But they do not need to know what the other is doing; thus, they are not interdependent. Under these circumstances, processing may be distributed, but planning, software development, and hardware selection should be centralized, to keep processing costs down and to more easily migrate to new systems.

Deciding whether the information processing in two parts of a business is truly homogeneous is not always obvious. For instance, not all retail chains are the same. One major retailer found that it needed to create two information systems for handling credit charges—one for its upscale stores and one for its discount stores. The needs of the two types of stores were so different that a single system would not suffice. However, corporate IS does control planning, which gives the retailer the ability to seize marketing opportunities quickly when it can reuse systems built by either operation. Many large organizations practice centralized planning for their distributed systems, but allow execution to be decentralized at the users' level.

Does the Corporate Culture Support Decentralization?

Even if the business units do quite different things and do not need to know what the others are doing, corporate culture might dictate that some functions be centralized.

Wetherbe cites the example of a large company with 60 widely diverse business units. Although it might appear logical for this company to distribute all functions, management chose to centralize finance, HR, and systems planning. They want to offer corporate-wide career opportunities with as little retraining as possible. With central staff doing systems planning and coordination, the company can more easily move people and reuse systems.

If none of these three criteria—interdependency, homogeneity, or corporate culture—forces centralization, each business unit can direct its own IT activity, with the central organization coordinating the plans.

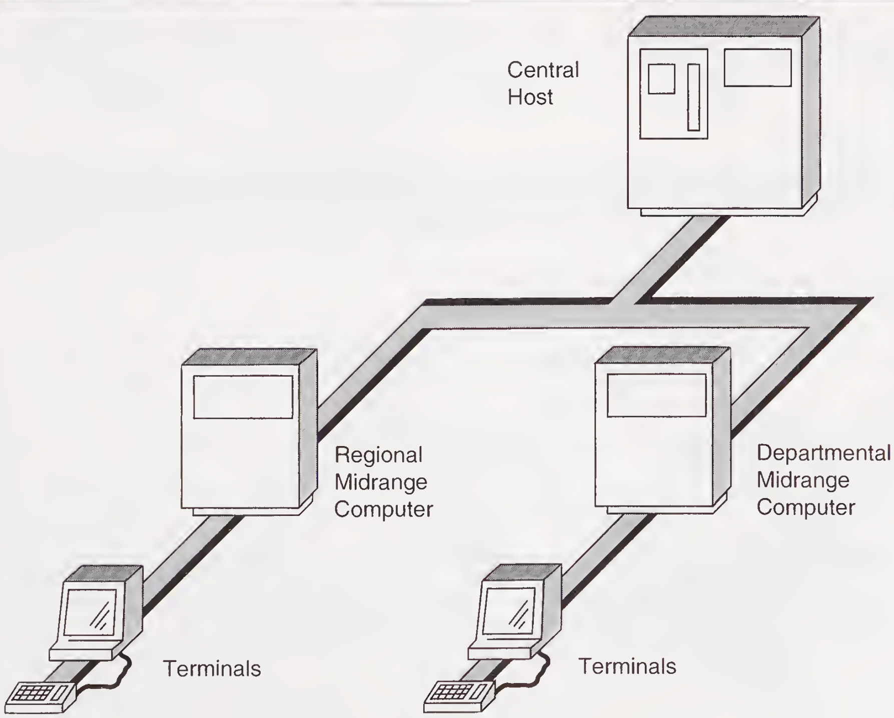
TYPES OF ENTERPRISE DISTRIBUTED SYSTEMS

As noted earlier, the distributed systems field has been continually evolving. The seven forms of distributed systems basically developed as follows.

Host-Based Hierarchy

A hierarchy of processors was the first distributed system structure. It was favored by mainframe vendors because the large host computer at the top controlled the terminals below. It is a master–slave relationship. More than one level of processor can be part of this hierarchy, as shown in Figure 5-1, with the total workload shared among them. The important characteristic of this structure is that the host computer is the central and controlling component. The other important characteristic is that the processing is done on the computers. The terminals are simply access (input/output) devices; they are designed to have no processing or data storage capabilities.

FIGURE 5-1 Host-Based Hierarchy



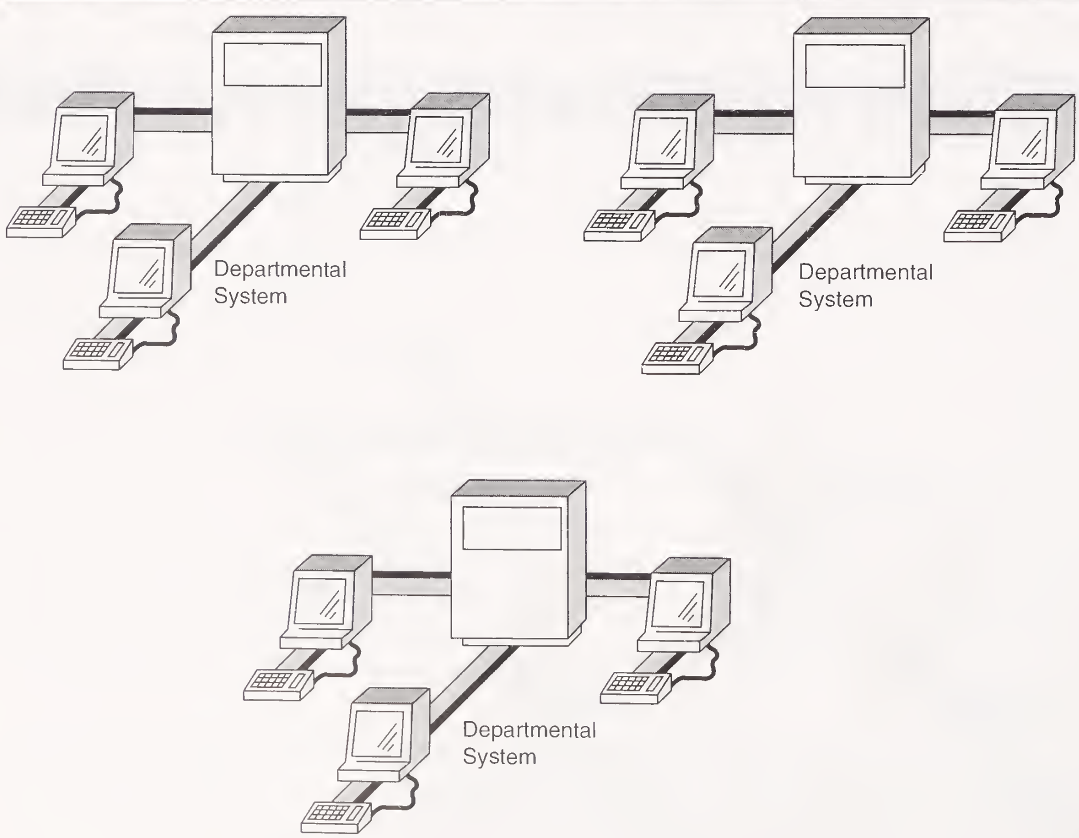
It is not always clear just where to store the data in such a system. One view is to centralize all data at the top level, such as at the headquarters. Another is to have the master records at the top but selected subsets at intermediate levels; the master records are then updated periodically and revised records are sent to the intermediate files. Still another view is to store master records where they are most used, and periodically provide updated records to the top for backup purposes. In any of these views, though, it is assumed that any processor can access any data record in the hierarchy, as long as it is authorized to do so.

In a private network or over the Internet, thin clients are diskless computers meant to obtain their applications from a server. They are an intriguing flashback to distributed computing, but they have two important distinctions from the terminals of old. One, they initiate requests; terminals of old did not. Two, they can do local processing; terminals could not. It is not the same master–slave relationship as with mainframes and terminals.

Decentralized Stand-Alone Systems

Decentralized stand-alone systems do not really form a distributed system at all. They are basically a holdover from the 1960s, when departments put in their own minicomputers with no intention of connecting them to the corporate host or to other departmental systems. Hence, they are decentralized, not distributed (see Figure 5-2). Over the years, many such "islands of computing" have been developed and are still in use. Their architecture is monolithic in that processing routines, data, and interface all

FIGURE 5-2 Decentralized Stand-Alone Systems



reside in the same system. They have been connected to allow a little data to flow, but this flow has been mostly upward to the corporate host.

Many IS professionals refer to these systems as legacy systems or antiquated systems. The business world in developed economies has a load full of legacy systems in large and well-established industries—banking, airline reservations, accounting. These systems are expensive to maintain; they are expensive to replace. Yet, they have run well and are still running. A short-term solution is to install new systems with backward compatibility. A long-term solution is to migrate them to an enterprise-wide system. A major goal in introducing ERP systems was to replace such disparate systems—in finance, manufacturing, administration—with a single platform of interconnectable modules to serve these various functions.

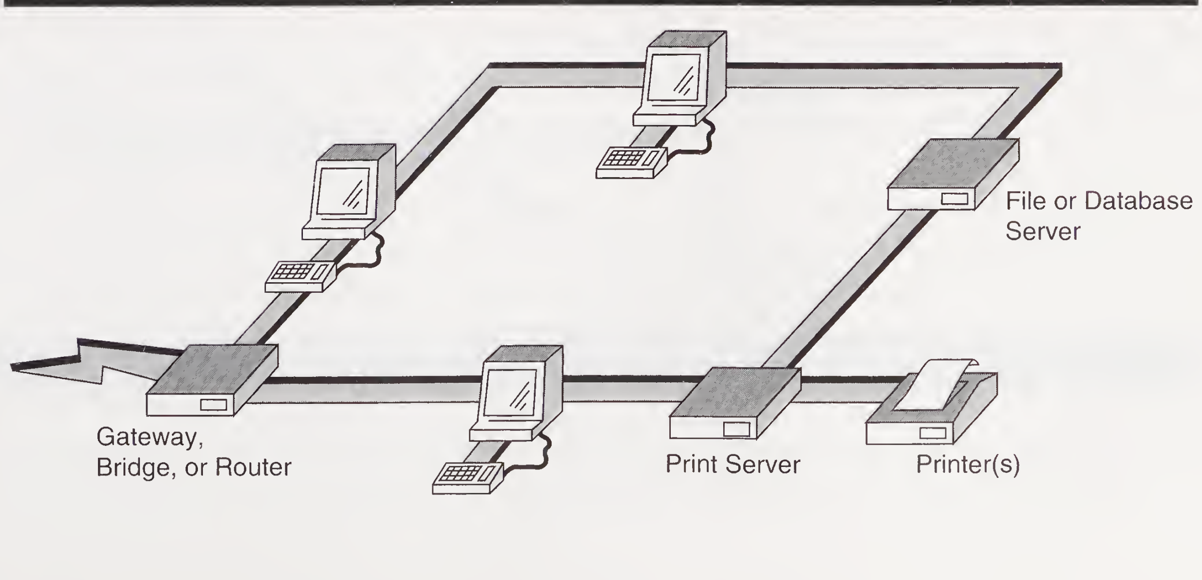
Peer-to-Peer LAN-Based Systems

Local Area Networks (LANs) have been the basis for distributed systems of desktop machines since the 1980s. This approach began in the office system arena with LANs providing the links between PCs, print servers, and gateways to other networks. Computers in peer-to-peer (P2P) networks typically have equivalent capabilities and responsibilities. This differs from client-server configuration, in which some computers are designed to serve the others. One type of P2P application is to have computing units situated physically near to each other and to run similar networking protocols and software. An example of this is when two PDAs try to exchange data on appointments or business addresses. As shown in Figure 5-3, this structure has no hierarchy or top-down dependencies. Another type of P2P application is data exchange using the Internet Protocol (IP). Perhaps the most popular form of P2P is file sharing. A new development in this area is peer-to-peer wireless LANs, as discussed in the next chapter.

Hybrid Enterprise-wide Systems

The typical structure of distributed systems today draws on these three forms of distributed systems, linking them via three kinds of networks: LANs, WANs, and the Internet. This system is illustrated in Figure 5-4. Today's distributed systems mix and match

FIGURE 5-3 Peer-to-Peer LAN-Based System



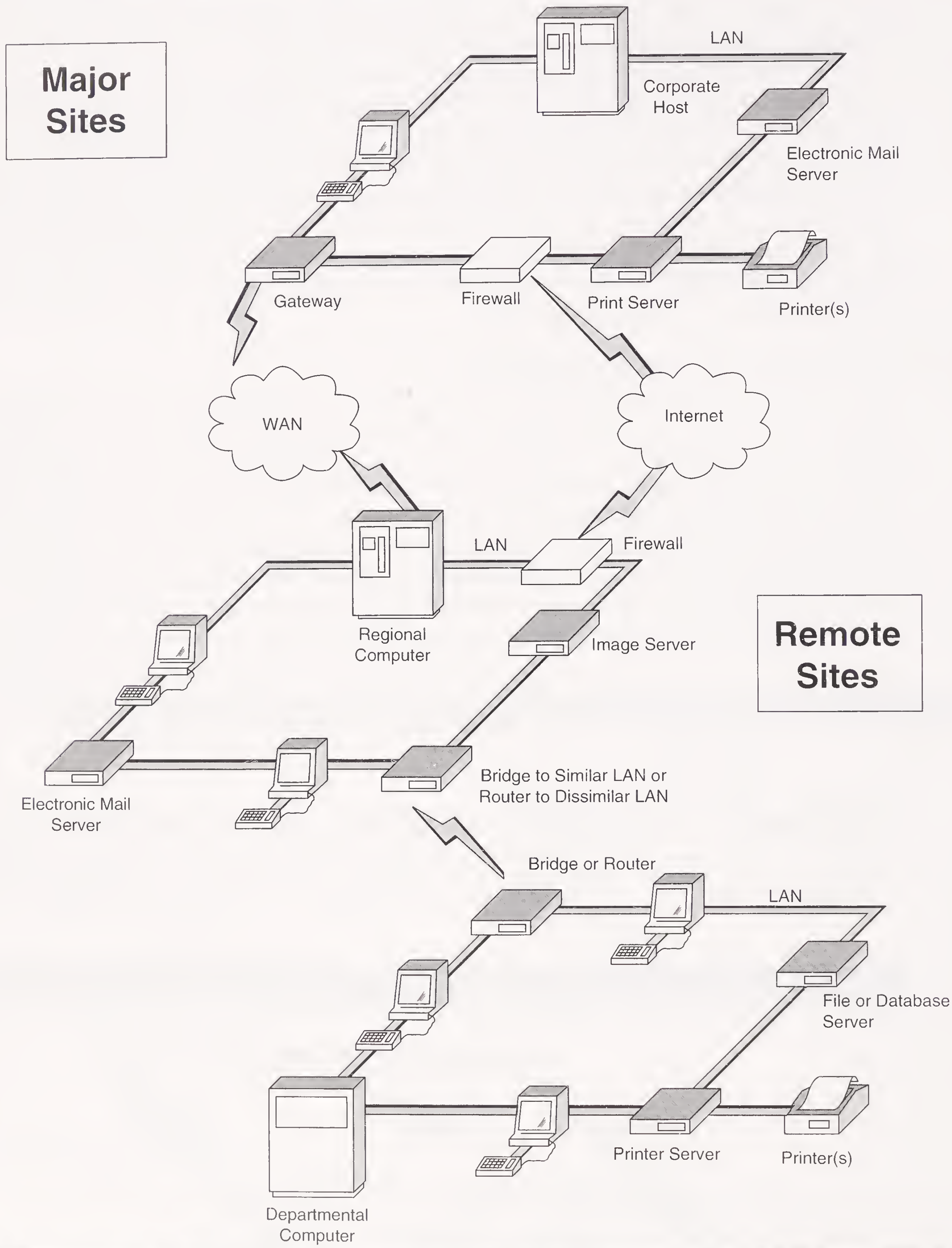


FIGURE 5-4 Hybrid Enterprise-wide System

hierarchical host-based processing favored for corporate and Web site computing with departmental processing favored by departments, such as manufacturing and engineering and the LAN-based systems used in offices. This hybrid structure is likely to be the structure of choice for many years as companies link their various islands of automation and increasingly link to systems in other organizations.

One important point is that this hybrid approach does not necessarily put all the machines under the aegis of a host mainframe computer. In fact, a number of companies have replaced their central computer altogether, dispersing applications to departmental machines and servers. A host computer is shown in Figure 5-4, but it is not the central control. For some applications, it could be the host; for others, it could be merely just another server.

A second important point is that this structure allows companies to automate business processes that span several functions within the organization or work cooperatively with systems in other enterprises. Inter-enterprise computing is the tenet of e-business. For example, Expedia.com links its B2C hotel booking system to its suppliers, allowing their customers to access a large selection of hotels.

Such cooperating processes allow companies to take advantage of specialized computer programs, while at the same time extending the usefulness of some legacy systems. The process of pulling together such individual applications or components is called system integration.

Client-Server Systems

In the 1990s client-server systems arose to take advantage of the processing capabilities of both host machines and PCs in the same system. Even though the host could handle huge databases and order processing, the PCs, laptops, and smaller devices could handle graphics, sound, and even video, which were important in some applications.

Client-server computing splits the computing workload between a client, which is a computer that makes a request, and a server, which answers the request. A request might be to print a document (handled by the print server on the LAN) or it could be a request for the gate number of one's soon-to-leave flight—a request sent by an Internet-enabled cell phone from a taxi and handled by the airline's Web site.

The most widely recognized depiction of client-server computing comes from Gartner EXP.[2] It shows the possibilities for splitting work between clients and servers, as illustrated in Figure 5-5.

The network presents the dividing line between what is housed on a client and what is housed on a server. The three components being split are the HCI (Human Computer Interface), Applications, and the Info-Management. Briefly, from left to right, the spectrum is as follows:

- Distributed Man-Machine Interface puts all the data, all the application software, and some of the presentation software on a server. Only part of the HCI is on the client. This approach is one way to leave a mainframe-based legacy system in place while updating user screens, making them graphical rather than character based, for example. This approach is also appropriate for wireless Web-based computing.
- Remote Man-Machine Interface puts all the software on the client machine but leaves the applications and information (data) on the remote server. This

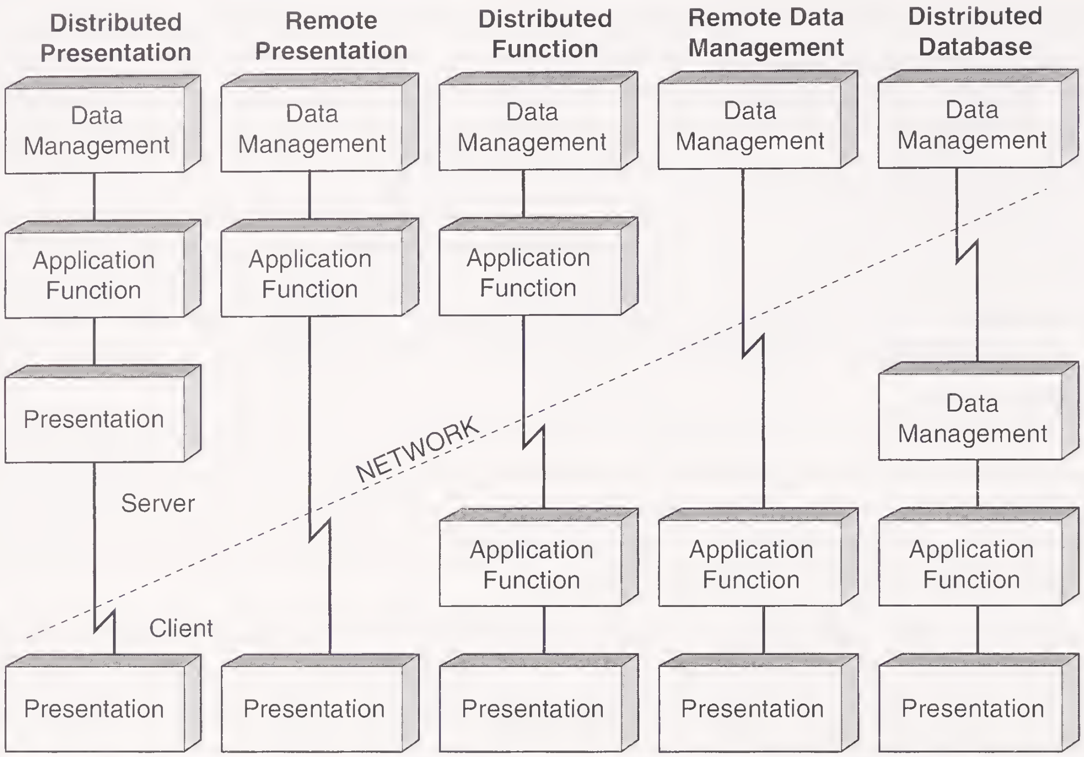


FIGURE 5-5 Client-Server Computing

Source: Adapted from Roger Woolfe, *Managing the Move to Client-Server*, Wentworth Research Program (now part of Gartner EXP, 56 Top Gallant, Stamford, CT 06904), January 1995.

approach also is a way to preserve a legacy system and simply update the interface it shows users. It has been used to put transaction processing behind Web sites.

- Distributed Business Applications function places all the software on the client, all the data on the server, and splits the application software between the client and the server. This option is quite complex, because splitting application processing between two machines requires coordination. However, it might be the most appropriate option for applications that run packaged software, such as spreadsheets or word processing, on a client in combination with corporate applications on a mainframe. It can also be appropriate for wireless computing and for major front-end applications, such as order entry, inventory inquiry, and so on. E-mail systems use this alternative: part of the processing on the client, part on the servers.
- Remote Information management places all software on the client, leaving only data and info management software on the server. This option is popular because it keeps all application software in one place (on a fat client) and takes advantage of the huge processing capacity of today's PCs. Although this solution is less complex, it has the disadvantage of requiring all the machines to be updated at the same time with a new release of the software. This level of coordination can be difficult unless all the machines are under a rigorous systems management system that routinely updates them when they connect to the corporate network.
- Distributed database places all presentation and application software as well as some of the data on the client. The remaining data are on the server. It is a complex solution, especially if the numerous databases are intended to remain

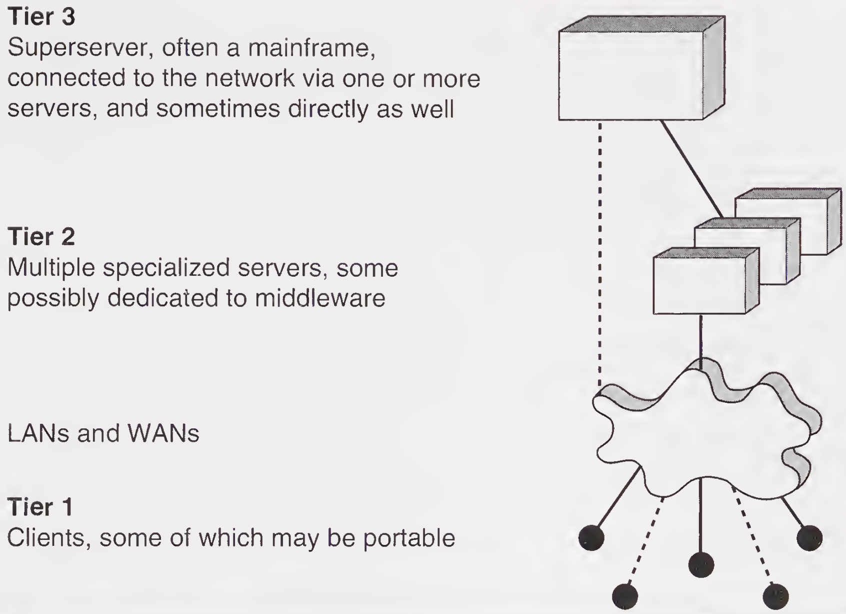


FIGURE 5-6 The Trend to Three-Tier Client-Server Arrangements

Source: Adapted from Roger Woolfe, *Managing the Move to Client-Server*, Wentworth Research Program (now part of Gartner EXP, 56 Top Gallant, Stamford, CT 06904), January 1995.

in sync. Even so, it is an important option used in mobile computing, where, for instance, each salesperson needs some data locally (probably the less dynamic data). Up-to-the-second data can be stored on the master database and accessed only when needed. This option also leads to fat client machines.

Another way to look at client-server systems is to view their architecture. The preferred architecture has been three tiered, notes Roger Woolfe.[2a] As Figure 5-6 shows, tier 3 is the high-performance server, perhaps a mainframe or a cluster of Web site servers. It can be connected directly to an in-house client-server network or it may be routed through tier 2 servers to the network. Companies have chosen this latter option to extend the life of their old-but-still-good legacy applications. Short-lived and fast-changing data, as well as corresponding integrity rules, are also stored at this high-performance server level so that the data can be shared.

Tier 2 is specialized servers. Data specific to departments or work groups are stored here, as are data that do not change often yet require rapid retrieval. Tier 2 also houses middleware, or software that eases connection between clients and servers. Middleware became an important concept in client-server systems because it performs translations between disparate systems. With middleware, a major application written for UNIX can be quickly set up to support Windows or Linux without needing to be rewritten.

Tier 1 is the end-user computing, connected via some sort of network.

The alternative is two-tiered architecture, consisting of only clients and servers or clients and a mainframe. The three-tiered architecture reduces client complexity by decreasing the number of interfaces that need to be accommodated by client machines. The drawback is that clients are more complex and access to tier 3 data is slower than to tier 2. Woolfe presents a case of a company that uses two of Gartner's client-server approaches in a three-tiered architecture. Here is that story.

CASE EXAMPLE

AN AEROSPACE COMPANY

A corporate enterprise systems group develops systems for use across the company. The group's goal is to never again build monolithic applications. Instead, it intends to build systems—even million-dollar systems—from off-the-shelf hardware and software components.

The Software

All the client-server systems use the same structure, with application code on the clients, data on the servers, and communication middleware shared between them. The software is written using object-oriented technology, and most of it comes from an object-oriented component library.

The Data

The heart of the architecture is a repository, which allows reuse of objects. The repository holds metadata: information about the data being used. This repository lets developers build sets of common data under the auspices of an enterprise master database, so data elements have common definitions. When in use, data are split between operational data in production systems and data warehouses, which are updated daily via replication software.

The Network

The network is an integral part of this architecture. Each company site typically has three components: desktop machines, servers, and one or more site hubs. Each of these components uses standard, plug-in equipment; thus, the architecture can be used anywhere in the world. To cope with the increased networking demands of client-server systems, the company is migrating from Ethernet to the higher-speed Asynchronous Transfer Mode (ATM) network. The conversion takes place at each site hub.

The applications communicate to a site hub (a gateway), which plugs into the public telephone network, forming a ring structure of ATM switches. The speed of the ring is 600 mbps. (See Figure 5-7.)

The Architecture

The client-server architecture is remote data management, to use the Gartner terminology.[2a] Data reside on servers, and applications reside on clients. The company chose this approach because it discovered that only 5 to 6 percent of the average PC is utilized. The company plans to use the remaining 94 to 95 percent of spare desktop capacity for application code.

The company also uses the distributed function approach, but only on a few complex systems, because this approach requires more effort than remote data management.

The distributed presentation and remote presentation approaches do not take full advantage of the spare PC capacity, so they are not used. The company also does not plan to use the distributed database approach, where databases are housed on client machines, because it is just too complex. The client machines must be polled to get the data,

(*Case Continued*)

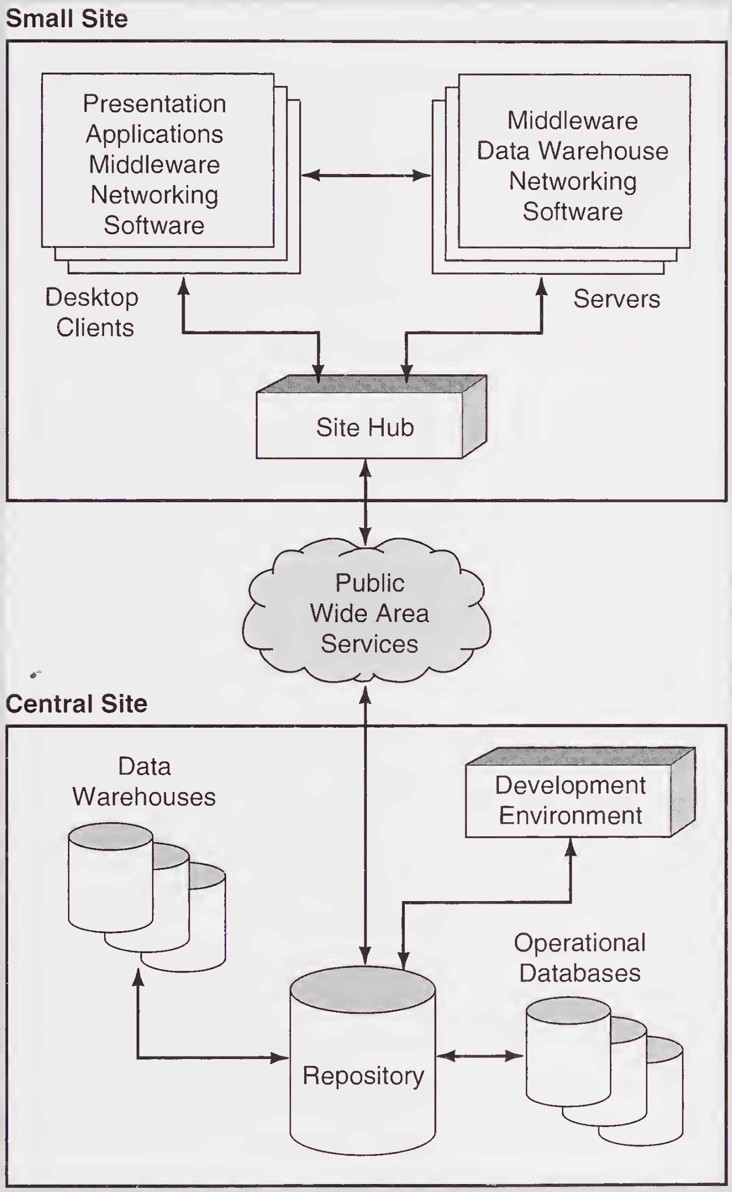


FIGURE 5-7 The Company's Distributed System Architecture

which is impractical except for highly structured workflow applications or conversation-oriented applications, such as IBM's Lotus Notes.

In short, the company uses the distributed function and remote data-management configurations because they minimize total costs. The company's migration strategy has been first to build the architecture and then to build applications using as many reusable components as possible. ■

Benefits of Client-Server Computing

The benefits of client-server computing are well known. The primary ones include the ability to distribute the computing and data storage workload between client workstations and shared servers, improved customized graphical interfaces for users, and increased overall system performance and, in certain situations, reduced cost thanks to scalability.

Retail chains have also used client-server systems to look into their stores to see what is selling, what is in inventory, and what is on order. Greater precision helps them keep less stock on hand and replenish inventory more on a just-in-time basis. It also lets them more closely watch the market and react to changes faster. Client-server computing has shifted the focus of computing from keeping track of the business to using information to fulfill strategic objectives.

Client-server computing also blended the autonomy of PCs with the systemwide rules and connectivity of traditional systems. This combination reversed the role of the host and PCs. Whereas the host was previously the focus of attention, in client-server computing, PCs are. This change shifted the focus of computing to end users, empowering employees, especially those who directly serve customers.

Client-server systems have also been used to streamline workflows by encouraging people to work together via networks, giving them powerful local processing power as well as access to other people and internal and external information.

Most powerfully of all, client-server computing supports new organizational structures via its connectivity. By providing a platform that supports individuals and groups who are geographically dispersed, it allows companies to experiment with dispersed work groups. In fact, experience with these technologies and their infrastructure enabled companies to more easily take advantage of the Internet. It is like a big client-server system.

However, client-server systems have not been lower in cost than mainframe systems (as first touted), because they entail so much coordination and maintenance. What initially looked like simple connections between clients and servers has turned into large, often fragile, complex systems. Although client-server systems are easier for end users to use, day-to-day management is more complex, due to the following situations: the operating system software is distributed to hundreds of individual machines rather than a single monolithic system; the workstations are geographically dispersed with a variety of nonstandardized hardware (from scanners to desktop printers) and controlled by individual departments. There could be some additional indirect costs as well: loss of worker's productivity and exposure to additional security-related risks.

Large businesses have tried automated tools to administer workstations from a central location. Updated software modules can be installed automatically when a user is authenticated by the central servers. Also, workstations can be configured to deal with a variety of security concerns.

On a global client-server computing platform, the client-server computing can lead to organizational turmoil as the adopting organization deals with cross-boundary data, flow and cultural differences between people using the same data. The biggest challenge for effective client-server computing is thus often organizational and cultural.

Internet-Based Computing

Internet-based computing can be depicted as simply a computer that interacts with other computing devices via the Internet. Initially, it was expected that network computers—with no hard disk, just a browser, memory, keyboard, and a modem—would access the

Internet. When a network computer needed to perform a function, it would get it from the Internet. The concept of desktop network computers has not taken off, but the concept of utilizing programs on the Internet has taken hold in the handheld world. The computer field distinguishes between fat clients (typical PCs loaded with all the programs) and thin clients (devices that utilize remote programs). The thin-client concept often applies to the retrieval of small programs (applets) off the Web that are written in Java, a programming language created specifically for the Internet.

To illustrate the versatility of Java-based computing, following is a case study from IBM's Web site.[3] IBM, like most vendors, has wholeheartedly embraced the integration of the Internet into business computing, using the Java language to do so. From a business perspective, Internet-based computing is the requisite for ubiquitous computing, offering new ways of doing business.

CASE EXAMPLE

IBM, NOKIA, AND SABRE: PERVASIVE COMPUTING

www.sabre.com; www.ibm.com; www.nokia.com

IBM has worked with the SABRE Group (the airline reservation company) and Nokia (the cell phone manufacturer) to create a real-time, interactive service delivered via cell phone using an open-standard, Wireless Application Protocol (WAP).

The service allows business travelers to not only receive updates from airlines (anytime, anyplace) but to even initiate changes. For example, if a meeting runs significantly over and the travelers realize they are going to miss their flight, they can request flight details using their Internet-enabled Nokia phone and make new travel arrangements. Travelers can also make or change hotel reservations, rental car reservations, and so forth. Likewise, if a flight is delayed or cancelled, the service notifies travelers so they can adjust their itineraries.

The service draws on SABRE's online corporate travel purchasing system and Nokia's server, which transmits the travel information to a wireless network and to its Internet-enabled phones. The service utilizes XML (eXtended Markup Language), a language that allows objects to be identified by type, which is important for constructing a user's Web site screen on-the-fly, custom-tailored to that user. It also uses Java, a language for writing small applets used to deliver applications over the Internet. In this case, SABRE is using Java to translate its travel information into XML. Finally, it is using Wireless Markup Language (WML), a language for presenting XML information to Internet-enabled devices. Nokia has created an Internet micro-browser with its WAP phone.

This application of pervasive computing also illustrates the benefits of technology integration to deliver new business solutions, and the necessity of inter-organizational collaboration. Each

(*Case Continued*)

of the three players brings to the table a unique set of technological and business expertises—Nokia with its leading role in the Internet-enabled mobile phone technology and the creation of the WAP open standard, Sabre Holdings with its software expertise in providing travel-related information and reservation, and IBM with its application development tools capable of transporting targeted information from the Sabre system to a highly condensed form that is sent to the mobile phone. The project also has allowed IBM to release a number of new software that dynamically translates Web information—including text and images—to a format readable on a variety of Internet appliances. With virtually all new cellular phones equipped with some form of Internet access, and new technologies (e.g., mobile IPv6, IPSec for security), the application described here is just one of many potentials of pervasive computing.

Server-Based Computing. Server-based computing can be seen as a thinner-client computing style that puts all processing back onto the servers where they can be managed centrally. With more and more employees carrying their offices with them on laptop computers, security and operational concerns have increased. Laptops do not have strong security features; updating them en masse is not easy, and even individual downloads can require help-desk support.

The solution companies are turning to is server-based computing, where applications and sensitive data reside on corporate servers rather than on the laptops. With server-based computing, applications can be securely accessed by any device, they can be updated directly on the server, and they do not have to be tailored to run on specific machines.[4]

As discussed earlier, the servers can be centrally managed, more securely, and implemented at a lower total cost than in a typical client-server configuration. However, there are fewer hidden costs in this architecture. This system design is appropriate for businesses that practice telecommuting or work-at-home when there is not much diversity in computing needs.

The following example illustrates server-based computing. ■

CASE EXAMPLE

3i

www.3i.com

Starting as a British company 60 years ago, 3i, which stands for "Investors In Industry," is today an international venture capital firm, with a $13.2 billion market capitalization. By 2007, 3i had expanded its activities to buyouts, growth capital, and venture capital. To expand beyond England, the company needed to

(*Case Continued*)

give its investment professionals anytime-anywhere access to its systems. With this access, staff members could conduct business and complete a deal on the spot with just a laptop and a modem. To permit such location-independent remote and mobile working with up-to-date information on users' laptops, 3i turned to server-based computing.

3i called on Specialist Computer Centre in England to create new data centers in the United Kingdom and elsewhere. These centers consist of Citrix application server software installed on Hewlett-Packard servers.

Remote employees dial in to one of the centers through a secure modem service, which uses both authentication to verify their identity and encryption to jumble the messages. Using Microsoft Windows terminal server software and Citrix software, the staff create their own virtual offices. They have secure access to 120 in-house applications, all of which are housed on a variety of devices. The sessions are managed by the Citrix software.

From the IS department's point of view, the applications are much easier to manage because the software is housed in one place. Thus, updates are made once and remote employees always use the latest version. If employees had the software on their machines, all laptops would need to be updated at once, which is a difficult task.

The arrangement has allowed 3i to expand globally and let its employees work wherever they happen to be. As of 2007, 3i had offices located in more than 14 countries. ■

Peer-to-Peer Computing

With P2P, tasks are distributed over a wide number of computers (peers) connected to the Internet. It is a grassroots movement, much like the open-source movement, but some corporations now take it seriously.

Perhaps the most controversial example of P2P was Napster, a central directory of music, and the PCs on which the music was located. Using Napster software, people could find music titles at the Napster site and then download that music from the listed PCs. Everyone swapped with everyone. Napster was infamous because the music industry contended it infringed on copyright laws by encouraging music piracy. It eventually closed down. Author Jeremy Rifkin[5] says that the Napster dispute goes to the heart of two economies: the "old" economy that is made up of buyers and sellers and the "e-economy" that has clients and servers. Beyond Napster, practical and useful business P2P applications include file sharing, rich media sharing, instant messaging, and simulation.

A typical P2P system resides on the edge of the Internet or in ad hoc network.

- ***Valuable externalities.*** Many resources are pooled together through extremely low-cost interoperability, making the whole or collective information base more valuable than the sum of its isolated parts.
- ***Lower cost of ownership and cost sharing.*** The cost of interoperabiity is extremely low by using existing infrastructure and minimizing maintenance cost (or cost transferring to users).

- ***Anonymity/privacy.*** A P2P system can be designed to offer peers a high degree of autonomous control over their data and resources. Conversely, security is a real concern.

The issue has been how to make money in the P2P environment. Rifkin believes subscriptions will replace sales. People will pay for access rather than for ownership. Why buy one CD when you can have unlimited access to a continually growing gigantic music collection for a month? In physical markets, physical property is purchased. In networks, access to experiences is purchased. When hyperspeed and continuous change are the norm, it makes less sense to own and more sense to subscribe.

Web Services

The forms of Internet-based computing just described could be considered first-generation Internet-based distributed systems. Web Services are said to be the second generation. The term refers to software modules that have a URL, that is, an Internet address, so that they can be called upon to perform their function (as a service) via the Internet.

Drawing on object-oriented tenets, a Web Service is a computer program that makes a request of another Web Service to perform its task (or set of tasks) and pass back the answer. Gottschalk et al.[6] call this the transactional Web, and they believe it will be dominated by program-to-program, business-to-business interactions. In essence, many Web Services calling upon each other form a highly distributed system. Such message-based systems will allow systems in one company to work with systems in many other companies without first having to hard code the links between each other. The firms can use software standards and communications protocols to make the interconnections.

Many technology experts predict that Web Services will be the ultimate form of market-driven distributed systems. Data-processing needs can be called upon on demand, and for an agreed-upon price, a sequence of Web Services can be put together to execute these needs. Traditionally, sequences of steps have had to be hardwired (preprogrammed) ahead of time. With the dynamic binding of Web Services, this decision can be made at execution time, making systems far more flexible. As such, the Internet becomes the hub of computing, which aims to ease inter-enterprise computing (something many enterprises want to avoid because of large infrastructure costs). Web Services can possibly release companies from having to build and maintain so much software in-house. The promise is that they can rent functionality via Web Services either on a subscription basis or as needed. Web Services will draw on existing systems.

Web Services can be used as a wrappering technology. Companies can wrap (encapsulate) some functionality from an existing application in an XML envelope and expose it for use by others by publishing its existence in a special directory. (Two new terms used in the Web Services world are "wrapping" and "exposing.") Thus, a bank with a credit authorization system can publish it as a Web Service that others can use, for a fee. Or a company that allows customers to configure their own product online (e.g., a computer, a bicycle, a car) may actually be using a Web Service (built in-house or obtained from a third party) to offer that functionality on their Web site to people or to the computers of, say, their largest customers.

Needless to say, vendors are now vying to be the providers of the platforms on which Web Services run. Companies are experimenting with Web Services, either to test out this loosely coupled, service-oriented architecture in-house or with a trusted trading partner.

Web Services Standards

The world of Web Services will be possible because of three software standards (XML, WSDL, and UDDI) and three communication protocols (SOAP, HTTP, and TCP/IP), note John Hagel and John Seely Brown of 12 Entrepreneuring.[7]

- ***XML (eXtended Markup Language).*** XML is a language for describing data in a standardized way so that different applications can use the same data. Web Services are created by wrapping XML around a piece of software that performs a function. The XML wrapper describes the services its bundle provides.
- ***WSDL (Web Services Definition Language).*** Web Services make themselves known by publishing their description in an XML document using WSDL. This service description describes the service, how to make a request to it, the data it needs to perform its work, and the results it will deliver. WSDL provides the standard language for creating these descriptions so that they can be understood by Web Services requestors.
- ***UDDI (Universal Discovery, Description, and Integration).*** The descriptions are stored in a UDDI registry, a "yellow pages" of Web Services. An application or a Web Service can find another Web Service by either knowing its URL or by searching UDDI repositories for services that meet the parameters it seeks.
- ***SOAP (Simple Object Access Protocol).*** Web Services communicate using SOAP, an XML-based communication protocol that works over any network and with any equipment. A Web Service interacts with another by sending a request for service to that other Web Service, "directly binding to it and invoking it," state Gottschalk et al.[6] The two do not have to be preprogrammed to work together. Web Services can be combined in any pattern of use.
- ***HTTP (Hypertext Transfer Protocol).*** Web sites have addresses that use the HTTP protocol. Web Services draw on this same protocol to indicate the address where they can be located.
- ***TCP/IP (Transmission Control Protocol/Internet Protocol).*** The Internet is true to its name; it is a network of networks because it uses a protocol that permits transmitting messages across networks. This protocol is TCP/IP, and it is the protocol used by Web Services as well.

The Significance of Web Services

Hagel and Brown,[8] two leading thinkers in the IT field, believe Web Services offer the computing architecture of the future, and thus will significantly change the job of CIOs. Rather than own and maintain their own systems, companies will buy their IT as services over the Internet. Thus, within the next few years, old assumptions about managing IT will be overturned.

Web Services offers a completely new IT architecture, one based on the Web and openness. Rather than build proprietary systems, companies can obtain the functionality they need from the Internet. Some Web Services will be proprietary, some public; some will be subscription based and others on demand.

Hagel and Brown see a three-tiered Web Services architecture:

1. Application services are the top tier. These perform specific business activities, such as credit card processing, shipment scheduling, or loan risk analysis.

2. The service grid is the middle tier. It provides utilities used by the application services. One type of utility is shared utilities, such as security utilities (to authenticate requestors and authorize access), and billing and payment utilities (to handle charges for using a Web Service). Another type of utility is service management utilities, which handle the management and billing of Web Services. Resource knowledge management utilities, a third type, provide directories and registrars for requestors and services to find one another and interact. Transport management utilities, a fourth type, handle messaging and transportation of files. Until this service grid is robust, though, companies will not use Web Services for their critical business activities because they will not have a trusted environment for running important systems.

3. Software standards and communication protocols (the six listed earlier) reside in the bottom tier. They provide the foundation for the utilities and the application services. Without these standards and protocols, Web Services cannot speak the same language nor connect.

To illustrate the potential of Web Services, consider a loan application. Rather than have one large, integrated, in-house application that handles all the steps in the loan approval and funding process, each step in a Web Services environment will be performed by a different Web Service. In fact, the Web Services will be so specialized that the most appropriate one can be chosen at each processing step in real time. Hence, the application data from a hospital will be sent to a Web Service specializing in risk analysis of hospital loans, whereas the data from a restaurant will be sent to the service that specializes in restaurant risk analysis. Each of these Web Services may draw on other specialized functionalities to do even more specialized processing, depending on the data in the application and the amount of the desired loan.

This feature permits the handling of a huge variety of possibilities by mixing and matching. In addition, it will allow easier cross-company system linking. As a result, companies only pay for the functionality they use when they use it, which reduces the number of IT assets companies need to house and maintain in-house. The providers handle the maintenance of their own services and are forced to stay abreast by the competitive nature of the Web Services marketplace.

Moving to Web Services will require organizational changes in IS. It will require the outsourcing of IT activities to providers (as they emerge) and the designing of their own Web Services offerings based on their enterprise's business acumen. Following is an example of what one enterprise is doing.

CASE EXAMPLE

GENERAL MOTORS

www.gm.com

General Motors formed eGM in 1999 to explore how it should interact with car buyers using the Internet. For three years, eGM was run by Mark Hogan, who gave innumerable speeches describing the progress his business unit was making. eGM was then folded into GM's IT organization and Hogan was promoted. Hagel and Brown point out that during his tenure at eGM, Hogan became a strong advocate of the Web Services architecture, going so far as to believe it could be used to move GM from its supply-driven, build-to-stock business model to a demand-driven, build-to-order business model. That change would be an enormous (some say impossible) feat.

eGM began modestly building Web sites to connect GM to both consumers and dealers. Moving to a demand-driven business model (where every vehicle is built for a specific customer after the customer orders it) would require GM and its 8,000 dealers to collaborate electronically and quite differently. There would be no way to shift the business this dramatically using conventional IT architectures because that would require standardizing the systems used by the dealers, which was too costly a task for GM and its dealers to consider.

However, Web Services provides a way to create such a new business platform without replacing the disparate systems the dealers use or trying to get them all to agree to standard new systems. By exposing existing (and new) functionality in both GM and dealer systems using the Web Services standards, GM can roll out new business processes incrementally at a reasonable cost.

GM began the evolution by first enhancing its existing supply-driven model, state Hagel and Brown, offering new functions via a Web Services architecture. For example, it offers a locate-to-order Web Service to dealers, which allows them to easily find a specific car a customer might want in the inventory of other GM dealers. Another Web Service is order-to-delivery, which shortens the time to deliver a custom-ordered vehicle. Through such incremental steps, GM "paves the way," state Hagel and Brown, to eventually convert to a make-to-order business model.

By taking this incremental route on this new platform, GM can achieve payback with each new Web Service, hopefully avoiding the huge disruption that an abrupt traditional system change would cause, and evolve as the Web Services model evolves. Economically, achieving this goal brings enormous paybacks, note the two authors. GM could cut its $25-billion inventory and working capital in half and potentially shave $1,000 off the cost of each vehicle. Furthermore, by gradually evolving new processes and adopting shared terminologies and meanings, GM and its dealers can influence their parts suppliers as well, fostering industry-wide change. ■

The seven systems discussed in this section are the different types of distributed systems that have emerged. To conclude this chapter, we come back around to the beginning of the chapter and discuss the subjects of architecture and infrastructure.

The Future of Distributed Computing

Perhaps one of the most futuristic trends of distributed computing is that it lays the foundation for a possible global intelligence. The architecture of a global intelligent network will undoubtedly be quite convoluted. Many business applications will increasingly depend on external sources of knowledge (e.g., data and processes). The global intelligence will be compartmentalized, with many independent components, separated from each other by business ownerships, privacy, and security-related interests. However, most of the building blocks of this global structure already exist: Communication protocols, collaborative filtering schemes, authentication algorithms, and computational economies will help the world's computing platform evolve into an interconnected source of digital intelligence.

DEFINING THE OVERALL IT ARCHITECTURE

An architecture is a blueprint. It shows how the overall system, house, vehicle, or other product will look and how the parts interrelate. As Roger Woolfe and Marcus Blosch note in their Gartner EXP report "IT Architecture Matters,"[2b] the intent of an IT architecture is to bring order to the otherwise chaotic world of IS by defining a set of guidelines and standards and then adhering to them. Designing a system architecture used to be considered strictly a technical issue. More and more, though, because the architecture needs to support how the company operates, it reflects the business strategy. Furthermore, as the business changes, the architecture needs to keep pace.

The Job of Chief Technology Officer

Due to the increased importance of IT architectures, the job title of chief technology officer (CTO) or chief architect has appeared. The CTO is generally the chief architect and reports to the CIO, who is in charge of the use of IT. In a few cases, CIOs have changed their title to CTO to emphasize their role as the technical head within their firm.

In the dot-com world, the title CTO was far more prevalent than CIO because these CTOs viewed CIOs as the executives who ran traditional IT organizations, including operations and maintenance. These CTOs preferred the title CTO to reflect their more strategic role as chief architect of the company's Web presence. Furthermore, most dot-coms began life outsourcing all or most of their IT operations, so the CTO title appeared more appropriate. The dot-coms that have survived, though, now have CIOs at the helm because the job has broadened beyond the architectural aspects of IT.

An Enterprise Architecture Framework

For more than 25 years, John Zachman,[8] an independent consultant, has been preaching the value of enterprise architecture and the modeling of data, processes, and networks. He offers one of the most comprehensive views of this subject we have seen, so we briefly describe it here.

The real world (an airplane, an enterprise, or a skyscraper) is so complicated that we cannot get our brain around it at one time, so we abstract out single concepts and variables. To completely describe an IS architecture, we need to look at the roles people play and the components they deal with. Together, these create the rows and columns of a framework.

The Rows: Planner, Owner, Designer, Builder, Subcontractor, and Consumer or User

No single architectural representation is available for an information system because building complex products requires six roles: planner, owner, designer, builder, subcontractor, and consumer: six perspectives, six models. For instance, an airframe manufacturer needs a statement of the objectives for the planner, an architect's drawings for the owner, an architect's plans for the designer, a contractor's plans for the builder, and detailed representations for the subcontractors. The completed airplane is the consumer's view. The same is true in IT. An information system needs a scope statement, a model of the enterprise, a model of the information system, a technology model, and a description of the components to produce the finished functioning system. These components make up the rows in Zachman's enterprise architecture framework, shown in Figure 5-8.

Each role has its own constraints. For instance, the owner is constrained by the use of the end product. The designer is constrained by physical laws. The builder is constrained by the state-of-the-art and the technology available. For these reasons,

FIGURE 5-8 An Architectural Framework

	DATA (WHAT)	FUNCTION (HOW)	NETWORK (WHERE)
Scope Planner			
Enterprise Model Owner			
Information System Model Designer			
Technology Model Builder			
Components Subcontractor			
Functioning System Consumer or User			

Source: Adapted from John Zachman, Zachman International, 2222 Foothill Blvd., Suite 337, LaCanada, CA 91011.

FIGURE 5-9 Enterprise Architecture—A Framework

	Data *What*	Function *How*	Network *Where*	People *Who*	Time *When*	Motivation *Why*
Objectives/ Scope (Contextual) *Planner*	List of things important to the business Entity = Class of business thing	List of processes the business performs Function = Class of business process	List of locations in which the business operates Node = Major business location	List of organizations/agents important to the business Agent = Class of agent	List of events significant to the business Time = Major business event	List of business goals/ strategies Ends/Means = Major bus goal/ critical success factor
Enterprise Model (Conceptual) *Owner*	e.g., Semantic model Ent = Business entity Reln = Business relationship	e.g., Business process model Proc = Business process I/O = Business resources	e.g., Logistics network Node = Business location Link = Business linkage	e.g., Organization chart Agent = Organization unit Work = Work product	e.g., Master schedule Time = Business event Cycle = Business cycle	e.g., Business plan End = Business objective Means = Business strategy
System Model (Logical) *Designer*	e.g., Data model Ent = Data entry Reln = Data relationship	e.g., "Application architecture" Proc = Application function I/O = User views	e.g., Distributed system architecture Node = I/S function (processor, storage, etc.) Link = Line characteristics	e.g., Human interface architecture Agent = Role Work = Deliverable	e.g., Processing structure Time = System event Cycle = Processing cycle	e.g., Knowledge architecture Ends = Criterion Means = Business rules
Technology Model (Physical) *Builder*	e.g., Data design Ent = Segment/Row/etc. Reln = Pointer/Key/etc.	e.g., System design Proc = Computer function I/O = Screen/Device formats	e.g., System architecture Node = Hardware/system software Link = Line specifications	e.g., Human/technology Interface Agent = User Work = Job	e.g., Control structure Time = Execute Cycle = Component cycle	e.g., Knowledge design Ends = Condition Means = Action
Detailed Represen-tations (out-of-context) *Sub-Contractor*	e.g., Data definition Ent = Field Reln = Address	e.g., Program Proc = Language stmt I/O = Control block	e.g., Network architecture Node = Addresses Link = Protocols	e.g., Security architecture Agent = Identity Work = "Transaction"	e.g., Timing definition Time = Interrupt Cycle = Machine cycle	e.g., Knowledge definition End = Subcondition Means = Step
Functioning System	e.g., Data	e.g., Function	e.g., Network	e.g., Organization	e.g., Schedule	e.g., Strategy

Source: Adapted from John Zachman, Zachman International, 2222 Foothill Blvd., Suite 337, LaCanada, CA 91011.

six models, rather than one, are needed, and they need to be kept in sync through configuration management.

The Columns: Data, Function, Network

Another significant factor is the lack of a single graphical representation for the components of a complex information system. As in engineering, systems need three components: data models (What is it made of?), functional models (How does it work?), and network models (Where are the components located?). These represent the physical manifestations of the system.

In addition, systems need a who (people), a when (time), and a why (motivation). These three elements represent the soft side of systems. Together, the six are all we need to know to build a complex system. So, the good news is that defining an enterprise architecture is not an infinite problem. The bad news is only a few might have done it. The entire enterprise architecture framework is shown in Figure 5-9.

Using the Framework

The cells in the framework contain models that can be used to describe any complex thing—an enterprise, an airplane, even a bicycle. All of these models exist; the question is whether an enterprise spends the time to make them explicit.

For instance, your organization has a data model, whether it has been explicitly defined or whether it just grew haphazardly without an underlying design. That model is intended to work as your enterprise works. A problem occurs, though, when IT or users bring in a package that follows a different data model. If the rules in that model are inconsistent with the rules in your company, you will either spend a lot fixing the package, says Zachman, or you will require people to change how they work to be consistent with the package. Models are important because they allow people to properly evaluate packages. They also help builders align with what owners want. And they can help companies realize what changes need to be made when they move to a new business model, such as deciding to reorganize around customer groups rather than around products.

The most important reason to make a firm's enterprise system architecture explicit is to be able to make changes to the enterprise and not disintegrate as those changes are made.

To better understand IT architecture development, consider the case of FMC, noted in Woolfe and Blosch's Gartner EXP report.[2b]

CASE EXAMPLE

FMC CORPORATION

www.fmc.com

FMC, with headquarters in Philadelphia, Pennsylvania, is a global $2.3-billion chemical manufacturer with 5,000 employees focusing on three areas: agricultural, industrial, and specialty chemicals. It is first or second in the areas in which it competes, and half its sales come from outside the United States.

(*Case Continued*)

In 2000, FMC was a $4-billion conglomerate. In 2001, it split into two equal halves: FMC (to focus purely on chemicals) and FMC Technologies. IS spent all of 2001 pulling the IT architecture apart. The deadline for establishing separate IS operations was January 1, 2002.

Designing Two New IT Architectures

FMC outsources its telecommunications, data networking, voice mail, Web hosting, virtual private networks, remote access, and some data-center operations. It worked with its outsourcers to pull the infrastructure apart and designed two two new IT architecture infrastructures. Headquarters was moved from Chicago to Philadelphia, yet no IS staff moved; FMC now has 130 IS headquarters staff.

The CIO, Ed Flynn, created a new position to report directly to him: Architecture and Technology Director. During 2001, this director had a virtual organization. He led five subteams—data, applications, integration, desktop, and platform—each with five to six team members from FMC and FMC Technology IS staffs. In addition, he supervised an emerging technologies subteam to look out into the future. None of the team members was full-time on a team; they also had their day-to-day jobs.

The five teams' tasks were to

- Describe the "today architecture" (inventory their area)
- Define the "tomorrow architecture" (how their area would look on January 1, 2002)
- Detail the "next-minute steps" (how to get from today to tomorrow)

They accomplished their task in 2001 with only a few transition service agreements on January 1 (where FMC and FMC Technologies would buy services from one another).

Lessons from the Work

"The split taught us we could get workable solutions by having subteams with subject matter experts define the technical architecture, and overlay them with an architecture steering team to add the enterprise and business viewpoints," says Flynn. The top team consisted of Flynn and some of his direct staff members. They implemented some of the recommendations from the subteams and took those requiring corporate action to senior management.

Another lesson from the effort was that the "today architecture" can be created by IS staff. However, it then needs to be put into a framework the business folks can understand, because they need to help define the "tomorrow architecture." Then the work continues as a joint effort to define the "next-minute steps."

"Before the split, we had already standardized on SAP as our transaction backbone and on Windows for our desktops and laptops. But getting those standards was a brutal fight—probably because we were our own worst enemy. We had not defined 'tomorrow,' so everyone's 'today' answer would work," says Flynn.

"When we have a tomorrow architecture, and everyone agrees on it, we have fewer next-minute battles because the architecture limits the choices. We saw this happen in the corporate split. Once we agreed on the tomorrow architecture, we were no longer the people who said 'no.' Being a purely chemical company now also helps us with standardization," says Flynn.

(*Case Continued*)

Because the chemical business is so cost competitive, FMC wants low-cost IT; therefore, the operating policy is to use common tools, common processes, and replicable solutions. "You have to architect to be able to do that," says Flynn.

Designing the "Tomorrow" IT Architecture

Flynn's organization is now using the same approach, starting with a clean slate, to architect a new tomorrow IT architecture. If they can pull the corporate architecture apart in one year, they believe they should be able to lay out a new tomorrow architecture in a year, even though the scope is broader. The new architecture will include applications in the operating units to include Voice-over-IP and Web Services.

The organization for the current architecture effort is the same as the one used for the split—the same subteams, the same steering committee. In fact, some of the business folks who helped support SAP after implementation in the mid-1990s stayed in IS and have been on the architecture efforts, bringing their business knowledge with them.

Once the new architecture is defined and bought off by senior management, it will be communicated and implemented via FMC's capital planning process. The expenditures must track the defined next-minute steps, some of which could have time frames attached to them. "We may even get to the level where we talk about standards, and all purchases will have to adhere to these standards," says Flynn.

Flynn envisions this rearchitecting process as being ongoing. Each new effort will start with today as its reference point, draw on the work of the emerging technologies group to peer into the future, and create a new "tomorrow" architecture. ■

Service-Oriented Architecture

As noted, the importance of an architecture is that it spells out the relationships among the components of an airplane, bicycle, building, system, and such. In information systems, the architecture spells out how the software components interact with each other. In the past, these interactions have been hard coded point-to-point (one to another); this is efficient, but costly to maintain. Changing one component might require changing the others that interact with it.

An emerging system architecture has caught the attention of the field because it moves these interactions away from being hard coded and point-to-point: Service-Oriented Architecture (SOA). SOA is a form of distributed computing and modular programming. Its fundamentals parallels that of Web Services because it uses the same architectural concept and it can be implemented with Web Services.[9]

Rather than think about how to get information out of one system and into another, this architecture thinks about how to expose the data and functions in a way that other systems can easily use—as a service in a wrapper with a well-defined interface that performs a business process. The wrapping hides the technical complexities developers have had to incorporate in their point-to-point interfaces. Ideally, one service would open a new account, another would update a customer account, a third would close an account, and so on. Applications that needed to provide one of these services would use the existing one, rather than their own version.

The current thinking is that an SOA might finally allow IT developers to create reusable code, which has long eluded IS organizations. The goal is to be able to quickly assemble a large set of software modules or functionalities, arranging them in such a way that they meet the needs of ad hoc applications.

An additional benefit of this architecture is that CIOs can leverage their past systems investments, because functions in legacy systems can be exposed as services and then used in new applications. Thus, SOA supports the integration of heterogeneous systems, which has bedeviled IS organizations for years. SOAs also can help CIOs converse with their business peers because the services are essentially business processes, rather than IT services. Discussions about systems are about the business, rather than the technology.

SOA also addresses the need for IS organizations to be more agile, that is, able to more quickly build systems to address new business needs. Each service can be upgraded to use a new technology without affecting the other services. Companies can build on the systems they already have and continually upgrade either technologies or the use of SOA piecemeal, rather than in one fell swoop. In short, SOA is evolutionary, not revolutionary. That is why it is attracting so much attention.

To briefly delve into the jargon, to achieve the much-desired code reusability an SOA must support loosely coupled, coarse-grained, standards-based interactions. This means, first, that a requestor of a service must simply know where to find it (loose coupling) rather than have a preprogrammed link to it (tight coupling). Second, the interactions must be at the business-service level (coarse grained), rather than at the technical-function level (fine grained). And third, the interactions must use interfaces based on industry standards that have been adopted by vendors so that they work across proprietary platforms (standards based).

An SOA can achieve loose coupling between services in several ways. The most recent is to create the services using Web Services protocols (discussed earlier). Although CIOs may eventually migrate to this option, Web Services is still so new that the pioneers have generally not taken this route. A second alternative is to use a publish-and-subscribe approach, which is what Delta Air Lines has done (see Chapter 11). A third is to implement messaging-and-integration middleware. Credit Suisse has used the concept of an "information bus" to build its SOA.

CASE EXAMPLE

CREDIT SUISSE

www.credit-suisse.com

Credit Suisse, with headquarters in Zurich, Switzerland, is a global financial services company with 45,000 employees operating in 50 countries. With the CIO as a Group Board member, Credit Suisse has pioneered the implementation of enterprise-wide SOAs. Its former architecture depended on proprietary middle-

(*Case Continued*)

ware. Maintenance had become increasingly expensive, because as the number of computing platforms and technologies grew, so did the number of interfaces and the amount of time needed to change the interfaces when applications changed. To address this maintenance problem, Credit Suisse revamped its IT infrastructure to be a service-oriented architecture by implementing two "information buses"—a service bus and an event bus.

The Service Bus

The front-end bus, that is, the bus that integrates front-end and back-end applications, is the service bus. The architecture uses Orbix from Iona Technologies, which is a set of tools for integrating applications that run on mainframes, Unix, and Windows platforms.[10] Through Orbix, Credit Suisse is reusing business procedures, business logic, and data formerly locked up in its applications.

The service bus takes a request–reply approach. Through Orbix, each business service is exposed by being stored in a central repository. When a front-end application has a request, it triggers a call to Orbix, which sends the request to the appropriate business service and waits for a reply (from a back-end application), which it then forwards to the requesting application. Thus, the bus uses a demand-pull model—the request from one application pulls the reply from another.

Credit Suisse took this approach so that it could integrate the software functions housed in the multiple generations of technology it has in-house, by presenting its core business applications as a collection of reusable business services. The SOA gives it a way to design new applications that draw on these business services using a documented interface. Because of the interface, developers do not need to worry about the software or database underlying each business service.

The Event Bus

The event bus integrates the back-end systems. It also uses a service-oriented architecture, but it uses a supply-push mode of operation, implemented using publish-and-subscribe. When an event occurs in one system, it is "published." All of the systems that need to know about that event are "subscribed" and are notified of the event that has taken place (the update is pushed to them). An event is a change in the state of an object, such as a customer. Credit Suisse has developed specific message types to run over the event bus; each is for a different type of event. The purpose of the event bus is to ensure that all systems are using the same up-to-date data. It connects all back-end systems: host applications, ERP systems, new nonhost applications, databases, data warehouses, and external data feeds.

A typical use of the event bus is to replicate the data in Credit Suisse's customer information file from its legacy application (developed in-house) and to copy it to a trading application that stores its own copy of these data. The event bus also allows Credit Suisse to transform the data between applications (that is, convert it from the format used in one system to that used in another) and to route data based on their content. The event bus was built using IBM technologies (Websphere MQ/Integration Broker).

Benefits

The SOA effort began in 1999. By the end of the year, Credit Suisse had five SOA-based applications drawing on 35 business services that were being used by

(Case Continued)

800 users. The numbers have grown since then. Two years later, it had 50 applications running on the information bus, drawing on 500 business services and being used by 15,000 internal users. In addition, customers using Credit Suisse's online trading and Web-based e-banking applications generated some 15 million invocations of the SOA-based business services each week.

Soon after, well over 100 applications were using 800 services, invoking 800 million transactions per year on the service bus. Actually, it is no longer quite clear what an application is, but these figures give a feel for the high processing volumes. The event bus, implemented in 2003, integrates over 32 back-end systems and handles over 1 million messages a day.

Credit Suisse was able to implement the architecture without disrupting applications. The effort was a major investment, but the company can now implement new applications much faster. In fact, it has found that some 80 percent of the business services needed in new applications are already in existing applications. Credit Suisse believes its development speed allows it to respond to customers' requests for new financial services faster than its competition. ■

INTER-ORGANIZATIONAL IT ARCHITECTURE AND DIGITAL SOCIETY

Peter Weill and Marianne Broadbent[11] describe the structure of the IT infrastructure; how local, firmwide, and public infrastructures mesh; and the different ways companies justify infrastructure investments. Such investments are a vital part of corporate IT portfolios, yet they are the most difficult to cost-justify beforehand and to measure benefits of afterwards.

The Structure of the IT Infrastructure

Weill and Broadbent define IT infrastructure as "the shared and reliable services that provide the foundation for the enterprise IT portfolio." The shared characteristic differentiates an IT infrastructure from IT investments used by just one function. On top of this infrastructure sit applications that perform the business's processes. Thus, infrastructure does not provide direct business performance benefits. Rather, it enables other systems that do yield business benefits, which is what makes infrastructure so difficult to cost-justify.

Weill and Broadbent divide the IT infrastructure into four layers, as shown in Figure 5-10, underlying local applications. Local applications are fast changing. They include such applications as an insurance claims system, a bank loan system, or a customer service support system. Due to their fast-changing nature, they are not part of the infrastructure, but they do draw on it.

It is easiest to understand their view of infrastructure reading from bottom to top because that order describes it from the technologists' point of view to the business users' point of view. Weill and Michael Vitale,[12] of the Australian Graduate School of

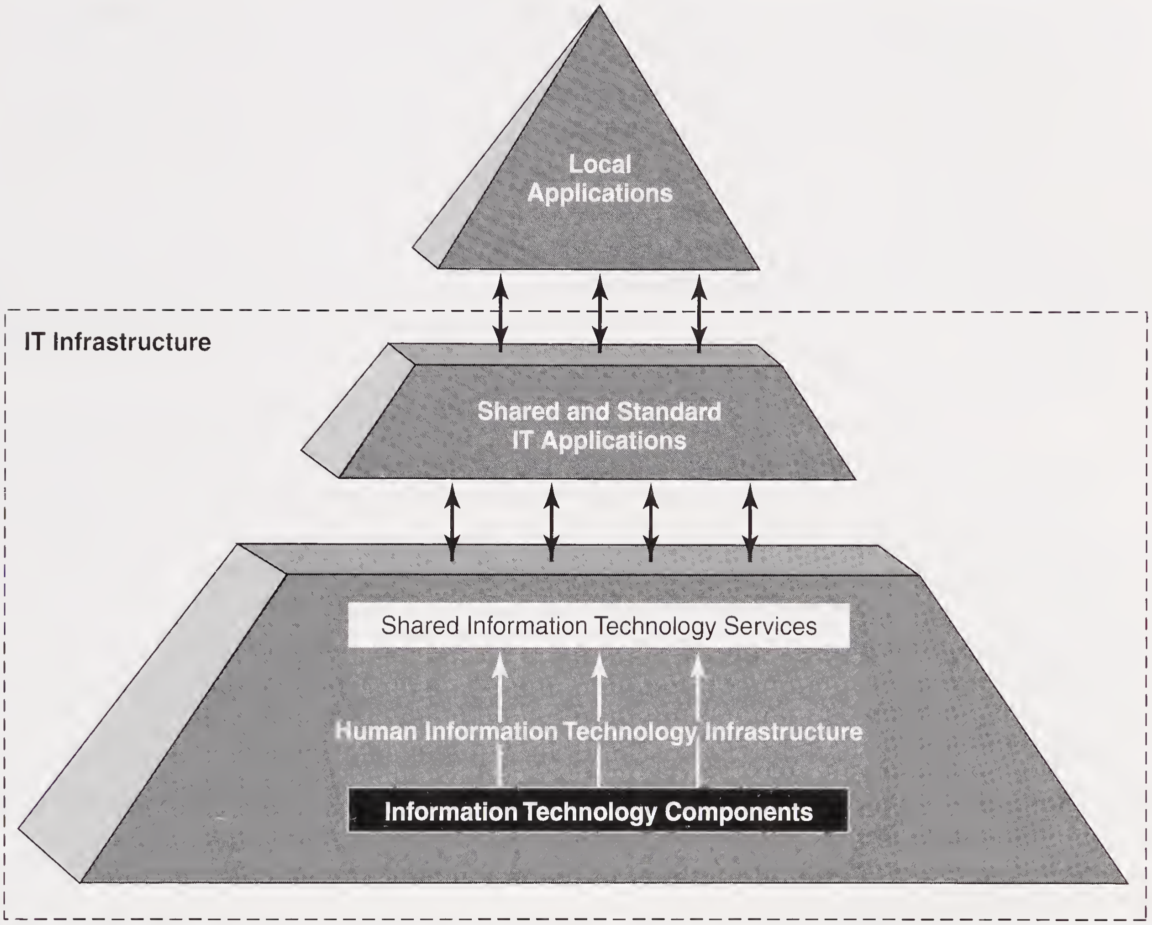


FIGURE 5-10 The Structure of the IT Infrastructure

Source: Adapted from Peter Weill and Marianne Broadbent, *Leveraging the New Infrastructure: How Market Leaders Capitalize on IT* (Boston: Harvard Business School Press, 1998).

Management, present the following description of the infrastructure layers, from bottom to top, which discusses the infrastructure capabilities needed by e-business models:

- ***IT Components.*** This layer is the foundation of a firm's IT infrastructure. It consists of technology components, such as computers, printers, DBMS packages, operating systems, and such. Whereas technologists understand the capabilities of these components, businesspeople do not. That is why IT and businesspeople have had such a difficult time talking about infrastructure at this level. They are not speaking a common language, note Weill and Vitale.
- ***Human IT Infrastructure.*** The translation of the IT component layer into business terms occurs at this layer and is handled by humans. This layer consists of experts' knowledge, skills, experience, and standards to bind IT components into services that businesspeople can understand.
- ***Shared IT Services.*** This layer is the business view of the IT infrastructure, and it presents the infrastructure as a set of services that users can draw upon and share to conduct business. Weill and Broadbent's recent refinement, working with Mani Subramani of the University of Minnesota,[2c] identifies 70 infrastructure services grouped into 10 clusters. Examples of services are Web sites,

wireless applications, firewalls on secure gateways, and large-scale data-processing facilities.

- ***Shared and Standard IT Applications.*** These applications, which are at the top of the IT infrastructure, change less regularly than the fast-changing local applications above the infrastructure. They include such stable applications as accounting, budgeting, and HR.

Again, the importance of this four-level description of IT infrastructure is that it gives technologists and business users a common language. Business users can discuss where they need specific services, and technologists can translate those services into the technical components that underlie them.

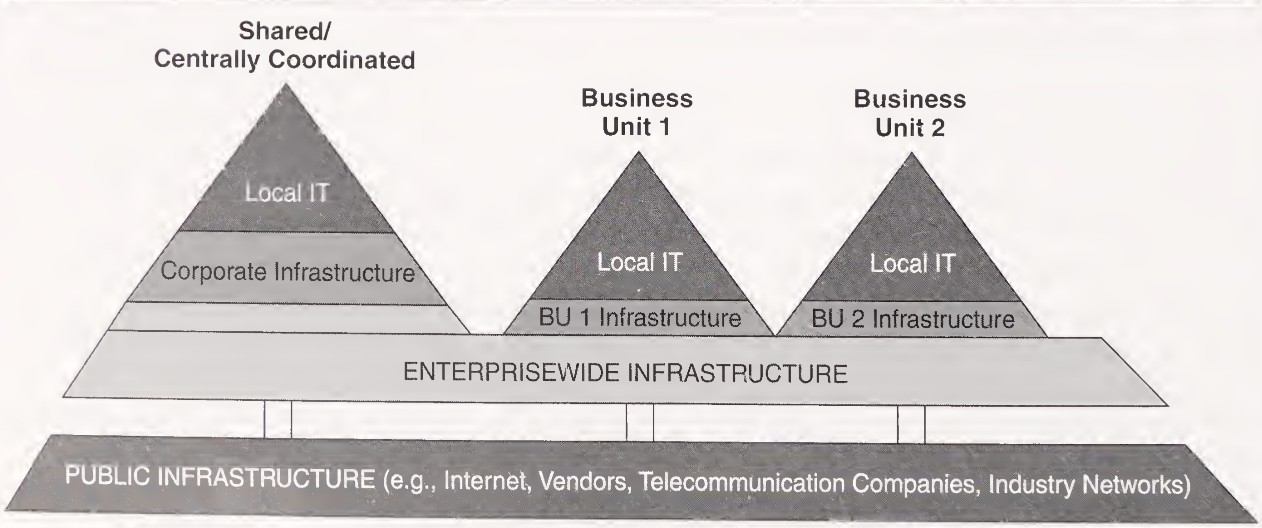
To take this infrastructure discussion a bit further, Weill and Broadbent note that it sits on top of the public infrastructure, as shown in Figure 5-11, that is, the Internet, industry networks, vendors, and telecommunications companies. Also note in this figure that in some cases the firmwide infrastructure provides corporate-wide services. In other cases, it provides infrastructure for individual business units.

Similar to Public Infrastructure

IT infrastructure is strikingly similar to public infrastructure, such as roads, hospitals, sewers, and schools, note Weill and Broadbent.

- Both are provided by a central agency and funded by some form of taxation.
- Both are long term and require large investments.
- A central agency provides an essential service that users are not motivated or able to provide.
- Both enable business activity by users that would otherwise not be economically feasible.
- Flexibility is valued in both because they must be in place before the precise business activity is known.

FIGURE 5-11 IT Infrastructure



Source: Adapted from Peter Weill and Marianne Broadbent, *Leveraging the New Infrastructure: How Market Leaders Capitalize on IT* (Boston: Harvard Business School Press, 1998).

- Both are difficult to cost-justify in advance as well as to show benefits in hindsight.
- Both require a delicate investment balance: Too little investment leads to duplication, incompatibility, and suboptimal use, whereas too much discourages user investment and involvement and may result in unused capacity.

Three Views of Infrastructure

The benefits a firm actually realizes from its infrastructure investments depend on its objectives for the infrastructure. A firm might invest in infrastructure for the following three reasons:

1. Economies of scale (utility)
2. Support for business programs (dependent)
3. Flexibility to meet changes in the marketplace (enabling)

Utility

Companies that view their infrastructure as a utility see it as a necessary and unavoidable service that must be provided by IS. Expected benefits are cost savings achieved through economies of scale. Normally, firms with this perspective treat infrastructure costs as an administrative expense, and they act to minimize these expenses. Therefore, they offer the fewest infrastructure services. For instance, they might promote use of networks for messaging but not as part of inter- or intra-organizational business processes. This objective requires the lowest investment, but it also only results in lowering costs (not in reengineering the business). Outsourcing may be viewed favorably because the IT infrastructure is not seen as strategic.

Dependent

A business that ties its infrastructure investments to specific, known business programs, takes the dependent view. The infrastructure is treated as a business expense because investments are tied to business plans, and its value is measured by short-term business benefits. Firms with this view include infrastructure planning in current business planning. They also see the network as critical. Furthermore, this view of infrastructure appears to smooth the way for simplifying business processes. In fact, Weill and Broadbent surmise that this view is a minimum requirement for successfully implementing business process reengineering.

Enabling

A firm that develops and continually modifies its infrastructure in co-alignment with its business strategy—where infrastructure influences strategy and vice versa—takes the enabling view of infrastructure. The primary benefit is long-term flexibility, thus the firm does not limit infrastructure investments to current strategy. The infrastructure is intended to provide the foundation for changing direction in the future, if need be. Thus, infrastructure costs are seen as business investments. For example, the firm might use networks extensively in business processes, both within the firm and with customers and suppliers.

Needless to say, the appropriate viewpoint is not a technical decision; it is a top management decision. It is IS management's job to make this clear to senior management and show them the options. Again, as we pointed out in Chapter 2, teamwork among the various levels of management is absolutely necessary to align technical investments with business strategy.

No view is superior, though; different views are appropriate for different strategies. Moving from utility to dependent to enabling increases up-front investments and the number of IT infrastructure services provided.

The Digital Economy

The three views of infrastructure discussed previously lay the foundation toward the creation of the digital economy. Driven by technological innovation, the digital economy is characterized by new business models, new products and services, new business processes, new means of communication, and new forms of community. The digitization of the global economy has evolved in three phases. First, the advent of computers revolutionized data processing and fundamentally changed the way most businesses operate. In the second phase, the increasing power of micro-processors and their diminishing costs have made it possible for engineers to develop a wide variety of electronic appliances—from low-cost notebooks for elementary schools to advanced Internet appliances. In fact, there are more chips installed in stand-alone applications (e.g., kitchen microwaves, treadmills, GPS navigation systems) than on computers. The third and current phase is the exponential growth of electronic commerce. According to the U.S. Census Bureau of the Department of Commerce, in 2005, e-commerce grew faster (17%) than total economic activity (8%) in three sectors: manufacturing, merchant wholesale trade, and retail trade. E-commerce sales in the first quarter of 2007 accounted for 3.2 percent of total sales ($31.5 billion). This is a significant increase from two years before, $19.8 billion during the first quarter of 2005.

With the growth of electronic commerce, businesses should expect faster productivity growth, increasing importance of immaterial assets (e.g., services in the knowledge-based economy), and fiercer competition in a global scale with less friction (shrinking distance and time). Thus, it is important that CIOs take into consideration the emerging digital economy to design and implement their IT corporate infrastructure.

Corporate IT Infrastructure in the Digital Economy

As discussed throughout this chapter, ubiquity and networking are important elements in the new economy. They are important for a firm to remain competitive. They are important for a firm that seeks cooperation on a global scale. The point here is that CIOs should help guide their organization to become a proactive entity of the networked economy. A proactive business is one that knows how to exploit Internet-enabled technologies to set up an IT infrastructure that best supports its business strategy in the digital economy. The strategies can be:

- ***Extended enterprise:*** An extended enterprise is one that is composed of not just its employees, managers, and shareholders, but its suppliers and customers. The IT infrastructure is an interconnected network of information to help all members make better decisions and coordinate business processes in such a way that improves the overall performance. Thus, the focus here is Internet-supported supply-chain management and value creation through effective information management.
- ***Strategic alliance:*** Alliances allow participating organizations to share resources, enhance their competitive position, and internalize the unique strengths of each of the partners. Alliances typically get created for research and

development, technical exchange, co-production, and sale distribution. While traditional ventures are asymmetrical, strategic alliances are more symmetrical in that collaboration. As many industries are getting mature and their prospects for growth become low, combined skills to foster innovation while sharing R&D costs are becoming pressing. Many giant organizations such as Boeing, General Electric, IBM, and Rockwell have formed strategic alliances. An enterprise IT solution is required to support collaborative work between partners. Shared data and processes must be seamless while protecting proprietary data of the members. CIOs should explore the use of knowledge management and infrastructure integration skills and adoption of embedded software, middleware, and business software to develop a project-specific, net-centric and integrated computer platform based on existing infrastructures.

- ***Virtual Organization:*** In a virtual organization, members are geographically apart, likely independent and legal entities, but working together as a single, productive, unified organization with a real physical location, seeking to achieve a well-defined task. Once the task is completed, and the mission is over, the virtual organization is dissolved until a new task is called for. Technology to support a virtual organization can be simple office automation tools (word processing, spreadsheet, databases, workflow management, project management software), communication software (e-mail, bulletin board, Web portal), and enterprise software (CRM, ERP). Beyond the normal business context, a well-documented and science-fiction-like example of a virtual organization is Second Life, launched in 2003 but known to the public only a few years later. A viewer ("residents") can use a downloadable client program to see other people, socialize, participate in individual and group activities, and trade items and services. As of 2007, there were more than 8.5 million registered "residents" or accounts.

  The concept of a virtual organization further illustrates the trend toward a dynamic world where speed and efficiency are key for survival, as well as profitability. Again, a network-enabled IT infrastructure is the essential technology.

CONCLUSION

Distributed systems dominate the computing landscape, with the Internet now at the heart. Distributing processing, databases, and communications allow companies to move more quickly because they can more easily snap in new products and services into their existing systems. The advent of Web Services is fueling the use of the Internet to extend the tenets of distributed systems even further.

The Internet turned attention outward because it provides the infrastructure for global distributed systems. Recent evidence has shown that while it is true that IT-enabled global alliances have opened up new cross-boundary opportunities, they have also considerably complicated strategic formulation and operational control. If not done so, IS managers should help top management turn its attention outward toward customers, suppliers, and its business ecosystem. With IT providing the foundation for electronic collaboration within such an ecosystem, CIOs are working, or should work, closely with top management to ensure that the firm's IT infrastructure not only meshes with corporate strategy but is also flexible enough to support changes in strategy. Building a comprehensive infrastructure is the challenge facing CIOs and CTOs. Even though they might outsource the operation of their infrastructure, they and their top-management peers must do the strategic thinking behind selecting infrastructure elements.

Effective implementation of any system architecture requires top-management commitment, realistic budgeting, and sound project management. With the overall technical framework for systems provided, we now turn to the essential technologies used in distributed systems—telecommunications, information resources, and operations.

QUESTIONS AND EXERCISES

Review Questions

1. What is the difference between an architecture and an infrastructure?
2. What are the four attributes of a distributed system?
3. What does open source mean?
4. List and briefly explain the questions that should be asked when deciding whether to distribute computing responsibilities.
5. What are the components of the guiding framework for distributed systems as provided by Stefferud, Farber, and Dement?
6. Give seven examples of system structures that can be called distributed.
7. What are Gartner's five types of client-server systems? Which two did the aerospace company choose and why?
8. What are server-based computing and peer-to-peer computing?
9. According to Rifkin, what is the Napster dispute really about?
10. What are the six standards underlying Web Services?
11. Describe the rows and columns in Figure 5-9.
12. What benefits has FMC received from having defined a "tomorrow" architecture?
13. What are the four layers of IT infrastructure, according to Weill and Broadbent?
14. In what three ways can companies view an IT infrastructure?

Discussion Questions

Discussion questions are based on a few topics in the chapter that offer a legitimate basis for a difference of opinion. These questions focus discussion on these issues when the book is used in a seminar or classroom setting.

1. Some people want all their programs and data stored locally on a PC. Others would be willing to get everything from a corporate portal. Which would you prefer? Why?
2. Web Services sounds way too complex to be viable. How are little chunks of code from many organizations really going to work together and provide a reliable and secure computing environment? Discuss.
3. Although it seems like a useful, albeit expensive, exercise to create an enterprise-wide IT architecture, computing has been going on too long for management to rein in legacy systems. Discuss the pros and cons of this argument.

Exercises

1. Find a recent article in the literature that describes a distributed system.
   a. Describe it using the four attributes given in this chapter.
   b. What benefits are claimed for the system?
   c. Describe its infrastructure.
2. Identify a company in your community that is using what it calls a distributed system. What was top management's or the business unit management's involvement in justifying the system? How do the system's characteristics compare with those given in this chapter? What challenges has the IS organization encountered in building the system, and how has it dealt with these challenges?
3. Identify a company in your local community that has an IT infrastructure. Does management see it as utility, dependent, or enabling? Explain their rationale.
4. Find a description of a Web Service. Why was this approach taken? What benefits are being received or expected?

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CHAPTER

6

MANAGING TELECOMMUNICATIONS

INTRODUCTION

In the previous chapter, we emphasized the need for networking through various forms of distributed computing, and indicated that distributed systems require a reliable telecommunications infrastructure. For most businesses, they use outside service providers (a phone company, an Internet Service Provider (ISP)) for their telecommunications needs. As the business environment is becoming more Internet-centric with VoIP, WAN, and wireless networks, it is important for managers to understand the basic concepts underlining telecommunications technologies that are needed to support the network-centric strategy of the organization.

Telecommunications is also a fast-paced industry that affects every aspect of our lives, including voice telephone calls, Internet access, high-speed data communications, satellite communications, the World Wide Web, and rich-media communications. This knowledge is critical for designing cost-effective telecommunications that enable new business models in a fast-changing economy.

This chapter examines telecommunications in the broadest sense: electronically sending data in any form from one place to another between people, machines, or objects. In this view, the telecommunications system is an electronic highway system. Generally, IS departments have been responsible for designing, building, and maintaining that information highway in the same way that governments are responsible for building and maintaining streets, roads, and freeways.

Once built, the network, with its nodes and links, provides the infrastructure for the flow of data, information, and messages. This flow is managed not by IS professionals, but by users, just as users manage the flow of vehicles on physical highways. Government agencies provide standards and laws for the flow of highway traffic that are enforced by the police and highway patrol. In the same way, IS departments select and enforce telecommunications standards for information traffic while governments divvy up the spectrum for different wireless uses. This analogy could be pursued in more detail, but the point is clear: Telecommunications are the basis for the way people and companies work today. It provides the infrastructure for moving information, just as a transportation system, such as shipping lanes, railroad right-of-ways, and the airspace, provides the infrastructure for the movement of people and goods.

This analogy presents telecommunications as a linking mechanism, which it is. However, the Internet has also opened up a different view of telecommunications, that of providing a cyberspace, a place where people can "exist" in a virtual world, where organizations can conduct business, and in fact, a place where organizational processes exist. It is an online world, a sort of cybercity. This view, too, is providing the foundation for the online economy.

However, even more is happening. Just about everything in telecommunications is shifting, from the industry itself to the protocols (the languages networks use to communicate with each other).

THE EVOLVING TELECOMMUNICATIONS SCENE

125 Years of Technological Innovation and Industrial Revolution

The history of telecommunications began with smoke signals and drums in early generations. However, it was not until 1844, when Morse's electric telegraph was first shown to the public from Baltimore to Washington, that the era of global telecommunications actually began. Less than 20 years afterward, telegraph communication was completed coast-to-coast in the United States (1861), and from the United States to Europe (1866). The innovation continued with the creation of the telephone by Bell and Watson in 1875. These were the first technological inventions that changed the world and triggered the invention of the telephone, telewriter, coaxial cable, broadband carrier for simultaneous calls over a single pair of wires, magnetic tape machine with transmission capacity of 1,000 words per minute, communication satellites, fiber optics, cable modems, DSL Internet services, and cellular wireless technologies.

From a business perspective, the oldest part of the telecommunications infrastructure is the telephone network, commonly called the public switched telephone network (PSTN), or affectionately called POTS (plain old telephone service). This global network was built on twisted-pair copper wires and was intended for voice communications. It uses analog technology (signals sent as sine waves) and circuit switching, which means 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. Although appropriate for delivering high-quality voice communications, circuit switching is inefficient because of all the unused space in the circuits when no sound is being transmitted.

The overhead of establishing a circuit was tolerable for voice calls because they lasted several minutes, notes an in-depth telecommunication study by PricewaterhouseCoopers (PwC),[1] before it became part of IBM Global Services. However, data traffic is sent in bursts that last less than a second. Opening and closing circuits at this rate is not economical, so the basic traffic-handling mechanism for data had to change.

PSTNs were also built on the premise of dumb voice telephones; therefore, they needed intelligent switches in the network to perform all the functions. Telephone company central offices house the intelligent switches that implement all the services, including call waiting, caller ID, call forwarding, conference calling, and so on.

The new telecommunications infrastructure being built around the world is aimed at transmitting data. The wired portion consists of fiber-optic links (glass fiber rather than copper wire) sending digital signals (ones and zeros instead of sine waves). The wireless portion consists of radio signals. Both use packet switching; messages are divided into packets, each with an address header, and each packet is sent separately. No circuit is created; each packet may take a different path through the network. Packets from any number of senders and of any type, whether e-mails, music downloads, voice conversations, or video clips, can be intermixed on a network segment. These networks are able to handle much more and a greater variety of traffic. Packet nets also can handle voice. The analog voice signals are translated into ones and zeros, compressed, and packetized.

Unlike voice-centric networks, data-centric networks assume intelligent user devices that provide the addressing information; therefore, the network only needs store-and-forward routers to route the packets. This architecture allows new kinds of services to be deployed much more rapidly, notes the PwC study, because the basic functions of the network need not be changed. Thus, for example, it was easy to add the World Wide Web as a new kind of layer on the Internet infrastructure. Other such layers are multiplayer gaming, e-mail, and file transfer. This infrastructure would not have been possible with PSTN.

The Internet can handle new kinds of intelligent user devices, including Voice-over-IP (VoIP) phones, personal digital assistants (PDAs), gaming consoles, and all manner of wireless devices. It can allow these devices to handle different kinds of services, such as voice, e-mail, graphics, gaming, and so forth. Thus, the global telecommunications infrastructure is changing from a focus on voice to a focus on data—both from a technical perspective and a revenue generation point of view.

With the increasing demand for high-speed multimedia mobile communications services to users, there are a number of ongoing initiatives to replace the current low-speed voice and data wireless networks by stratospheric communications systems or High Altitude Platform Station (HAPS). A HAPS is a station located at an altitude between 20 and 50 km and at a specified, nominal, fixed point relative to the earth. HAPS has a number of important advantages: flexibility of network planning and construction, wide bandwidth, wide coverage, ease of maintenance and operation, no need to deal with national and international regulatory issues. The technologies are still evolving. However, once they become proven, they would tremendously improve the performance of current telecommunications infrastructure.

The Future of Telecommunications

The early 2000s could be seen as a correction of the investment excesses of the late 1990s and the misreading of the market ability to adapt to technological changes. Corporate giants suffered losses (e.g., Covad, PSINet, JDA, and Nortel Networks to cite a few). Despite the significant financial downturn of the telecommunications industry, broadband subscription continues to increase steadily. According to OECD, the number of broadband subscribers in the OECD country members increased 26 percent from 157 million in 2005 to 197 million in 2006. Innovation is expected to accelerate. Thus, CIOs should expect changes in both technologies and market forces. If there is anything we can learn from history, the telecommunications industry will continue to surprise us with innovative inventions and disruptive technologies.

At the risk of making erroneous predictions, we do see a number of emerging trends:

1. ***Steady growth in telecommunications usage:*** We discussed earlier the era of social computing. Communications are the requisite of the digital age. While communications usage in North America and Western Europe have been consistently high, demand for telecommunications services has exploded in the rest of the world, in particular Eastern Europe, Asia, and Latin America. Developing countries have been able to leapfrog into new digital technologies, avoiding otherwise significant replacement costs from legacy technologies. Also, thanks to the results of industry deregulations, the cost of telephony and telecommunications have significantly decreased.
2. ***Quick and global adoption of new telecommunications-based technologies:*** Cellular telephony, GPS navigation systems, video programming, music and video download, wikipedias, blogs, and instant messaging have become major telecommunications applications. These new and ubiquitous applications will likely push significant pressures on both telecommunications providers (such as Verizon and AT&T in the United States), Internet Service Providers, and media networks to offer high-bandwidth, high-resolution, and inexpensive integrated services.
3. ***Competition in broadband markets is expected to accelerate:*** One new market area is in the fixed-mobile convergence market, with fixed and mobile operators competing against each other.
4. ***Mass-individualization of real-time programming:*** With the evolution of high-definition video on-demand, and the global adoption of video exchange (e.g., YouTube.com), the trend toward media-rich networks has started to take

off. It is now economically viable to dynamically offer individualized programs allowing real-time interaction with the users.

5. ***The new economic model for financing the telecommunications industry has yet to be defined:*** In addition to the corporate mergers among telecommunications giants, pricing of services will be an important issue for managers to watch carefully. On the one hand, the market continues to ask for low-cost or no-cost services—free e-mailing, free download, free access to GPS signals. On the other hand, the costs for establishing and maintaining a reliable, secure, and robust corporate telecommunications infrastructure are likely to go up. The deregulation, consolidation, and technological innovation in the telecommunications industry lead to complex pricing and billing schemes.

Indeed, the future of telecommunications depends on a number of factors that are beyond the control of a business: Due to conflicting interests among numerous stakeholders, regulators from many countries are still slow in making the industry more competitive. The telecommunications giants need to recapture the large amounts of capital they invested in current networks, and some are hesitant in adopting new technologies. Last but not least, many large user groups are reluctant to embrace new value propositions as they do not want to change their working habits. The inertia within the customer base could slow down the unstoppable evolution of telecommunications.

TELECOMUNICATIONS FOR BUSINESS

In this section, we do not intend to provide the readers with a detailed technical description of the basic concepts and elements of telecommunications technologies. Any data communications book would do a more comprehensive job. Instead, we highlight here only a few aspects that we think any manager should be aware of when trying to understand the role and functions of telecommunications in today's business.

Visualize the world's networks as huge fire hoses, transmitting at the whopping speed of a terabit (10^{12} bits per second) over fiber-optic cable. Then visualize the twisted-pair phone line coming into your home or business as a straw, only operating at speeds of 56 kbps (104 bits for second) for a modem or 1.2 mbps (10^6 bits per second) for a digital subscriber line (DSL). DSL runs over the same copper wire but has improved electronics that boost the speed, allows simultaneous voice and data, and is always on, eliminating the need to dial in. The last-mile problem is the bridging of this fire-hose-to-straw gap. See Figure 6-1.

In the 1990s, the Regional Bell Operating Company (RBOC) began encountering competition for this last mile. So the jargon expanded. RBOCs became known as incumbent local exchange carriers (ILECs) and the new competitors became competitive LECs (CLECs). The importance of CLECs is the new kinds of connection options they have brought to businesses and homes, such as cable modems, optical fiber, wireless, satellite, and faster wire lines. In response, ILECs have bundled local phone access with Internet access, and ISPs use their brand-name recognition to expand into the local carrier market, becoming CLECs. You really need a scorecard to see who's who.

FIGURE 6-1 Telecommunication Technologies and Their Speeds

Bits per Second (bps)	Notation	Abbreviation	Amount	Term	Technologies
1,000,000,000,000	10^{12}	1 tbps	Trillion	Terabits	Optical fiber potential (and higher)
100,000,000,000	10^{11}	100 gbps			
10,000,000,000	10^{10}	10 gbps			Optical wireless local loop (20G),OC-768 (40G), WMAN (100G)
1,000,000,000	10^{9}	1 gbps	Billion	Gigabits	Microwave LANs (1.5G–2.0G), OC-48 (2.5G), ATM (2.5G), Gigabit Ethernet (1G), WMAN (24G)
100,000,000	10^{8}	100 mbps		Megabits	OC-12 (622M), ATM (155M to 622M), T4 (274.176M), OC-3 (155.52M), Faster Ethernet (100M), infrared (100M), WMB (100–400M)
10,000,000	10^{7}	10 mbps		Megabits	T3 (44.736M), E3 (34.318M), frame relay (10M), Ethernet (10M), WLANs (10M), cable modem (10M), Wi-Fi (11-54M)
1,000.000	10^{6}	1 mbps	Million	Megabits	T2 (6.132M), infrared LAN (4M), stationary 3G wireless (2M), E1 (2.048M), DSL (L544M to 7M), T1 (1.544M), Wi Max (1.5–10M)
100,000	10^{5}	100 kbps		Kilobits	Wireless local loop (428K), mobile 3G wireless (384K), ISDN (128K), 2G wireless (128K)
10,000	10^{4}	10 kbps		Kilobits	Modems (56K), 2.5G wireless (57K)
1,000	10^{3}	1 kbps	Thousand	Kilobits	2G wireless (9.6K to 14.4), infrared LAN (9.6K)
100	10^{2}	100 bps		bits	
10	10^{1}	10 bps		bits	

The Internet and Telecommunications Services

Although it may feel like old news now, the biggest telecommunications story of the past 15 years has been the Internet, the global packet-switching network that is the epitome of next-generation networks. What has surprised most people was the Internet's fast uptake for business uses and then the fast plummet of the dot-com and telecommunications industries. However, in both arenas, the crashes were needed reactions to the excesses of the late 1990s. In the mid-1990s, the Internet caught most IS departments by surprise, not to mention the hardware and software vendors that serve the corporate IS community. Many executives are relieved that the Internet pace of the late 1990s has now slowed down so that they can plan their online business strategies rather than feel the need to react quickly to dot-com invasions in their industry.

The Internet actually began in the 1960s; it was funded by the U.S. Department of Defense's Advanced Research Projects Agency and was called ARPANET. The network was intended for electronic shipment of large scientific and research files. It was built as a distributed network, without a controlling node, so that it could continue to function if some of its nodes got knocked out in a nuclear war. Much to the surprise of its creators, it was mainly used for electronic mail among government contractors, academics, researchers, and scientists.

In 1993, the Internet was still mainly a worldwide network for researchers, scientists, academics, and individuals who participated in news groups. It was all text, no graphics. It had e-mail for sending messages, maintaining e-mail lists, and interacting with news groups. It had file transfer protocol (FTP) for sending files, Telnet for logging onto another computer, and Gopher for searching and downloading files from databases.

That all changed in 1994 when the World Wide Web was invented by Tim Berners-Lee at CERN in Geneva. This graphical layer of the Internet made it much more user-friendly. Web sites had addresses specified by their URL. Its multimedia Web pages were formatted using HTML. The Web sites could be accessed via an easy-to-use browser on a PC. Hyperlinks hidden behind highlighted words on a Web page, when clicked, would jump to the linked page. Following the links became known as "Web surfing." This graphical electronic world was first populated by homepages of computer geeks and young people. The Web's use by businesses began skyrocketing a few years later, in the late 1990s.

The Internet has done for telecommunications what the IBM PC did for computing: It brought it to the masses. In 1981, when the IBM PC was introduced, its architecture was open; all the design specifications were published. This openness led to thousands of peripheral manufacturers, component makers, and clone makers producing compatible products. An entire industry developed around this open architecture. The same has happened with the Internet because it provides the same kind of openness, this time in the telecommunications arena. Vendors have a standard set of protocols to work with so that products can work with each other. Businesses do not need to commit to a proprietary architecture. Like the PC, this openness yields the most innovative solutions and the most competitive prices.

The Internet has three attributes that make it important to corporations: ubiquity, reliability, and scalability. It is global, thus it is ubiquitous. Enterprises, both large and small, potentially have global reach with a browser and global presence with a Web site. As noted earlier, the Internet was designed to survive computer crashes by allowing alternate routing. This capability makes it highly reliable. People might not be able to access a crashed server, but they can still access all other nodes that are operating. The Internet has also been able to sustain incredible growth since its beginning. Specific Web sites can handle tremendous amounts of traffic, in the tens of millions of hits a day, if they have been properly designed. That is scalability!

Today, the protocols underlying the Internet have become the protocols of choice in corporate networks for internal communications as well as communications with the outside world. The norm is now end-to-end IP networks.

To illustrate how a company might build a corporate network from scratch utilizing the Internet, here is the fictitious example of XYZ Company.

CASE EXAMPLE

XYZ COMPANY

XYZ Company, which makes and sells widgets, is in the process of installing a corporate network. The CTO has a myriad of decisions to make. Of course he wants employees to be able to access each other, corporate data, and the Internet, so he will create an IP network using the Internet's standard protocol, TCP/IP, which packages data into packets, each with a header that tells where it is to be delivered.

The Internet will be the heart of XYZ's corporate operation. Hence the CTO will create an intranet for use by employees; an extranet for use by suppliers and some large customers; and of course, the Internet as the all-important central public network.

The CTO has a basic way of thinking about all the computer-based devices in his company: He sees them as either clients or servers. Computers, handhelds, cell phones, and wired phones used by the employees are clients; they make requests of other computers. Computers that respond to these requests are servers. They can act as storage devices for shared files for teams or departments or even customers. They may house shared applications or shared peripherals or they can connect the client devices to a network, including the Internet. Now that IP phones offer good voice quality, he may opt for them as well.

Serving Remote Users

Every PC will be outfitted with a Network Interface Card (NIC) that lets it talk to the network. XYZ has four choices of communication wiring: twisted pair (the standard telephone line), coaxial cable (like cable TV), fiber optic (glass fiber that carries signals via light pulses), and wireless. Fiber carries tremendous amounts of traffic and is expensive; therefore, it is mainly used in backbone networks. Each NIC will support the medium the company will be using.

Each computer also needs a network operating system. These days, it is part of the computer's operating system. Furthermore, some of the machines need a modem to convert (modulate) the digital signal

(*Case Continued*)

from the computer to an analog signal for the telephone or cable system, and vice versa.

For employees working from computers in their homes, who need to transmit larger and larger files such as PowerPoint presentations, the CTO could choose DSL modems, which communicate at 1.2 mbps (10^6). Or he could choose cable modems, which communicate at a whopping 10 mbps. Like DSL, cable modems are not available everywhere. Also, like DSL, they are always on; no dial-up is needed. However, this convenience can present security problems because the session code does not change as it does with dial-up sessions.

The CTO needs to decide how to connect these remote users to the corporate network and provide the speed and security they need. The salespeople, for instance, no longer have company-supplied offices; their offices are in their homes. They have company-supplied laptops and PDAs; they dial in from hotels, client sites, or their homes or use an always-on personal communication service (PCS) for e-mail.

Serving Local Users

In the office, all the computers and telephones will be connected directly to an always-on LAN.

The various LANs in XYZ's offices will use three types of computers to route traffic.

- Hubs are repeaters; they 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. This configuration can get congested with many computers, so hubs will only be used within a work group.
- Switches are smarter; they only forward packets to the port of the intended computer using the addressing information in each packet's header. Switches will be used to connect work groups.
- Routers are smarter still; they use a routing table to pass along a packet to the next appropriate router on a network. Thus, they can direct packets via the most efficient route or relay packets around a failed network component. Routers also link network segments that use different protocols, such as linking an Apple-Talk network with an Ethernet network. Routers also can connect to WANs. XYZ will use routers to connect its LANs to a WAN.

The CTO will likely choose the Fast Ethernet Protocol for his IP-based LANs. It has a speed of 100 mpbs (10^8) to accommodate employees' multimedia and video needs. Using Ethernet, when a computer has a message to send, it broadcasts the stream of packets and then listens for an acknowledgment of receipt. If it does not receive a reply within a specified time, it rebroadcasts, presuming the packets collided with packets from other computers and did not reach their destination.

The LAN will give in-office employees an always-on connection to the company's intranet, its employee-only Web site that is protected from the outside world by a firewall. The firewall is a server that lets in e-mail but does not permit access to applications or executable code. The intranet will essentially

(*Case Continued*)

be "the office" for XYZ, because it will house all the firm's forms, processes, and documents. It will also be accessible by remote employees.

Intranet—Communicating Between Offices

To help XYZ employees communicate between sites using WAN, the CTO set up a high-speed asynchronous transfer mode (ATM)—up to 622 mbps (10^8). ATM is used by telephone companies for their network backbones; they then offer ATM services to companies like XYZ for their WANs. However, due to the high cost of ATM long-distance bandwidth, the CTO might not be able to afford it.[2]

A fairly new option to link several offices in a city or to link floors within a building is Gigabit Ethernet, which operates at speeds of 1 gbps (10^9 bits per second). One hundred gigabit Ethernet (10^{11}) is on the horizon. Gigabit Ethernet has been outselling ATM because it is less costly. It is definitely the option the CTO would prefer.

These issues are some of the major considerations for the CTO. He is definitely going to base all his decisions on being IP-centric. ■

Extranets

Not long after creating intranets for employees, businesses realized they could extend the concept into extranets—a special part of the intranet for use by trading partners, customers, and suppliers for online commerce. The following case of National Semiconductor illustrates the use of an extranet and shows how the company tackled the challenge of conducting business online globally.

CASE EXAMPLE

NATIONAL SEMICONDUCTOR

www.national.com

Founded in 1959, National Semiconductor, with headquarters in Santa Clara, California, designs and manufactures semiconductor products used in personal computers, consumer electronics products (cars, cameras, cell phones, and so on), and telecommunications systems. With reported sales of more than $2.6 billion in 2006, National is focusing on its key competency—advanced analog and mixed analog/digital signal technologies—for use in the newest breed of electronic devices, information appliances, which are low-cost, easy-to-use, wireless devices that interact with the Internet without the use of a PC. In 2007, National employed some

(*Case Continued*)

7,600 people around the globe, held 2,916 unexpired U.S. patents, and offered more than 15,000 products.

To gain market share and move into new markets in Europe, South America, and Asia, National looked to the Web. It created an *intranet* that the sales force could access to keep up to date on products and place orders. It created the "National Advisor" using Internet-based push technology to electronically send news, sales reports, and customer information to the sales force and its management.

National also created an *extranet* for distributors and channel partners and a Web site for design engineers who use its components in electronic and telecommunications products. This Web site contains descriptions of more than 15,000 products in the form of PDF databooks. Design engineers can view these databooks and order samples either via the Web or through distributors.

To give far-flung engineers decent download times of these 10k-to-200k-size files, National initially installed mirrored servers in Germany and Hong Kong and planned for eight more sites. However, management discovered that the logistics of maintaining 10 such sites would be a nightmare as well as cost prohibitive at approximately $4 million a year.

They thus turned to outsourcing to a company with data centers around the globe that offers hosting and other Internet infrastructure services. It replicates Web sites on edge servers, which are servers close to users (on the edge of the Internet), so that download speed is fast. Some servers even perform language translation so that when a request is made, the closest edge server detects the type of user device, type of network, and country (and its regulations) and adapts the content to those conditions.

The cost would be $400,000 a year, or one-tenth the in-house cost. More importantly, performance was so much better that National could reach markets in Asia, Eastern Europe, Indonesia, and Latin America, where Internet service was generally slow. In addition, the company could distribute daily customer data and market information within 24 hours, which would speed product development and responses to design engineers' queries.

National's Web site now supports 1 million design engineers around the globe who download more than 10,000 databooks a day, in about two seconds each. The company only needs to replicate its site once; the hosting company takes care of the global coverage. Finally, National receives reports on which pages are being accessed in each part of the world, which is important information to the sales and marketing staff. National's extranet application, which won the "Business on the Internet (BOTI)" award given at Internet World and *CIO Magazine*'s "CIO Web Business Award for Online Business Excellence," has thus been able to use the Internet to create business advantages, improving its customers' ability to make faster decisions. ■

Digital Convergence

Almost any type of information content can be converted into a digital form and then exchanged over the Internet, via fixed or mobile connections and using multiple platforms.[3] Digital convergence is the intertwining of various forms of media—voice, data, and video. All the separate media—books, newspaper, TV, radios, telephone, personal computers, etc.—will be replaced by integrated digital appliances. When all forms of media can be digitized, put into packets, and sent over an IP network, they can be managed and manipulated digitally and integrated in highly imaginative ways. IP telephony and video telephony have been the last frontiers of convergence—and now they are a reality.

IP Telephony

Recently, enterprises have been investigating the use of the Internet to transmit voice to replace their telephone systems. This new Internet use is called Voice-over-IP (VoIP), Internet telephony, or IP telephony. According to James Cope,[4] it works in the following manner: A special IP phone with an Ethernet jack in the back instead of the standard telephone jack is attached to a company LAN, perhaps through a PC. Rather than the analog signals sent by traditional phones, the IP phone generates a digital signal. That signal is routed over the LAN just like any other data in packets either (1) to another IP phone on the LAN, (2) through the company's WAN to a distant IP phone on another of the company's LANs, or (3) through an IP voice gateway to the PSTN to a standard telephone.

Few companies have yet given up their telephone networks for a VoIP network, but as the cost differential continues, more will switch. Like other devices on a network, IP phones have an IP address, so they can be easily moved to another location and still be located.

IP telephony became the hot telecommunications technology in 2004. Until that time, voice quality over the Internet was poor, so people were not interested in switching to digital IP phones. But by 2003, voice quality was sufficient for early adopters, and surprisingly, Cisco became the largest IP telephone company, shipping over 3 million IP phones by mid-2004 and purportedly shipping over 2 million in the third quarter of 2004 alone. (As the primary supplier of Internet routers, Cisco also expects to sell lots of its routers to telecommunications companies as they switch their networks from analog to digital networks.)

Voice has become another digital medium that can be managed electronically, from one's PC, for example. One new possibility this digitization presents is ad hoc conferencing (or just-in-time collaboration, as it is also called). For instance, with the appropriate VoIP infrastructure, two people instant messaging with each other via their computers could seamlessly switch to a voice conversation, talking rather than typing. Furthermore, because each person's telephone, instant messaging, and e-mail share one address book, they can instant message, phone, or e-mail others to join their call just by clicking on their names. Anyone in the conference can pull up a PowerPoint slide or a spreadsheet to discuss a point on it—or even scribble on it—or view a new video clip. They can even archive the call and send it to other people.

Video Telephony

The same is happening with video telephony, which is not video conferencing via a PBX, but rather video over IP. With the appropriate IP infrastructure, video telephony can be, say, launched from an instant-messaging conversation. IP phones with cameras also facilitate it, phone to phone.

Oodles of new converged products are flooding the marketplace now that high-quality voice has become IP based. In fact, when VoIP is mentioned these days, it is done so in the context of collaboration. The point is not so much that VoIP offers essentially free voice calling worldwide over IP networks. The point is that VoIP now permits cost-effective, full-media collaboration worldwide. That is a new paradigm, which can change how businesses work. One early effect has been the boom in offshore outsourcing.

In addition, some new converged offerings add presence, by indicating how someone can be reached at a particular moment, often through a green indicator beside the appropriate contact option in the converged address book. Such a system then automatically dials that option. Presence will likely become a major feature of converged IP systems.

Skype.com is a prime example of successful use of IP for telephony and beyond. It is a peer-to-peer telephony network. Unlike typical VoIP clients that are under a client-server model, Skype has a user directory that is entirely decentralized and distributed among the nodes in the network, allowing scalability, without a complex and expensive centralized infrastructure. Launched in 2003, adoption of Skype technology was nothing but phenomenal. By 2006, there were more than 100 million registered users. eBay purchased Skype in 2005, hoping to use this technology to bring its online trading business to the next level: allowing users to use voice and video in their online trading process. Skype.com introduced videophony in December 2005 and continues with a number of telecommunications innovations, in particular, the inclusion of video content in chat. The explosive growth of the service is not without glitches. In August 2007, due to heavy traffic and technical complications, millions of Skype users were unable to connect to the networks for a few days.

At the business level, digital convergence can also change the way business is operated. The Toronto Pearson International Airport illustrates the reality of digital convergence via IP.

CASE EXAMPLE

TORONTO PEARSON INTERNATIONAL AIRPORT

www.gtaa.com

Toronto Pearson International Airport is Canada's busiest airport, with 31 million passengers in 2006. It handles more than 1,200 arrivals and departures every day. In April 2004, a new terminal opened that Cisco touts as a next-generation showcase because its infrastructure is a single, common-use IP network.[5]

The network is common use because its infrastructure is shared by all the airport tenants. Its backbone is two independent high-speed rings for reliability and growth, with over 100 network switches, 1,000 IP phones, and 1,000 wireless access points. There is no separate telephone network, just one IP network

(*Case Continued*)

that combines 14 communications systems and that supports integrated voice, data, and video.

Each tenant has a private LAN for its own voice, data, and video applications. The LAN is accessed via virtual private networking (VPN) technology so that it is private and secure. Yet each network can be accessed from anywhere in the terminal with the appropriate authorization by just plugging in, either via a wired or a wireless access point. The wireless network is highly restricted and tightly controlled so that the data traveling over it are also private and secure.

In essence, the airport authority acts as a service provider to the airlines, tenants, and passengers. The network is used for all applications. For passenger check-in, for instance, the gates have IP phones as well as data connections. Each gate can be used by any airline; the gate crew just plugs in to access the airline's voice and data services. Passengers can also check in at any kiosk for any flight for any airline, which has reduced congestion.

Baggage tracking is integrated with passenger reconciliation via the network, improving security. The network also supports security systems, emergency responses, video surveillance, and network security.

The network and the interlinked applications it permits have reduced network operations costs, consolidated network support (because there is only one network), increased operational efficiency in the terminal (in baggage handling and check-in), enhanced security and made it consistent, and increased capacity (handling 15 percent more passengers soon after the terminal opened). ■

Digital convergence is setting up a collision among three massive industries, state Stephen Baker and Heather Green.[6] The first is the $1.1-trillion computer industry, led by the United States. The second is the $225-billion consumer electronics industry, which has Asian roots and new, aggressive Chinese companies. The third is the $2.2-trillion telecommunications industry, with leading wireless players in Europe and Asia and data networking leaders in Silicon Valley. These industries need each other to offer converged services. Innovative offerings and services are now being released by large and small companies alike. It is not yet clear which business models or offerings will emerge as the big winners. It is only clear that this is a disruptive time for all three industries, note Baker and Green, as it likely is for a host of other industries as well, such as the music, television, gaming, and movie industries, to name just four.

The Internet and its protocols are taking over. To understand the complexity of telecommunications, we now look at the underlying framework for the Internet: the OSI Reference Model.

The OSI Reference Model Underlies Today's Networks

The worldwide telephone system has been so effective in connecting people because it is based on common standards. Today's packet-switching networks are also following some standards. The underpinning of these standards is the OSI Reference Model.

Closed Versus Open Networks

The first concept that is important to understand is the difference between closed and open networks. A closed network is one that is offered by one supplier and to which only the products of that supplier can be attached. Mainframe and mini-computer manufacturers used this approach for years to lock in their customers. Closed networks were originally adopted for the corporate, regional, and site levels of computing described in Chapter 5. Companies generally used the proprietary network offered by their mini-computer or mainframe manufacturer. In the Internet world, the first commercial offerings (CompuServe, Prodigy, America Online, and Microsoft Network) also used proprietary software initially. However, as direct connection to the Internet spread, these firms all finally embraced the Internet's open network approach.

An open network is based on national or international standards so that the products of many manufacturers can attach to it. Open networks have been favored by suppliers serving the ecosystem, department, work group, and individual levels of computing described in Chapter 5. Today, proprietary networks are out and open networks are in because no provider is large enough to serve all of a firm's telecommunications needs—to say nothing of connecting the firm to other enterprises and people.

We now live in an open-systems world, and the most important telecommunications architecture is the OSI Reference Model.

Why Is It Called a Reference Model?

The International Standards Organization (ISO) and other standards bodies have adopted the seven-level OSI Reference Model to guide the development of international standards for networks of computers. It is called a reference model because it only recommends the functions to be performed in each of the seven layers; it does not specify detailed standards for each layer. Those details are left up to the standards bodies in the adopting countries. OSI is used by suppliers to make their products interconnectable. Understanding the OSI Reference Model is a step toward understanding how telecommunications systems actually work.

An Analogy: Mailing a Letter

In the model's layered architecture, control information is used to route messages to their destination. The following is a four-level analogy of an executive mailing a paper document to another executive (Figure 6-2). Although mailing letters is old-fashioned, this example makes the intricacies of message passing understandable. Notice that control information—the address and type of delivery—is on the envelope or mailbag. This control information determines the services to be provided by the next lower layer, and it contains addressing information for the corresponding layer on the receiving end. It defines the interfaces between the layers as well as the dialog within a layer.

- At layer 4, the business executive writes a letter and gives it to a secretary.
- At layer 3, the secretary puts the letter into an envelope, addresses the envelope, puts the return address on the envelope, stamps it, and then mails it.
- At layer 2, the mail carrier takes the letter to the postal sorting office where all mail for the same postal district is put into one bag with the destination postal office name on it. Mail of different types—express mail, first-class mail, third-class mail—have their own bags.

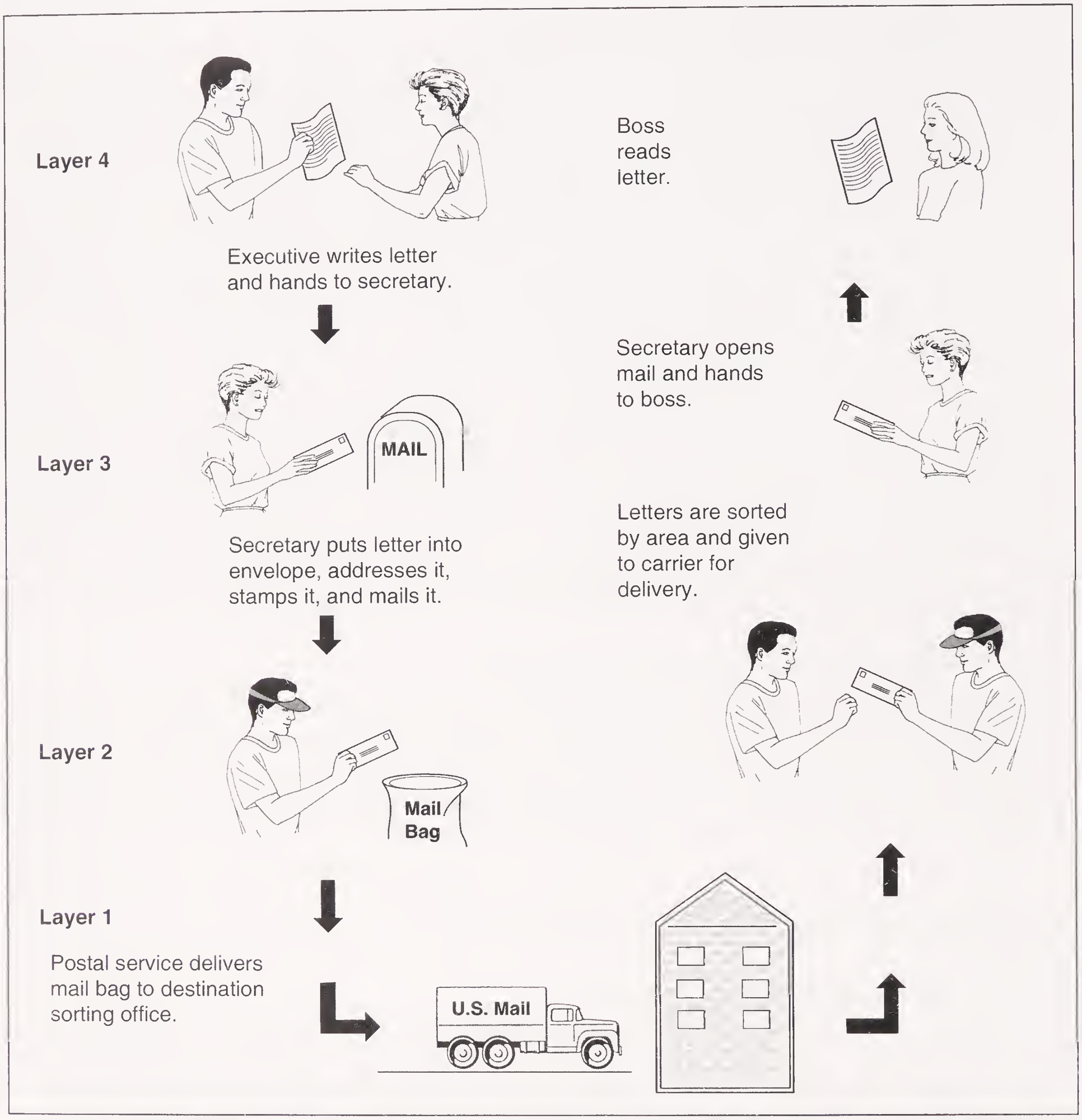

FIGURE 6-2 How Control Information Is Used to Route Messages

- At layer 1, the postal service delivers the mail bag to the destination sorting office.
- At layer 2, the sorting office checks that the bag has been delivered to the right office. Then the letters are sorted by area and passed on to the individual carriers who deliver them.
- At layer 3, the recipient's secretary rejects any mail delivered to the wrong address, opens the letter, and passes it to the recipient, saying, "Here's a letter from . . ."
- At layer 4, the recipient takes the letter and reads it.

Layer	Name	Job	Protocol Examples
7	Application Layer	Interface to application	HTTP, X.500, X.400, ODA, Internet key exchange (IKE), Postscript
6	Presentation Layer	Translates data to and from language in layer 7	NetBIOS
5	Session Layer	Controls dialog, acts as moderator for a session	Secure Sockets Layer (SSL)
4	Transport Layer	Controls flow, ensures reliable packet delivery	TCP
3	Network Layer	Addresses and routes packets	IP, X.25, Packet-level Protocol
2	Logical Link Layer	Makes sure no data are lost or garbled	Ethernet, Token Ring, FDDI, ISDN, ATM, Frame relay
1	Physical Layer	Defines physical connection to network	Ethernet 50-ohm coaxial cable, lOBaseT, twisted pair, fiber-optic cable

FIGURE 6-3 The OSI Reference Model

When a layer receives a message from the next higher layer, it performs the requested services and then wraps that message in its own layer of control information for use by the corresponding layer at the receiving end. It then passes this bundle to the layer directly below it. On the receiving end, a layer receiving a bundle from a lower layer unwraps the outermost layer of control information, interprets that information, and acts on it. Then it discards that layer of wrapping and passes the bundle to the next higher layer.

The Model's Seven Layers

In a similar way, the OSI Reference Model describes the types of control data produced by each layer. See Figure 6-3.

Starting at the top of the model, or the layer closest to users, here are the layers and what they basically do.

- ***Layer 7 is the Application Layer.*** This layer contains the protocols embedded in the applications we use. One familiar protocol at this level is HTTP, which anyone who has surfed the Web has used to locate a Web site. Other TCP/IP protocols at this level are FTP, for transferring files on the Internet, and Telnet, for logging onto and using a remote computer on the Internet. Other protocols at this level permit worldwide communication in various ways. For instance, ISO's X.500 directory services protocol is for creating distinct Internet (or other) mailing addresses. OSI's X.400 mail handling service is for permitting e-mail systems to handle e-mail created and sent from dissimilar systems.
- ***Layer 6 is the Presentation Layer.*** The telecommunication protocols in this layer translate data to and from the language and format used in layer 7. This layer does not have many familiar protocols.
- ***Layer 5 is the Session Layer.*** Telecommunication protocols in this layer control the dialog for a session and act as a moderator, seeing that messages are

sent as directed and interrupted if necessary. An important protocol in this layer is Secure Sockets Layer (SSL), which provides Internet security. It uses a combination of public key and other cryptography to provide confidentiality, data integrity, and authentication.

- ***Layer 4 is the Transport Layer.*** This layer ensures reliable packet delivery. Protocols in this layer handle flow control and ensure the integrity of each message, resequencing portions if necessary. A main protocol at this level is Transmission Control Protocol (TCP), which is the TCP found in TCP/IP. TCP manages the connections made by IP in the next lower layer, layer 3.
- ***Layer 3 is the Network Layer.*** Protocols in this layer address and route packets to their destination. Here resides the all-important IP, which allows packets to traverse an Internet—that is, a network of networks.
- ***Layer 2 is the Logical Link Layer.*** Protocols at this layer mainly do error correction, making sure that no data is lost or garbled. LAN protocols, such as Ethernet and Token Ring, work here.
- ***Layer 1 is the Physical Layer.*** Protocols at this level are responsible for defining the physical connection of devices to a network. This level is the most basic and actually defines the electrical and mechanical characteristics of connections. Thus, these protocols describe modem standards as well as the characteristics of transmission wires, such as Ethernet 50-ohm coaxial cable, 10BaseT twisted-pair wire, and so on.

These layers define the OSI model, which has provided the world with a map for implementing today's telecommunications architecture.

The Rate of Change Is Accelerating

Although no one seems to know for sure, many people speculate that data traffic surpassed voice traffic either in 1999 or 2000. Changes are still moving at a fast clip, even with the retrenching in the telecommunications industry. Author George Gilder[7] explains why he believes the pace of IT change is picking up, and even more importantly, why it will increase faster still.

Gilder notes that the technologies of sand (silicon chips), glass (fiber optics), and air (wireless telecommunications) are governed by exponential rules. Mead's Law, named after Carver Mead of California Institute of Technology, says that N transistors on a sliver of silicon yield N^2 performance and value. It is the rule of semiconductors, which is why this technology has been so powerful. This law of semiconductors now is joined by the law of the telecom—networking N computers yields N^2 performance and value. Combining the two laws leads to the compounding force of exponentials that have been sweeping through the world economy.

Gilder presents the following astounding facts: In 1995, exactly 32 doublings of computer power had occurred since the invention of the digital computer after World War II. Therefore, since 1995, we have been on "the second half of the chess board," and a stream of profound developments has taken place. E-mail outnumbered postal mail for the first time in 1995—95 billion external e-mails to 85 billion postal mails. The number of PC sales overtook the number of TV sales in late 1995. And on and on. Such changes will only accelerate, he predicts. For this reason, everyone in business must become comfortable with technology to cope with a world of ever-increasing technological change.

Bandwidth Abundance?

Gilder also predicts an abundance of bandwidth around the world. He notes that an economic era is defined by the plummeting price of the key factor of production. During the industrial era, that key factor was horsepower, as defined in kilowatt hours, which dropped from many dollars to 7.5 cents. Since the 1960s, the driving force of economic growth has been the plummeting price of transistors, translated into MIPS and bits of semiconductor memory. The latter has fallen 68 percent a year, from $7 some 35 years ago to a millionth of a cent today.

We are now at another historic cliff of cost in a new factor of production: bandwidth. "If you thought the price of computing dropped rapidly in the last decade, just wait until you see what happens with communication bandwidth," says Gilder, referencing a remark by Andy Grove, CEO of Intel. Up to this point, we have used MIPS and bits to compensate for the limited availability of bandwidth, but now we are moving into an era of bandwidth abundance.

Fiber-optic technology is just as important as microchip technology. Currently, 40 million miles of fiber-optic cable have been laid around the world. However, half of it is dark; that is, it is not used. The other half is used to just one-millionth of its potential, because every 25 miles it must be converted to electronic pulses to amplify and regenerate the signal. The bandwidth of the optical fiber has been limited by the switching speed of transistors, 2.5 to 10 billion cycles per second.

The intrinsic capacity of each thread is much greater. There is 10 times more capacity in the frequencies used in the air for communication, from AM radio to KU-band satellite. The capacity of each thread is 1,000 times the switching speed of transistors—25 terahertz. As a result, using all-optical amplifiers (recently invented), we could send all the telephone calls in the United States on the peak moment of Mother's Day on one fiber thread. Putting thousands of fiber threads in a sheath creates an era of bandwidth abundance that will dwarf the era of MIPS and bits. Or to give a more personal example from *Business Week*,[8] downloading a digital movie, such as *The Matrix*, takes more than 7 hours using a cable modem and 1 hour over Ethernet; it would take 4 seconds on an optical connection.

Over the next decade, bandwidth will expand 10 times as fast as computer power and completely transform the economy, predicts Gilder. The issue is whether or not this increase in bandwidth can satisfy new data-intensive applications. The race between supply and demand remains as keen as it has always been.

The Wireless Century Has Begun

The goal of wireless is to do everything we can do on wired networks, but without the wire, says Craig Mathias of Farpoint Group, an expert on wireless telecommunications.[9a] A better term than wireless would be "radio," because most wireless is over-the-air radio signals—for nationwide networks as well as LANS.

Wireless communications have been with us for some time in the form of cell phones, very small aperture terminals (VSATs), pagers, building-to-building microwave links, infrared networks, and wireless LANs in warehouses. Tomorrow's uses span a vast spectrum.

Frank Dzubeck, a long-time telecommunications consultant,[10] agrees, stating that whereas the twentieth century was the Wireline Century, the twenty-first century will be the Wireless Century. The motivation for laying copper wire, cable, and fiber throughout the twentieth century was voice communications. The motivation for wireless is data. Dzubeck sees wireless equivalents arriving that rival today's wireline technologies. But before delving into these alternatives, it's important to understand the distinction between licensed and unlicensed radio frequencies.

Licensed Versus Unlicensed Frequencies

Some frequencies of the radio spectrum are licensed by governments for specific purposes; others are not. The distinction has become very important in the wireless arena because it has led to the rapid innovation, and resulting tumult, the telecommunication industry is currently experiencing.

Anyone can create a wireless device to operate in unlicensed frequencies without first getting a license from the government, notes Heather Green.[11] Wi-Fi and other technologies mentioned here use unlicensed frequencies. This has led to greater competition, more innovation, and faster changes in unlicensed technologies than in those using licensed frequencies. The licensed portions of the spectrum are owned by large companies that can afford government licenses that give them a monopolistic hold on specific frequencies. In the absence of competition, these companies have tended to be more plodding in introducing new innovations. But now they face more fleet unlicensed competitors.

The devices that tap unlicensed frequencies are cheaper than their licensed counterparts because they do not need to absorb the huge billion-dollar licensing fees. This discrepancy has caused major pricing disparities, which is good for consumers, but not for licensees.

The downside of the unlicensed frequencies, though, is the possibility of collisions between signals in these parts of the radio spectrum. That is why there is so much lobbying in the United States for the U.S. Federal Communications Commission to take away frequencies from the major TV broadcasters and open it up for unlicensed uses.

This section discusses wireless technologies for networks that cover different distances, from a few feet to thousands of miles, as shown in Figure 6-4:

- ***Wireless Personal Area Networks (WPANs).*** Networks that provide high-speed connections between devices that are up to 30 feet apart.
- ***Wireless Local Area Networks (WLANs).*** Networks that provide access to corporate computers in office buildings, retail stores, and hospitals, or access to Internet "hot spots" where people congregate.
- ***Wireless Metropolitan Area Networks (WMANs).*** Networks that provide connections in cities and campuses at distances up to 30 miles.
- ***Wireless Wide Area Networks (WWANs).*** Networks that provide broadband wireless connections over thousands of miles.

WPANs

For distances of a few feet, the high-bandwidth wireline technology is USB—the ubiquitous port on PCs for fast connections to printers, monitors, DVD drives, and the like. The equivalent wireless technology, notes Dzubeck, is IEEE 802.15, which is also known as ultrawideband (UWB) and 802.15.3 (WiMedia). It can transmit from 100 to

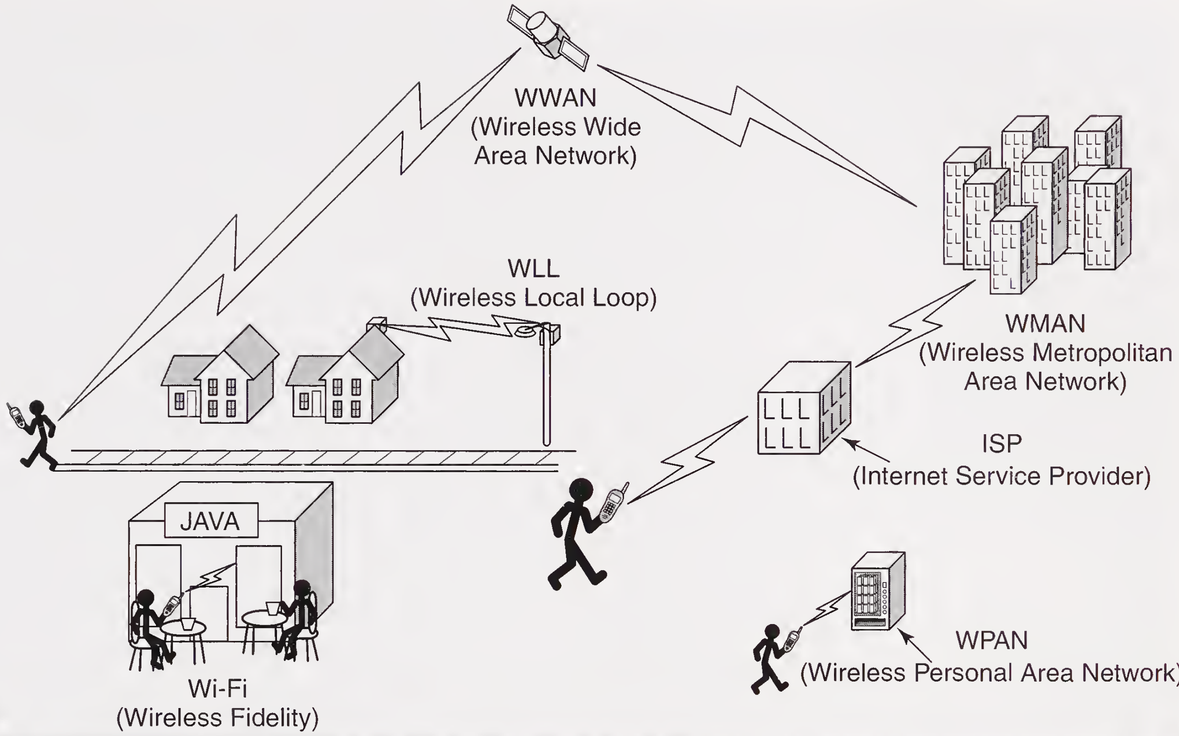

FIGURE 6-4 The Span of Wireless

400 Mbps (or higher), and it uses unlicensed bandwidth. Green foresees UWB being used to transmit huge files from a laptop sitting in the trunk of a salesperson's car to the PDA being held in the front seat. However, standards are not yet in place.

WLANs

For distances greater than several hundred feet, the high-speed wireline technology has been Ethernet, transmitting from 4 to 10 Mbps. Its wireless counterpart is IEEE 802.11, also known as Wi-Fi. Some people call Wi-Fi the wireless technology for the last 100 feet. Using a wireless modem card, which is essentially a radio transmitter, a laptop or PDA can transmit at 11 Mbps. Newer 802.11 standards are increasing speed and distance.

Wi-Fi is replacing wired LANs in offices and creating wireless LANs where none previously existed—hot spots. A hot spot is an area around a Wi-Fi relay antenna that transmits the wireless signal from a laptop or PDA to a nearby computer or to an ISP to link to the Internet. Some hot spots are public; some are private; some are free; others charge by use or subscription. They are now found wherever people congregate—in restaurants, airports, hotel lobbies, parks, convention centers, and so on.

One private use of Wi-Fi is in cash registers so that salespeople can check inventory and prices at the register rather than having to check the racks. Such uses will grow, Heather Green believes, especially for people who must be on the move in an area, such as a hospital, a construction site, a warehouse, an airport terminal, and such.

The following example is a fairly typical use of a WLAN in manufacturing. The importance of this example is that the LAN is used to provide visibility into manufacturing operations, which is a crucial first step that companies need to make internally to take advantage of online commerce.

CASE EXAMPLE

BMW

www.bmw.com

BMW builds more than one million vehicles a year in Germany and the United States. It opened a facility in South Carolina, and more than 30 suppliers have built facilities nearby to work with BMW. When this plant was slated to take on the manufacture of the company's sport-utility vehicle, BMW wanted to implement the new assembly line quickly, which meant helping its suppliers scale up quickly as well.

Real-time delivery of data to the suppliers was one key to moving quickly. Suppliers needed accurate inventory data on the components they were supplying to BMW so that they knew when to make just-in-time deliveries to the plant. BMW uses SAP's ERP system to track parts inventory. To gather the inventory data that needed to be fed into the ERP, BMW decided to place bar codes on each part. The bar codes could then be scanned as the parts moved through the assembly process so that BMW's planners, operations personnel, and suppliers would know the current status of all parts.

Originally, BMW used Intermec bar code scanners attached to hardwired data terminals at different locations on the plant floor. But more recently, it upgraded to Intermec's wireless scanning system. The scanner terminals transmit the data from the bar code readers to the SAP ERP via a wireless network that covers the entire 2-million-square-foot plant. The system uses radio frequency (RF) technology. The move to wireless allows BMW to more quickly reconfigure or expand the data-collection system. Stations are simply moved; they do not need to be rewired.

A number of BMW's suppliers have followed suit and have implemented wireless data-collection networks in their operations. As a result, the supply chain—from supplier to supplier warehouse to BMW's production line to shipment to a dealer—is supported by a flow of data that travels over interconnected wireless and wired networks. ■

WMANs

For distances of 10 to 30 miles, three wireline technologies have been used for local-loop connections and access to cable networks: T-1, cable modem, and DSL.

The wireless equivalent to these wireline technologies is 802.16, which can deliver speeds of 5 to 10 Mbps over these distances. The stationary version is called WiMax (Worldwide Interoperability for Microwave Access). Like Wi-Fi, WiMax creates a hot spot around its radio antenna. It is perfect for aggregating 802.11 hot spots, notes Dzubeck, giving them access to a long-distance carrier network. Proprietary broadband microwave transmission capabilities have been around for years, notes Green, connecting

Frequency	Frequency Name	Technologies	Spectrum Uses
3,000 EHz 300 EHz 30 EHz		Gamma rays	
3 EHz 300 PHz 30 PHz		X-rays	
3 PHz		Ultraviolet radiation	
		Visible light	
300 THz 30 THz 3 THz 300 GHz		Infrared radiation	
30 GHz	Extra high frequency	Microwave	Wireless Local Loop (71–95 GHz) Terrestrial microwave
3 GHz	Super high frequency		Satellites (0.5–51.4GHz)
300 MHz	Ultra high frequency	Radio waves	Wireless LANs (2.4–5.0 GHz) 3G wireless (1,800–2,200 Mhz) 1G cellular (800–900 MHz) UHF TV (500–800 Mhz)
30 MHz	Very high frequency		VHF TV (175–216 MHz) FM radio (88–108 MHz)
3 MHz	High frequency		
300 KHz	Medium frequency		Wireless local loop (1.25 MHz) AM radio (540–1800 KHz)
30 KHz	Low frequency		GSM 2G wireless (200 KHz)
3 KHz 300 HZ 30 HZ	Very low frequency		
7.5 HZ	Earth		

FIGURE 6-5 The Electromagnetic Spectrum and Broadcast Frequencies

2G cellular. Second-generation (2G) cellular, which predominates today, uses digital technology, but is still circuit switched. Although not developed to provide data transmission, 2G phones can carry data. Anyone who has used a laptop computer with a wireless modem to communicate is familiar with 2G data transmission.

2G also can carry messages using short messaging service (SMS). SMS is packet based and is used for paging and short messages, often from one cell phone to another. SMS is a large driver of wireless data services. It has been hugely popular with Scandinavian teens who use it for instant messaging. And in Japan, NTT DoCoMo introduced i-mode phones for Internet services and e-mail in 1999. Within a year, NTT had 6 million subscribers and some 12,000 i-mode sites. Many were for consumer uses, such as banking, ticketing, weather reports, paying bills, and so on.

3G cellular. The goals of third-generation (3G) technologies are to provide WANs for PCs and multimedia devices to access the Internet or to tap other wireless services at data rates of 384 kbps for mobile and 2 mbps fixed. These speeds are orders of magnitude greater than 2G wireless services. They could support multimedia and video. Some believe that low-bandwidth wireless services, such as the BlackBerry e-mail pager and SMS, are still the true killer applications.

It is too early to tell what the killer apps of wireless will be, because the promise of 3G networks is alluring. As Peter Howe notes, "Coming soon to your cell phone: Everything!"[13] Cell phones have gone from just being telephones to being cameras, camcorders, televisions, messaging and gaming devices, Etch-A-Sketch art screens, flash cards, small computers, and digital wallets. They may become whatever consumers want in the future, he notes. The uses truly are exploding. South Korea's SK Telecom even claims to have ring tones that are silent mosquito repellents. Another claims to be a smoke detector. Phones that can send signals to devices remotely, such as starting the home air conditioner so the house is cool when the owner arrives, are being called smart phones.

Of course, one mitigating factor with cell phones is battery life. Companies are investing lots of resources to resolve this issue. Another mitigating factor is input, due to the tiny keyboards found on most cell phones. Speech recognition has long been hailed as the solution to the input problem. Time will tell whether that's what consumers will want, notes Howe. It's part of the digital convergence noted earlier.

Cell phones are also becoming multimodal, supporting 802.11 as well as cellular technology. With this development, notes Mathias,[9b] the cell phone can become the relay point between the Internet (via Wi-Fi) and other devices, such as a notebook computer, PDA, camera, or some other device. The next generation of cell phones with Wi-Fi will act as a type of router, because it is a far cheaper solution than installing a WAN radio in every device, each with its own WAN service (and monthly fee). An example of this technology is Apple's iPhone that was introduced in July 2007. The unit is an integrated digital appliance that can be used as a cell phone, a Web browser, a music and video player, a digital camera, a GPS navigation system, and a Personal Digital Assistant. Apple sold 270,000 units in the first two days of its market entry. Market analysts predict that 45 million iPhones could be sold by 2009 and the integrated technology would redefine the wireless market.

Wireless mesh networks. Mathias[9c] goes so far as to say that wireless mesh networks will become very important. A mesh network is a type of network in which many nodes are both end points and relay points. That is, each node can generate traffic, receive traffic, or pass traffic along to a nearby node.

What's important about a wireless mesh network, notes Mathias, is that it is far more flexible than a wired mesh network because its links are radio signals, not wires.

Paths through a wireless mesh can change, depending on traffic loads, transmission conditions, and such. He believes they are the most flexible network structure ever created. Furthermore, the more users, the more capacity. The downside, though, is that it uses a lot of battery power (a precious commodity these days). Even so, he believes they will influence the future of wireless.

VSAT (Very Small Aperture Terminal). Stationary wireless broadband is best provided today by VSAT, which is why this technology has taken off, notes Mathias. Just look on the roofs of gas stations and chain stores. They all have small VSAT dishes. The speed is 0.5 mbps. Hughes, for instance, provides two-way satellite at hundreds of bits per second—better than dial-up. Numerous wideband VSAT-based services will come online in the next couple of years, he predicts.

Obviously, companies use the Internet to sell their products and services. One company that was an early Internet user has also become an early wireless user, extending its Internet presence to cell phones. That company is American Greetings. Here is the history of its use of the Web.

CASE EXAMPLE

AMERICAN GREETINGS

www.corporate.americangreetings.com

Founded in 1906, American Greetings is the world's largest publicly owned creator, manufacturer, and distributor of social expression products—from greeting cards to giftware. In 2007, it employed approximately 18,000 full-time employees around the world, and serviced about 70,000 stores in the United States and 125,000 worldwide; a $1.7-billion greeting card company, it was a pioneer in utilizing the Web. It launched its Web site in 1996, featuring paper greeting cards, electronic greeting cards, flowers, and gifts.

At Business OnLine97, a conference sponsored by Giga Information Group,[14] the director of electronic marketing for American Greetings described how his firm decided to take advantage of the Web to sell its greeting cards.

The First Web Site

The director noted that his team began its thinking by asking, "Who is our biggest competitor?" The answer was not the other paper-and-ink greeting card competitors. The answer was "forgetfulness." People forget to buy greeting cards. The people who forget the most are those who are on the Internet—men. Although the team could not address forgetfulness at the retail store level, they could address it via the Web—to a potentially huge market—on a self-serve basis.

The company created a Web-based reminder service whereby a consumer can sit down for one-half hour and enter six months' worth of upcoming events that require greeting cards, such as

(*Case Continued*)

birthdays and anniversaries. Once American Greetings has this list, it will send the consumer an e-mail reminder to buy a card shortly before each event. Or, the consumer can select a card on the Web site, and American Greetings will address and mail it and send a follow-up e-mail to the consumer stating when the card was mailed.

The electronic marketing group then realized that being able to talk directly to consumers could be used as a value-added service. As a promotion, they sent 50,000 e-mail messages to people who had asked to be reminded of Mother's Day. But rather than simply send the reminder, they offered free postage for any Mother's Day card bought online. The response was overwhelming. In fact, it was far more successful than the group expected. An even more recent Mother's Day promotion swamped the site.

To build brand loyalty, the electronic marketing group went further by taking advantage of a unique attribute of the Web—personalized marketing. American Greetings has some 35 licenses with well-known brands. One, for instance, is with the National Football League. The electronic marketing group has leveraged these 35 licenses using the profile each consumer fills out for the reminder service. For instance, if a consumer notes in his profile that he is a football fan, he may receive a special promotion to buy a specific NFL card when he visits AmericanGreetings.com.

The manager's goal for all of these services—reminder service, electronic cards, and personalized online marketing—has been to build brand loyalty and establish switching costs so that customers will purchase all of their greeting cards from his company.

Not only is he targeting the consumer market, but he is also aiming at the enterprise market, especially salespeople and bosses. These people are likely to see greeting cards as a nice gesture, which will help them maintain and improve relationships with customers or subordinates.

Forming an Online Alliance

The demographics of card buying have changed over the past 20 years. Twenty years ago, 65 percent of greeting cards were bought in specialty card shops. Today, 66 percent are bought in mass retail chains, where the buyers are younger. American Greetings is the leader in this mass retailing channel. To continue as a leader, the company had to find new ways to offer greeting cards. The Internet is one possible channel.

To tap that channel, the electronic marketing group extended American Greetings' alliance with Wal-Mart to the Web. When consumers visit Wal-Mart's online greeting card section, they are actually sent to American Greetings' Web site through a special side-door Wal-Mart entrance. American Greetings then gives Wal-Mart a percentage of sales from these consumers' online purchases.

By using the side-door approach to link the two sites, American Greetings can track the origin of the purchaser and thereby pay Wal-Mart the agreed-on percentage. In addition, American Greetings can make its site appear to be part of Wal-Mart, strengthening Wal-Mart's brand. In reinforcing Wal-Mart's Web-based distribution channel, American Greetings also becomes a value-added partner, which is important if Wal-Mart decides to consolidate greeting-card suppliers.

In addition, to spur purchasing on the Web as well as at Wal-Mart's stores,

(Case Continued)

American Greetings has given online purchasers of greeting cards a money-off coupon that they can print out on their printer and take to a Wal-Mart store. Thus, each partner hopes to increase the traffic of the other. In so doing, they tighten their alliance, both in the marketplace and the Web marketspace.

Consolidating Its Online Presence

AmericanGreetings.com is the online greeting and personal expression subsidiary of American Greetings. Its network of sites in early 2002 was one of the world's top 15 Web sites, with more than 16 million unique monthly visitors. The company says it offers the largest selection of online greetings. To achieve that status, the company has acquired BlueMountain.com, Egreetings.com, BeatGreets.com (featuring musical greetings from over 200 artists), and Gibson Greetings.

American Greetings sees its mission as helping "people everywhere express their innermost thoughts and feelings, enhance meaningful relationships, and celebrate life's milestones and special occasions."

Moving to Wireless

Today, members of American Greetings' online card club, who pay $14 a year for membership, receive a choice of thousands of greeting cards, and they can create and print paper cards, invitations, package decorations, business cards, newsletters, stickers, and more on their color printers. Their personalized site contains their profile, favorites list, address book, list of cards sent and to whom, and a reminder list.

To extend the usefulness of membership, American Greetings teamed up with Nokia in 2002 to create a wireless Web presence. Using the WAP browser built into a Nokia phone, members can access American Greetings' WAP-based Web site to send an electronic greeting, either to another phone or to a computer. The company reasons that when people have idle time, besides checking e-mail or playing a game using their cell phone, they also might want to send a funny animated card to someone. ■

Is Wireless Secure?

Security is a major issue today. Security analysts have long assumed that hackers who have been intruding computers would soon attack smart phones, whose advanced network connections and operating systems continue to become more interoperable with computer networks and servers. When both wireline and wireless use the IP protocol, both will rely on the same kinds of security. Until that happens, though, different approaches are needed. Wireless security is not really a major additional concern, notes Mathias, because signals fade fast when they travel through the air. Eavesdroppers need special equipment to pick up radio signals from far away. Radio scrambling and spread-spectrum technologies add security, encryption protects data, and eventually, 802.11i will provide a framework for security.

However, the network is often not the main problem. Security leaks happen at the end, in the notebook computers or the smart phones. Therefore, users of wireless appliances should only visit Web sites that they know, use the Wi-Fi network they trust, try not to open Web links from e-mails, and, if needed, encrypt the data before they send them out.

Is Wireless Safe?

Although a lot of attention is focused on wireless services, a troubling question has not yet been answered: Are these transmissions safe for humans? The higher-frequency services are in the microwave range. They use almost the same frequency as microwave ovens. Microwave frequencies are more dangerous than lower-frequency radio waves because they cause molecules to vibrate faster, causing heat as the molecules rub against each other. This is how microwave ovens cook food. The power limits on cell phones, wireless modems, and WLANs (3 watts) aim to protect people from this short-term microwave heating phenomenon, says Roth.[15] Microwaves operate at 500 watts. Long-term effects from low-level vibrations that do not raise body temperature are still possible, though. Some studies on rats showed damage to DNA, which can cause diseases such as cancer.[16]

Although such health concerns have been dismissed by many scientists and scientific studies, their confidence has not settled the issue. Many have long believed that electromagnetic radiation from power lines, electrical appliances, and computers can interfere with the body's bioelectromagnetic field, causing an imbalance.[16] These imbalances leave people feeling drained, fatigued, and stressed out. Although it is likely that our bodies can rebalance disruptions caused by occasional exposure to electromagnetic radiation (EMR), frequent bombardment likely has an effect. It is probably difficult to directly link exposure to disease; it is more likely that exposure will gradually lower a body's immunity.

The amount of radiation emitted by cell phones is limited by governments, but these limits are averages. Spikes are possible, and these are known to kill cells; therefore, holding a cell phone next to one's head for prolonged periods of time is not wise. Voice use of cell phones by young people is especially disturbing. Thus, it is quite possible that there could soon be a backlash against wireless devices similar to the protests against genetically modified organisms.[16] Objective research is needed and protection could become a hot topic. Anyone care for metal-lined hats?

In conclusion, the success of wireless is guaranteed. People will not give up being mobile. There is no substitute technology, but we advise prudent use.

Messaging Is a Killer App

What has proven true with data-communication technologies over and over again is that the killer application is messaging. As noted earlier, the original inventors of the Internet expected it to be used by researchers to send files back and forth. Instead, researchers used it mainly for e-mail. And e-mail has remained a major use. In the wireless arena, the BlackBerry messaging service is indispensable to many people, and the driving force for wireless data services using 2G phones in Scandinavia and Japan has been SMS.

Likewise, instant messaging (IM) has become an important mode of communication. Importantly, it appears to be the current preferred mode of communication among young people. In his 2004 keynote address at Networld + Interop, Andy Mattes,[17] president and CEO of Siemens Information and Communications Networks, USA, included two brief video clips of five children, ages 8 to 11, talking about how they communicate with their friends. Behind several of them was a computer screen, often showing a couple of rows of open IM chat boxes, lined up side by side. As the children explained, they use IM to chat with all of their friends at the same time. One boy only uses the phone once a day, to call his Mom (who works in the computer industry). Another girl says that she does not use the phone because then she can only talk to one friend at a time. And she does not use e-mail because it is like regular mail—slow. In short, they prefer to chat with many friends at once. IM gives them this capability.

Many see IM as the killer app of wireless as well, not just for teenagers, but for businesses. Steven Cherry[18] points out that the U.S. Navy's Office of the Chief of Naval Operations turned to IM to communicate with its displaced employees who could not use the secure telecommunications system following the September 11, 2001, terrorist attacks. Top naval officers now use this specially designed and secured IM system routinely to communicate with each other and with their staffs. In addition, the U.S. Navy has connected 300 ships at sea with IM. Whereas teenagers use IM to chat, corporations and other enterprises are using it to quickly ask a question of someone, to share documents, and to exchange notes, says Cherry.

Newer technologies will allow messaging to become even more personal. This is one reason why camera phones have become so popular: a picture is often more personal than a voice description. Photo messaging will add to voice and text messaging. Video messaging is more personal still. Video phones will allow others to be there—a sick grandparent will be able to attend a graduation, a traveling mom will be at a grade school play, and a far-off relative can help celebrate a birthday party.

The key attribute of IM is that it provides presence, which means that a person on your buddy list can see when you are using a computer or device (if it has the appropriate IM software and service) and therefore knows that you are present and available to receive an instant message. Presence is being built into collaboration software, Webcasts, and online games as well. The downside of presence, of course, is that people with large buddy lists can be deluged with instant messages whenever they have their phone or computer on.

Always on is the communication mode of the future because it allows instant notification. For example, a sales team may ask to receive news releases and intranet entries about their specific clients or their main competitors, so they are always up to date. If the team's devices support a team calendar, team members might be able to schedule a quick telephone conference call if they receive important news, such as a competitor trying to snag an important customer or information about a market test. Or, they might just collaborate asynchronously via SMS. On-the-go multiparty collaboration is an important use of low-bandwidth wireless devices, and it could become the same with high-bandwidth devices. Or, a collector might ask for instant notification when specific items within specific price ranges come up for auction. The service might give the collector one-click transaction capabilities so the collector can bid on an item once he or she receives notification.

Mei Chuah, a researcher at Accenture Labs,[19] foresees cell phones, their IM capabilities, and online commerce commingling physical and virtual worlds. She believes the cell phone will become a person's portal to other people, physical things, and virtual entities as well. All will be part of a person's social network. Personal devices (including our cars) will be "socialized" by having communication capabilities and will potentially communicate wirelessly with each other. Phones will have sensing and even control capabilities. For example, a software robot in the phone will "sense" what friends are doing, and connect those who are, say, watching the same TV program or downloading the same song. Once companies realize they can sell more products and services to consumers by creating social activities (including virtual ones) around their products or services, even more types of things will be given communication capabilities.

Furthermore, Chuah sees the physical and virtual worlds interconnecting, with social networks in one moving to the other. People in virtual worlds already hold parties over the Internet. Such socializing in one world will flow to socializing in the other. Furthermore, items in one world will move to the other. Chuah cites the example of the virtual sword won by an advanced player in the online game Everquest being sold on eBay. Wireless communications will eventually link both worlds, she believes, and the nexus will be the cell phone.

A current-day example of using IM to sell products is Keebler's RecipeBuddie.

CASE EXAMPLE

KEEBLER

www.keebler.com

Founded in 1853, Keebler is today the second-largest cookie and cracker manufacturer in the United States, and a subsidiary of Kellogs.com. In September 2002, Keebler launched RecipeBuddie on its Web site, notes Gordon Bass.[20] "She" is an instant-messenger bot that converses with people who IM her. But she only talks about recipes, using her database of 700 recipes to, say, help someone figure out what to cook for dinner. Keebler's goal, of course, is for her to get people to buy more Keebler products. She has been given the personality of a humor-filled suburban housewife, which seems to best fit the demographics of Keebler's audience: suburban women ages 25 to 54.

Her origin is ActiveBuddy, a company founded by Timothy Kay that builds interactive agents (bots) to run on IM networks, private networks, and wireless networks. RecipeBuddie, for example, sits on someone's AOL IM buddy list and can answer natural-language questions about recipes. She can be accessed at www.keebler.com.

Emedia, the developer of Keebler's Web site, built RecipeBuddie using the scripting language BuddyScript (from ActiveBuddy). Development entailed writing scripts to reply to user questions. For RecipeBuddie, each natural-language response acknowledges the other party, repeats the request, and makes a suggestion, which is often one or more recipes. Scripting entailed making the link between what people might ask about (cooking dinner for the kids, a picnic lunch, no onions, feeling sad, etc.) and recipes in the database. Emedia initially wrote 2,000 pieces of dialog for RecipeBuddie, notes Bass.

(Case Continued)

Once developed, Emedia had to get permission to launch RecipeBuddie on the three major IM networks: AOL, MSN, and Yahoo! ActiveBuddy receives a fee every time RecipeBuddie is accessed. Keebler tracks the number of people who put RecipeBuddie on their buddy list, the number of messages exchanged with RecipeBuddie, and the number of recipes viewed and printed.

RecipeBuddie has been very successful, exceeding Keebler's expectations. The main developer, Anna Murray of Emedia, notes three lessons she learned from building the bot. One, users really like to converse with bots, so a lot more can be done with them. Two, scripting is like writing a novel, so it needs to be done by just a couple of people, and they need to work together very closely. And three, others, besides the original scripters, should be able to add their own content, such as answers to frequently asked questions.

In 2006, Kesebler launched another similar concept. HollowTree4Kids, an interactive online game, is an entertainment platform for children, and, along the interaction, promotes Keebler's line of products. ■

An Internet of Appliances, Traffic Prioritization, and Network Neutrality

Wireless communications are not just for people, of course. A machine-to-machine Internet is coming, notes Andy Reinhardt[21] and Heather Green.[11] Machines will likely use Wi-Fi as one wireless communication protocol. Another protocol is ZigBee, a radio-based communication standard used by tiny sensors. Such sensors might monitor the main systems in a vehicle; the inventory of ice cream in vending machines; a building's HVAC system; or the soil moisture, nutrients, and temperature in a field as well as a myriad of other uses.

The sensors are designed to send specific bits of information, be long lasting, require little energy, and communicate efficiently. With ZigBee, the sensors pass their information on to the next sensor in a sort of bucket-brigade fashion, with the last one passing the data to a computer for analysis or communication, notes Green.

Yet another protocol that involves communication among things is radio-frequency identification (RFID), which is discussed in Chapter 11. Like the bar code, it is a technology that involves small tags affixed to objects that provide information about the object. For example, an RFID tag on a package could tell a scanner where it is going, where it has been, the temperature range it has experienced (if that is important to the contents), and so on.

The problem CIOs face is tying such new sensor-based systems into their corporate databases. It is likely that the communication systems will use a mix of wired and wireless technologies, as appropriate. That is just one challenge.

Another challenge is Internet traffic prioritization. When Internet traffic loads exceed the routing and transmission capabilities of the networks, network administrators must manage data traffic flows by changing the queuing procedures—likely from a "first come, first served" basis to some prioritization policy. Initially, the open architecture concept discussed in Chapter 5 is based on the principle of equal priority in transmissions or Internet Neutrality. However, with the increased demand on bandwidth, many stakeholders in the telecommunications industry, such as network providers, argue that users (private citizens and business organizations alike) should pay to increase the priority of the transmissions over other users. Customers who pay would get data transmission faster and with higher quality. Those who do not may see their Internet use delayed. For example, a large bank that pays a premium Internet service would be able to transfer data faster than would its smaller competitors that just subscribe to a basic service. To say the least, this view is not universally accepted. Many user groups and policy makers see the concept of charging a fee for prioritized data handling over the Internet is a distortion of the basic elements of equality and openness promoted by the Internet.

The issue is not new, and the industry knew it would eventually surface. It did in 2006, when new software and hardware have made traffic management possible. Technically, network administrators can now prioritize Internet traffic at the router level by examining the destination IP address, port, and contents of the IP packet to determine its payload before passing it over the networks. The new technology allows them to regulate the traffic according to configurable rules.

THE ROLE OF THE IS DEPARTMENT

This long discussion of telecommunications gives just a glimpse into its complexity as well as its increasing importance. Given this central role of telecommunications networks, what is the IS department's role? We believe IS has three roles: create the telecommunications architecture for the enterprise, run it, and stay close to the forefront of the field.

Planning and Creating the Telecommunications Architecture

A network architecture needs to contain a set of company policies and rules that, when followed, lead to the desired network environment. The key challenge in network design is connectivity to improve productivity and business opportunities. Technically, connectivity means allowing users to communicate up, down, across, and out of an organization. The goal is not a single coherent network, but rather finding the means to interface many dissimilar networks. One guiding principle is to build systems that are coherent at the interfaces so that users think they are only dealing with one network. As discussed in this chapter, telecommunications services include voice and data, and the architecture is a portfolio of services to include local voice mail, domestic and international long distance, mobile voice mail, calling cards, home broadband, high-speed data such as frame relay, remote access VPN, and wireless e-mail and data services.

The second key concept in architecture design is interoperability, which means the capability for different computers, using different operating systems and on different networks, to work together on tasks—exchanging information in standard ways without any changes in functionality and without physical intervention. A truly interoperable network would allow PCs, laptops, handhelds, devices, and objects to interoperate, even while running different operating systems and communicating over IP networks. This interoperability is the goal of architecture and is the main job of the IS department.

Managing Telecommunications

The second job of the IS department is to operate the network. This subject is discussed in Chapter 8, "Managing Operations." Here, we focus on some business challenges that are specific to telecommunications.

An increasing area of concern for top management is to manage telecommunications expenses. As usage spreads out beyond corporate boundaries to suppliers and customers with multiple providers, errors related to the billing of telecommunications charges are becoming more common. Numerous industry reports suggest that poorly controlled telecommunications expenses can reach between 10 percent of a large organization's IT budget, or 30 percent of a highly distributed organization.

The major causes of excessive telecommunications costs include:

- ***Fragmentation of procurement:*** Many companies allow their business units to independently contract telecommunications services. The policy makes sense since units are geographically distributed, and operated in different countries or states. However, the fragmentation of procurement often leads to less than optimal procurement.
- ***Service usage:*** Service plans do not match actual use. For example, an organization unit leases a high-speed WAN, and the network is consistently underutilized. Conversely, other departments do not buy enough airtime in their monthly rate plans for mobile subscribers, and incur additional surcharges.
- ***Unauthorized use:*** Excessive or unauthorized use by employees or business partners increase costs. Furthermore, it could also decrease the overall performance of the communications sytems. Examples include unnecessary use of directory asistance, long-distance charges, heavy download of non-work-related files, and Internet access from mobile devices.
- ***Billing inaccuracies:*** Software bugs have been criticized for many billing errors. Lack of rigor in managing auto-payment lets the organization to continue paying the service providers while the employee-subscribers did cancel the services.

CIO's can help develop a telecom management information system that uses a portfolio approach to maximize telecommunications resources while minimizing the overall costs. Communication needs change along with business activities. Communication costs depend on the competitive situation of the industry. Therefore, a telecommunication MIS can help identify, report, and audit costs between locations, allocating resources based on changing needs and cost schemes (for example, promotional discounts, or volume discount from a telecommunications provider). Suffice it to say here that many companies are outsourcing this work to companies that specialize in network management because the issue is so complex, and there are too few network specialists to go around, and network infrastructures are costly investments.

Managing voice and data security should be another top priority for the CIO. By their very nature, telecommunications expose the business to its external world. Maintaining security outside the firm's boundary is difficult. Also, the organization should put into place disaster recovery planning to minimize possible disruption of business activities should the systems stop working. Network redundancy practices and disaster plans are critical but expensive. Management should carefully weigh the benefits and costs. It should also revisit their decision periodically.

Keeping Abreast of Telecommunications Technology Policy

The third job of IS is to stay current with the technology, and explore new business models to use new technologies for competitive advantages. As an example, if an IS department is not already experimenting with how handheld devices can interact with its Web site, they are behind competitors who are. Keeping abreast of new development requires continually peering into the future and testing out new ideas. It is a crucial job of IS departments, even when budgets are tight.

We alluded the current debate on network neutrality. The issue is rather complex involving social justice, business competitiveness with Internet prioritization seen by some as barriers to entry, technological innovation, and investment. It is important for IS to watch the political debate carefully. Any decision made will ultimately affect the impact of telecommunications on the performance of the organization.

CONCLUSION

The telecommunications world is big, and getting bigger by the day. It is complex, and becoming more complex. Some see it as a global electronic highway system where the goal is to establish links and interoperability. Others see it as a cyberspace where commerce is conducted and businesses operate.

The business world of old depended on communications, of course, but not to the extent of online commerce. The Internet unleashed e-mail, then Web sites for getting noticed globally, and now it is used for transactions and business. Although worldwide communication over the Internet enables global business, it also has the opposite effect: customized personal service to individuals anywhere, anytime.

For many companies, telecommunications services account for some of the largest expenses. For many reasons presented in this chapter, managing these expenses is a real challenge for management.

QUESTIONS AND EXERCISES

Review Questions

1. What are the two ways to view telecommunications?
2. What is the Internet? What three attributes make it important to businesses?
3. Describe the functions of hubs, switches, and routers.
4. What is digital convergence and why is it important?
5. Briefly describe each layer of the OSI Reference Model.
6. Why are unlicensed frequencies important?
7. What are four types of wireless area networks?
8. How is American Greetings moving into wireless?

9. Why might wireless devices not be safe for humans?
10. What is presence and why is it important?
11. Why is always on important?
12. What is RecipeBuddie and what does she do?
13. What is ZigBee?
14. What are the three roles of the IS department with respect to telecommunications?

Discussion Questions

1. The chapter implies that a company should stay at the forefront of telecommunications technology lest it fall seriously behind. On the other hand, it might be better to let others go first and then learn from their mistakes. When is each approach most appropriate? Why?
2. None of us needs a phone at home and a phone at the office. All we need is one phone that we always carry around. Such a practice would relieve the pressures on the telephone system for so many additional phone numbers and area codes. Better yet, each phone should have an IP address. Discuss the pros and cons of these ideas.
3. Although having a wireless device is handy, it is also an intrusion. People need some privacy. They should not always be reachable. Discuss.

Exercises

1. Read five articles on telecommunications.[22] What developments not discussed in this chapter do they see as important and why? Present a short briefing on these issues to the class.
2. Contact the CIO of a company in your community. What is the company's telecommunications architecture? What telecommunications standards does it use? How is it using the Internet? What is it doing about wireless?
3. Find one article that discusses senior management's or line management's role in either telecommunications, the use of the Internet, or online commerce.[23] What role do they play? Are they in partnership with IS? Discuss.

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CHAPTER

7

MANAGING CORPORATE INFORMATION RESOURCES

INTRODUCTION

In today's organizations, IS has been continually managing new forms of information resources in addition to the ones it has already been managing.

- Corporate databases are still a major responsibility of IS organizations, and management of data has gotten increasingly complex as it has become distributed and more prone to security problems. Not only are data now global in some cases, but the data are housed in a variety of database models, such as hierarchical, relational, and object-oriented ones. Data related to daily transaction processing grow at an exponential rate, and are stored in data warehouses.

- Information, in the form of documents (electronic or paper) and Web content, has exploded the size of the databases that organizations now manage. With the digitization of sound files, photographs, video, and 3D models, file sizes are growing at a fast clip. Unlike structured data, these unstructured forms of information are not easy to index for retrieval purposes.
- Knowledge management is becoming a key to exploiting the intellectual assets of organizations. The types of knowledge organizations are attempting to manage include explicit knowledge (know-what), which can be housed in a file or a process, as well as tacit knowledge (know-how), which is generally in people's heads and is difficult to make explicit.

This chapter deals with all three areas. Data and information (in the form of documents and content) are discussed in this chapter. Knowledge and related intellectual capital topics are discussed in Chapter 14. We begin by discussing managing data.

Managing information resources initially meant managing data, first in files or archives, then in corporate databases that were well structured, carefully defined, and generally under the jurisdiction of the IS department. Next, the term expanded to include information; that is, data that has meaning to those who use them. These include, but are not limited to, corporate reports, discussion minutes, e-mail archives with subject threads, etc. There also has been much talk of managing knowledge. With the emergence of the Internet, talk has turned to managing content, which includes text, graphics, sound, video, and animation. Managing them all is now included in our discussion of information resources in this chapter and in Chapter 14.

To begin, a few definitions are in order:

- Data consist of facts devoid of meaning or intent, where meaning and intent are supplied by a particular use.
- Information is data in context, which means the data have been given an explicit meaning in a specific context. In this book, we will often use the term "content" to refer to information. This term arose with the emergence of the World Wide Web. Content includes information presented electronically in a variety of media: charts, text, voice, sound, graphics, animation, photographs, diagrams, and video.
- Knowledge is information with direction or intent, where intent is derived from strategies or objectives.

An as example, consider two pieces of data: 1 and 121. They are just two numeric data that do not mean much. However, when put into context—U.S. $1 = Yen114 on August 17, 2007, the two numbers represent the currency conversion between the U.S. dollar and the Japanese yen. Furthermore, when the daily exchange rates are plotted on a chart, say, between March 15 and June 15, 2007, showing a consistent appreciation of the dollar against the Japanese yen, a foreign currency exchange analyst may reason and argue that the American currency is likely to continue to appreciate in the next coming days. The necessity to transform "meaningless" data into useful knowledge is well understood by businesses that invest significant resources into data analyses or business intelligence.

As the breadth and volume of the kinds of information resources have expanded, so has the job of managing them. This task is commonly known as data management, with data as a valuable resource. Data management encompasses development of computer architectures and policy and procedures in order to collect, store, manipulate, and distribute data to those who need them. Oftentimes, that job of managing data ends up in the IS organization, even though it may not have started there. For example, when PCs came on the scene, people created their own personal files to do their work. They depended on these files, but no one else did until they were shared. Then, when shared files were destroyed and had no backup, all of a sudden a department might not be able to function. Therefore, users asked IS to back up the file or house it on a computer that was regularly backed up. Thus, IS became involved. The same has occurred with Web content. When departments and field offices initially created their own Web sites, IS often was not in the picture. However, as the need for recovery, version control, corporate consistency, and such appeared, people again looked to IS to put in the necessary management procedures.

MANAGING DATA

To manage data, it is important to define in a structured way how data are represented, stored, and retrieved for use. A well-designed data structure helps reduce problems related to data storage (e.g., undesired duplication of records, multiple updating of records) and allows efficient manipulation of data (e.g., combined daily data into annual data). Ideally, each data item should be entered in the database only once. For example, for a company, an employee's name should be recorded and stored at a single location, and that database administrator should be able to retrieve to whomever needs this information, either for payroll, production, or social activities. Also, if daily data are stored, there is no need for storing weekly, monthly, or annual data, since the latter can be computed from the daily records. Thus, storage is likely less wasted and data retrieval for computation is faster.

Next, it is important that data adhere to a set of rules or constraints to ensure their integrity or correctness. For example, a business can define a business rule—"If a bank withdrawal is more than $500, then the balance of the account must be at least $700," or "The authorized discount must not exceed 20 percent."

Since the 1960s, Database Management Systems (DBMS) are the main tools for managing these entities in the business world. Data are valuable resources and, throughout the evolution of computer technology, companies have adopted many types and versions of DBMS to manage data to support daily business. Over the years, major mission-critical DBM applications were built in many sectors of the economy from manufacturing to services, creating legacy applications. DBMS are based on two major principles: a three-level conceptual model and several alternative data models for organizing the data. We briefly describe them here, from the perspective of the managers seeking to understand the fundamentals of DBMS. Interested readers should seek more detailed materials.

The Three-Level Database Model

One of the easiest-to-understand discussions of database technology is by James Bradley[1] in his description of the three-level database model. The concept is still an underpinning of the DBM field. The following discussion is based on Bradley, Martin,[2] and Atre.[3] It begins with the level that the application developer sees.

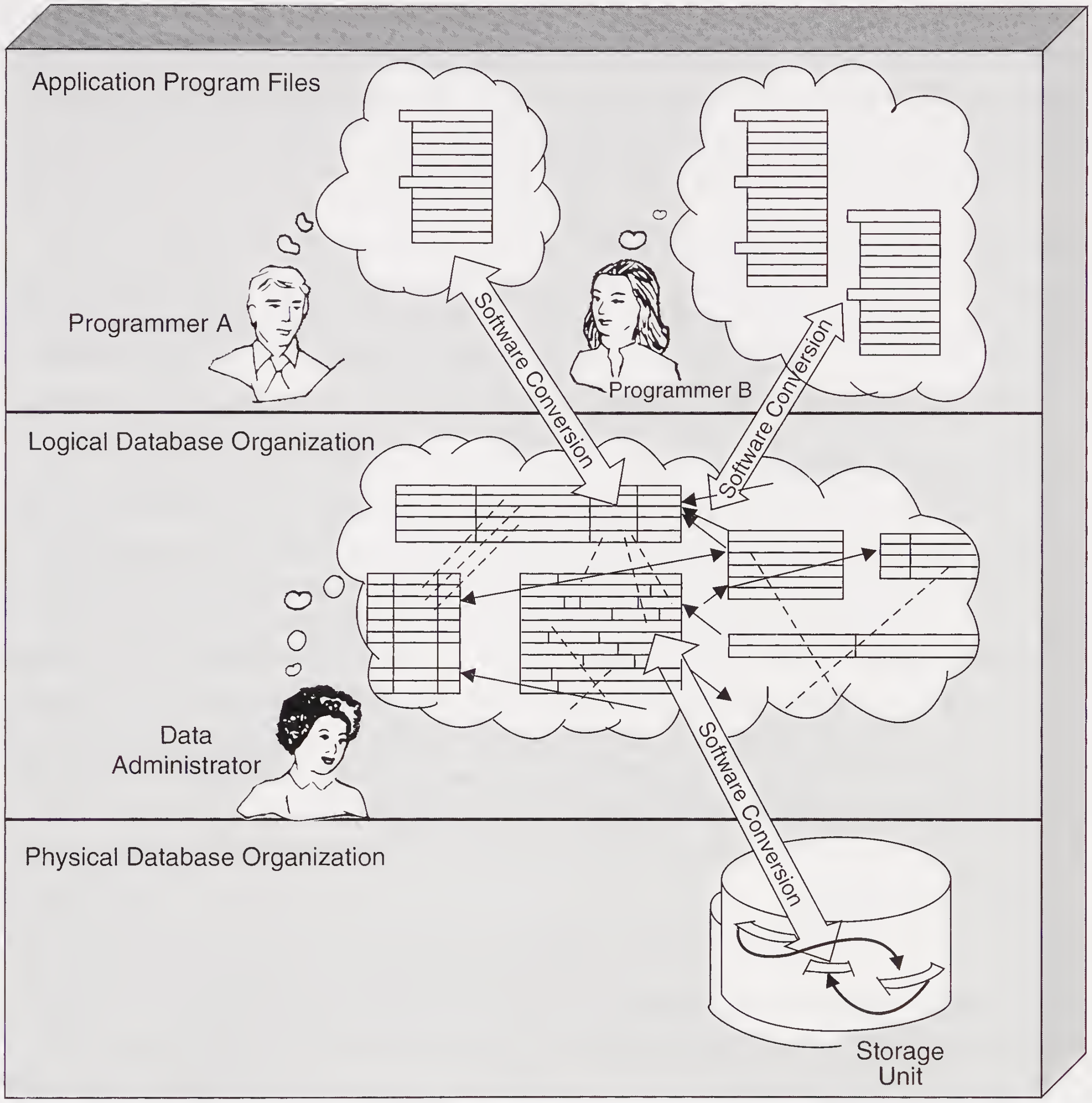


FIGURE 7-1 The Three-Level Database

Source: James Martin, *Principles of Database Management* (Upper Saddle River, NJ: Prentice Hall, 1976).

- Level 1 is called the external, conceptual, or local level. As Figure 7-1 illustrates, this level contains the various user views of the corporate data. Each application program has its own view. This level is not concerned with how the data are physically stored or what data are used by other applications.
- Level 2 is called the logical or enterprise data level. It encompasses all an organization's relevant data under the control of the data administrators. Data and relationships are represented at this level by the DBM. This level contains the same data as Level 3, but with the implementation data removed.
- Level 3 is called the physical or storage level. It specifies the way the data are physically stored. A data record consists of its data fields plus some implementation data, generally pointers and flag fields. The end user, of course, need not be concerned with these pointers and flags; they are for use by the DBM only.

The advantage of this three-level model is that Level 2 absorbs changes made at Level 3, such as using a new physical storage method, so that individual application programs in Level 1 do not need to be changed when the physical layer changes. Furthermore, data only need to be stored once in Level 2, and different programs can draw on it and vary the relationships among the data.

Four Data Models in Business

The second major concept in database management is alternative ways of defining relationships among types of data. Data models are methods to structure data to represent the real world and the way data are accessed. Five main data models are in use today: hierarchical, network, relational, and object.

Hierarchical Model

In this model, each data element is subordinate to another in a strict hierarchical manner, like the boxes on an organization chart. This model uses the terminology parent and child to represent these relationships, and each data item can have only one parent. For example, a company (a parent) has many departments (children). Next, a department (parent) has one or more than one unit (child). Then, in the third level, each unit (parent) has employees (children). Therefore, data related to the company, departments, units, and employees are structured like a tree, and to look for data, the user "navigates" through that hierarchy; no shortcut is allowed. This model is intuitive to the users as it reflects the hierarchy of most organizations.

Network Model

Invented by Charles Bachman, and officially developed into a set of standard specification by the Conference on Data Systems Languages (CODASYL), the network model seeks to provide a more flexible, less hierarchical approach to store data items. Instead of having a tree of records, the network model allows each record to have multiple parent and child records, forming a lattice structure. Assembly parts lists illustrate this structure; the same part can be used in more than one assembly. In both the hierarchical and network models, the data relationships are stated explicitly, generally by pointers stored with the data. These pointers provide the means by which programs access the desired data records. Compared to the hierarchy model, the network configuration allows more direct access to data. However, it can appear messy because the files are pointed to others. In the 1970s, Bachman combined the network model (to allow for fast data access) with the hierarchy model (to allow for easier use). This technique is called navigational since Bachman sees the computer programmer as the "navigator" who uses computer commands such as "next," "previous," "first," "last," "up," "down," etc., to search for stored data. Except for hierarchical file systems, navigational systems lost its importance in the 1980s in favor of the relational model. However, similar concepts are being reused in object-oriented programs and XML.

Relational Model

Edgar F. Codd of IBM[4] proposed the relational model in 1970. The idea is to find a way to store data in a form that is intuitive to the users, while improving database management efficiency.

Relational databases store data in tables like spreadsheets that represent entities. An entity is a real-world thing or a business object like "client," "part," or "factory." Each row of the table, called a tuple, represents a particular entity or instance (Mr. Smith, North East, 202-555-1234). Each column represents an attribute of the entities; For client, client (last name, region, phone number); part (part number, part description, part location). For each record, there is a "key" that uniquely defines a particular record.

For example, for the client record, the client account number would be unique, and can be used as a key. Instead of creating large tables that could create many storage problems (e.g., empty or redundant values), the relational model allows tables to be decomposed into "normalized" (or in nontechnical terms, optimal) tables that can be joined whenever needed through algorithms or "tuple calculus." With tuple calculus, various kinds of operations can be performed on the data, such as selecting one or more columns, projecting one or more rows, joining rows from several tables by matching column values, and such.

Relational systems are not as efficient as hierarchical or networked database systems, where navigational maps through the data are predefined. However, because relational systems allow people to create relationships among data on the fly, they are much more flexible. Thus, they were first used to handle end-user queries and they are now widely used in high-volume transaction systems with huge files. Relational has become the database technology of choice in business. All major software developers, to start with IBM (System R), and later, Sybase, Informix, Oracle, Microsoft SQL Server and MS Access, and many others, have made SQL (Structured Query Language) a standard database management language in business applications, large and small.

Object-Oriented Database Model

The term "object-oriented database systems" first appeared in the mid-1980s. The concept is the combined result of a series of research initiated a few years earlier (Brown University, University of Wisconsin, MCC, Hewlett-Packard, Texas Instruments, IBM, and others). The object-oriented approach expands the view of data by storing and managing objects, each of which consists of the following:

- A piece of data
- Methods, or procedures that can perform work on that data
- Attributes describing the data
- Relationships between this object and others

Objects are important because they can be used with any type of data, whether a traditional name or address, an entire spreadsheet, a video clip, a voice annotation, a photograph, or a segment of music. A collection of objects is called an object database.

Object-data-management (ODM) techniques draw from the past. They retain traditional DBMS features, including end-user tools, high-level query languages, concurrency control, recovery, and the ability to efficiently handle huge amounts of data. They include two other important concepts as well. One is object management, which is the management of complex kinds of data, such as multimedia and procedures.

The other concept is rule management, that is, managing large numbers of complex rules for reasoning and maintaining integrity constraints between data.

Benchmarks between ODBMS and relational systems suggest that ODBMS perform better for certain types of database manipulation, especially in scientific and engineering applications. To date and with the exceptions of a few niche applications such as financial and telecommunications services, ODBMS have made little progress in mainstream business applications. Relational systems with SQL technologies remain dominant. Perhaps the most fundamental reason for the slow adoption of ODBMS, despite its proven benefits, is the philosophical difference between the legacy RDBMS and new object-oriented programming.

Stonebraker and Kemnitz[5a] provide an example of an application that requires object management as well as data management and rule management. It is a newspaper application that needs to store text and graphics and be integrated with subscription and classified ad data. In this application, customer billing requires traditional data management, whereas storage of text, pictures, and the newspaper's banner require object management. Finally, it needs the rules that control the newspaper's layout. One rule might be, "Ads for competing retailers cannot be on facing pages." Stonebraker and Kemnitz believe that most data-management problems in the future will require all three dimensions: data, object, and rule management.

The tenets of objects become even more important in the world of Web Services because the XML modules utilize object principles. You can think of objects as little black boxes. They tell you what data they need to perform their function and what output they will give you. However, they will not tell you how they perform their function. If they need help performing their work, they send a request to another module. So, in addition to handling all varieties of data, objects provide a programming discipline to Web Services.

Silberschatz, Stonebraker, and Ullman[5b] give the following examples of typical, yet complex, database applications that may require objects.

- CAD data for a large office building must maintain and integrate information from the viewpoints of hundreds of subcontractors. For example, when an electrician drills a hole in a beam to run an electrical wire, the system should, ideally, recalculate the stresses on the beam to ensure that its load-bearing capabilities have not been compromised.
- Large retail chains record every product code scanned by every cashier in every store. Corporate buyers explore this data using ad hoc queries to uncover buying patterns. This procedure, called data mining, is growing, not only in retailing, but also in medicine, science, and many other fields.
- Databases of insurance policies now store photographs of damaged property, hand-written claim forms, audio transcripts of appraisals, images of insured objects, and even video walk-throughs of houses. These images contain so much data that these databases are enormous.

Just as there is essentially one worldwide telephone system and one worldwide computer network, some believe there will eventually be one worldwide file system. Achieving this vision requires collaboration among nations, which is actually happening in some areas. The Human Genome Project is one example. Defense contractors want a single project database that spans all subcontractors and all portions of a project. Auto companies want to give their suppliers access to new car designs. Both of these applications require inter-company databases. The challenge is making these databases behave as though they are part of a single database. This interoperability is the main challenge of distributed systems, as noted in Chapter 5.

Finally, security is of major importance in today's DBMS. Distributed, heterogeneous Internet-linked databases exacerbate the problem. Companies may want to permit access to some portions of their databases while restricting other portions. This selective accessibility requires reliably authenticating inquirers. Unless security and integrity are strictly enforced, users will not be able to trust the systems.

Getting Corporate Data into Shape

Attempts to get corporate data under control began in the late 1960s and early 1970s with DBMS. Not long after that, the database administration function appeared to manage DBMS and their use. Then, in the 1970s, the broader role of data administration was created to manage all the computerized data resources of an organization. These two functions have remained important.

The Problems: Inconsistent Data Definitions

In a nutshell, the problem has been incompatible data definitions from application to application, department to department, site to site, and division to division. How has this inconsistency happened? Blame expediency. To get application systems up and running quickly, system designers have sought the necessary data either from the cheapest source or from a politically expedient source, that is, using data from existing files and adding other new data. In effect, data have been dribbled from application to application. The result has been data showing up in different files, with different names, or the same name for different data items, or the same data in different files with different update cycles.

Use of such data may be acceptable for routine information processing, but it is far from acceptable for management uses. Management cannot get consistent views across the enterprise with such variations. Also, changes in data and programs are hard to make because a change can affect files anywhere in the organization. Furthermore, such inconsistency makes it difficult to change the tracking and reporting of the organization's products, markets, control structure, and other elements needed to meet changing business conditions.

If a major role of the IS organization had been managing data rather than getting applications running as quickly as possible, then a quite different scenario would have occurred. All the types of data of interest would first be identified. Then the single source of each data type would be identified, along with the business function that creates those data. Finally, a transaction system would be built to collect and store those data, after which all authorized users and applications would have access to them.

This data-driven approach does not result in one huge database to serve the entire enterprise, but it does require administrative control over the data as well as designing databases to support users from the outset. It starts out by describing the data the enterprise needs. Then the approach is selected that provides the data that gives a good balance between short-term, application-oriented goals, and long-term, data-oriented goals.

Proliferation of Heterogeneous Databases

Typical to many organizations over the years, DBMS have been developed to meet a variety of specific tasks. Some are large, using mainframe computers. Others are small and are populated across the organizations in hundreds or thousands of desktop computers. This practice leads to a proliferation of independent applications, using different data structures, naming conventions, and administrative procedures. The existence of "islands" of incompatible databases makes it difficult for IS department to manage them seamlessly. Indeed, many organizations are still using paper-based documents as a means to exchange data between computer applications. The problem is further compounded with inter-organizational systems or cross-border applications.

Data Availability, Integrity, and Security

Despite the fact that terabytes of data stored throughout the organization, users might not be able to get the right data at the right time. The needed data may exist but they are distributed and not reported to the IS department.[6a] Data should be entered correctly, and once in the system, they should be protected. This sounds like a simple requirement, but enforcing it is not a trivial effort. Data security is one of the top concerns of any database administration.

The Role of Data Administration

Not too long ago, the use of DBMS reduced, to some extent, the problems of inconsistent and redundant data in organizations. However, installing a DBMS is not sufficient to manage data as a corporate resource. Therefore, two additional thrusts have moved organizations in this direction: broader definition of the data administration role and effective use of data dictionaries.

Database administration concentrates on administering databases and the software that manages them so users have the information they need, when they need it, and in the form they need to do their jobs. One of its main purposes is determining what data are being used outside the organizational unit that creates it. Whenever data cross organizational boundaries, their definition and format need to be standardized under the data administration function.

The data dictionary is the main tool by which data administrators control standard data definitions. All definitions are entered into the dictionary, and data administrators monitor all new definitions and all requests for changes in definitions to make sure that corporate policy is being followed. The following is some of the information found in a data dictionary:

- Definition of data elements (e.g., last_name is used for defining a person's last name in computer programs, and must be declared as an alphanumeric object with a length of 20 characters).
- Schema. A schema is a collection of schema objects such as tables, views, indexes, clusters, links, procedures, and functions.
- Description of integrity constraints.

- General database structures.
- User names, roles, and privileges.

As can be seen, a data dictionary is more than a glossary of definitions. It should serve as a tool to help programmers create a corporate-wide consistent data structure.

Most organizations have a database administrator (DBA). A typical job description of the database administrator (DBA) is provided below:

- Analyze data to ensure that the organization has the data it needs, and that the data are managed in the most cost-effective manner.
- Design database, at least at the first phases of the life cycle, and interface between management and IT specialists.
- Oversee and monitor DBMS development (either by in-house teams or by outside contractors).
- Help integrate DBMS with applications software.
- Monitor and administer DBMS security (access authorization, backup, auditing, recovery).
- Work with CIO and system administrator to configure hardware and software for optimal deployment of DBMS.

Enterprise Resource Planning (ERP)

To bring order to the data mess, data administration has four main functions: clean up the data definitions, control shared data, manage data distribution, and maintain data quality. Interestingly, many companies did not take these four jobs seriously until the mid-1990s when they needed consistent data to either install a company-wide ERP package, such as SAP; support a data warehouse effort; or, in some instances, consolidate country-based databases on an intranet so that everyone in the company, worldwide, could draw from the same data pool.

Enterprise Resource Planning (ERP) is a multi-module application software that seeks to integrate all data and business processes of an organization into a corporate-wide unified system. Initially targeted to manufacturing, many ERP are developed to be used across an enterprise. Technically, a well-designed ERP helps a business seamlessly integrate key computer applications—product planning, procurement, inventory, supplier management, customer management, accounting and finance, and human resources. Most ERP in the market today uses relational database systems to feed data to application software. In particular, ERP has been the main driving force for getting some data into shape in many companies. It replaces many independent applications within the organization, thus avoiding the need for creating external interfaces to allow these applications to communicate.

ERP deployment is rather expensive. It requires top management to use the adoption of an ERP as an opportunity to improve or reengineer the company's business processes. CIOs have, in essence, two options to develop an ERP. They can purchase packages offered by major software giants (SAP, Oracle, IBM) and work with the vendors to implement the system to fit in the company's IT infrastructure. This option allows the company to tap in the knowledge and experience of the vendor. The issue is the company might be locked in with the proprietary system. The second option is to adopt an open-source solution. With open-source ERP, CIOs have access to a larger number of consultants or system integrators. With proper training, in-house teams could take the lead in developing the software as well. MeadWestvaco, discussed in Chapter 1, provided one example of implementing ERP.

One of the benefits of ERP is that it gives companies a ready-made IT architecture. But, as John Langenbahn of Mead Corporation wondered (in Chapter 1), does it reduce flexibility because divisions of a company need to move in concert with each other? McGrane of MeadWestvaco, Langenbahn's successor, thinks not, because once a decision is made it can be implemented quickly and across the entire corporation. However, the question of flexibility of ERP still remains.

Once enterprises get their data in shape, those data can more easily be turned into information. That is the next subject in this chapter.

Selecting Enterprise Resource Planning (ERP) Systems

The philosophy behind a corporate-wide ERP is to use IT to break down organizational silos, replacing them with a seamlessly connected and integrated horizontal structure to allow business strategy, organizational structure, and technologies to work together. Many ERP are manufacturing oriented with a focus on demand forecasting, procurement, activity-based costing, materials management, scheduling, quality control, report writing and technical documentation, distribution, and so on. Most ERP software is component-based. The components may include basic functional modules, such as accounting (general ledger, accounts receivables, accounts payable, order entry, inventory, standard costing), human resources, contact management, purchasing, shipping, etc. High-end packages include supply-chain management and customer relationship management (CRM). ERP pricing ranges from a few thousands to millions of dollars for purchase and installation.

As an ERP covers all accounting functions, many think it is an accounting system. There is a difference though. An accounting system is typically a single system that is centralized and located in a single platform. An ERP focuses on enterprise-wide distributed computing with accounting modules as a part of the integrated platform. ERP are much more expensive than a typical accounting system.

MANAGING INFORMATION

As noted earlier, information is data in context, which means the data have been given an explicit meaning in a specific context. We often hear such statements as "Information is power" or "We are in the information age." These and similar statements would lead you to believe that managing information is a key corporate activity. Indeed it is, and it is becoming increasingly so. In fact, some believe that information management, rather than technology management, is the main job of the IS department. We believe both are important. The technology can be viewed as the infrastructure and the information as the asset that runs on that infrastructure. Yet, information is just an intermediary—an intermediary for action. In this important intermediary position, the management of information is important. We begin this discussion by discerning four types of information.

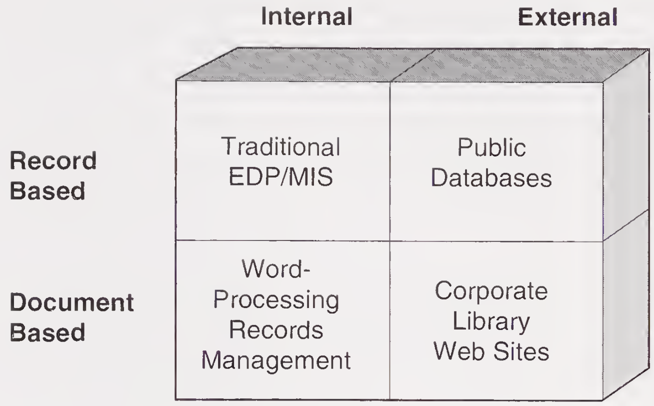


FIGURE 7-2 Four Types of Information Resources

Four Types of Information

One view of information resources is shown in the 2-3-2 matrix in Figure 7-2. The rows depict two structures of information—record based and document based—and the columns depict two sources of information—internal and external. Record-based data contain mainly facts about entities, such as patients, vehicles, and parts, and are housed in data records. The discussion up to this point in this chapter has dealt with record-based data. Document-based information, on the other hand, deals with concepts, such as ideas, thoughts, and opinions, and is housed in documents, messages, and video and audio clips. Figure 7-3 lists various differences between the two.

Internal record-based information was the original focus of IS organizations, because it is the type of information that computer applications generate and manage easily. External record-based information can now be accessed over the Internet or through other electronic means via public databases. End users themselves have generally handled the procurement of this kind of data by subscribing to database services.

However, internal and external document-based information have received little attention from IS organizations until recently, because it has been so difficult to manipulate in computers. Intranets changed that. Documents are now an integral part of information on these sites. Even in companies where the administrative vice president or the corporate librarian believe documents are their realm, after a short time, they gladly turn over responsibility for the technical issues to IS.

FIGURE 7-3 Structure of Information

	Data Records	Documents
Item of interest	Entity	Concept or idea
Attribute of item	Field	Set of symbols
All attributes for item	Record	Logical paragraph
All related items	File	Document
A group of related files	Database	File cabinet
A collection of databases	Application system	Library, records center
Data models (representational approaches)	Hierarchical, relational, rule-based	Keywords, hypertext, metadata, Standard Operating Procedures (SOP)

	Typical Corporate Authority	Information Sources	Technologies Used
Internal record-based information	Information systems department	Transaction processing Organizational units	DBMS Data dictionaries Enterprise data analysis techniques
Internal document-based information	Administrative vice president Word-processing center Records management	Corporate memos, letters, reports, forms, e-mail	Word processing Micrographics Reprographics Text-retrieval products
External record-based information	End users Corporate planning Financial analysis Marketing	Public databases	Internet-based services Public networks Analysis packages
External document-based information	Corporate library	Public literature News services Catalogs and indexes Subscriptions Purchased reports Internet (Wikipedia)	Bibliographic services Environmental scanning Public networks

FIGURE 7-4 The Scope of Information Management

In short, in the past, these four realms of information have been the responsibility of different functions, as shown in Figure 7-4. Today, the IS organization is likely to be involved in some way in each area. In fact, because the two types of information have such different characteristics, they are being managed in quite different ways. The following discussion notes that division. Managing record-based information is illustrated by the use of one technology: data warehouses. Managing document-based information is illustrated by two technologies: document management and Web content management.

Data Warehouses

Data warehouses appeared in the early 1990s, a bit before ERP systems. Like ERP systems, they, too, spurred getting record-based data into shape.

Data warehouses differ from operational databases in that they do not house data used to process daily transactions. Operational databases are meant to be updated to hold the latest data on, say, a customer's flight reservation, the amount of product in inventory, or the status of a customer's order. Data warehouses are not. The data are generally obtained periodically from transaction databases—five times a day, once a week, or maybe just once a month. The warehouse thus presents a snapshot at a point in time. They are not updated as events occur, only at specific points in time. In addition, unlike transaction databases, data warehouses are used with tools for exploring the data. The simplest tools generate preformatted reports or permit ad hoc queries. Yet warehouses are reaching beyond reporting on internal data. They are being combined with purchased data, such as demographic data, late-breaking news, and even weather reports, to uncover trends or correlations that can give a company a competitive edge. For example, a retailer might put the umbrellas and raincoats by the front door because a surprise storm is moving in.

The most common type of data in a warehouse is customer data, which is used to discover how to more effectively market to current customers as well as noncustomers with the same characteristics. As a result, the marketing department has, in large part, been the driving force behind warehouses. They want to use customer data—from billing and invoicing systems, for example—to identify customer clusters and see the effect different marketing programs have on these clusters.

Data warehouses are seen as strategic assets that can yield new insights into customer behavior, internal operations, product mixes, and the like. However, to gain the benefits, companies must take the often-delayed step of reconciling data from numerous legacy systems. When the perceived benefits appear to outweigh the costs, companies tackle the tremendous task.

Due to the strategic nature of such uses of data, warehousing projects need sponsorship from top management, not only to provide funding and guide the project in truly strategic uses, but also to ensure that departments cooperate and yield up their data for cross-correlations.

Key Concepts in Data Warehousing

As with all other areas of IT, data warehousing has its own set of terms and concepts. Here are few of them.

Metadata: Defining the data. One of the most important elements in a data warehouse is its metadata; that is, the part of the warehouse that defines the data. Metadata means "data about data." Metadata explains the meaning of each data element, how each element relates to other elements, who owns each element, the source of each element, who can access each element, and so on.

Metadata sets the standard. Without it, data from different legacy systems cannot be reconciled, so the data will not be clean; that is, comparable. Without comparable data, the warehouse is not of much use. So an important aspect of data warehousing is creating and then enforcing common data definitions via metadata definitions.

Because the world continues to change, so, too, does the metadata. Thus, a metadata librarian is needed to keep it up to date, to enforce the standards, and even to educate users about metadata features of the warehouse. Metadata can be used not only to understand the data in the warehouse, but also to navigate through the warehouse.

Quality data: The biggest challenge. Once metadata definitions have been established, the largest job of data-warehousing teams is cleaning the data to adhere to those standards. This cleaning process is onerous, lament warehousing teams, because legacy data often have definitions that have changed over time, gaps, missing fields, and so on. Sometimes, the source data were not even validated properly, for instance, to ensure that the postal code field contained the right number and type of characters.

The older the data, the more suspect their quality. However, because users want to track items over time, even with poor quality, data-warehousing teams cannot discard the old, poor-quality data. They must find ways to align it with the more recent data, generally by estimating the data that should be in the missing fields, realigning figures based on the newer formulas, and so forth. This grueling manual task is one of the largest the warehousing team must perform.

Data marts: Subsets of data warehouses. When data warehousing was first espoused, the ideal was to build one huge, all-encompassing warehouse. However, that goal has not always proved feasible or practical. For one thing, search times can be excruciatingly long in huge warehouses. For another, the cost may be too high.

Thus, the concept of data marts became popular. A data mart is a subset of data pulled off the warehouse for a specific group of users. A data mart is less expensive to build and easier to search. For these reasons, some companies have started their data-warehouse work by first building data marts. Then they populate the data warehouse by drawing from these marts. This approach is the reverse of what was espoused just a few years ago when purists believed that data should go from a data warehouse to data marts.

The main challenge in following this mart-to-warehouse approach is that the company must have unifying metadata, so that the data in all the marts use the same definitions. Otherwise, the data cannot be meaningfully correlated in the warehouse.

Steps in a Data-Warehousing Project

A typical data-warehousing project consists of five main steps.

1. Define the business uses of the data. Warehousing projects that are run solely by IS departments without a sponsoring user department are generally unsuccessful. The data need a business use to demonstrate payback.
2. Create the data model for the warehouse. This means defining the relationships among the data elements. This process can be quite a challenge, especially when commingling data from a number of systems.
3. Cleanse the data. This notorious step requires moving the data out of the operational systems and then transforming them into the desired standardized format. Specific tools can help cleanse standard kinds of data, such as names and addresses, but defining the transformations is often manual, as is filling in gaps.
4. Select the user tools. Consider the users' point of view and then select the tools they will use and train them to use them.
5. Monitor usage and system performance. Warehouse teams need to be particularly alert to changes in use. In many cases, usage begins slowly. But when it catches on, performance can degrade seriously as the system and the team are swamped with requests. If, however, the team monitors use and create standard queries that serve groups of users rather than individuals, the team can reduce its workload and speed up system response time as well.

The following case example illustrates numerous ways one company is using its data for competitive advantage. The case illustrates use of ERP, data warehousing, and the Web, not only for internal use of data, but as the basis for new revenue-generating services to customers and suppliers. It shows how innovative companies can use advanced information management technologies. This case is based on a paper that won one of the awards in the Society for Information Management's[7] annual paper competition. This competition attracts some of the best in-depth descriptions of IS management in practice. The company is Owens & Minor.

CASE EXAMPLE

OWENS & MINOR

www.owens-minor.com

Owens & Minor (OM), headquartered in Mechanicsville, Virginia, is a supply-chain solutions company that distributes name-brand medical and surgical supplies from 14,000 suppliers to over 4,000 hospitals, integrated health care systems, and group purchasing organizations throughout the United States. OM employs 2,700 people and had sales of $5.32 billion in 2006.

As Don Stoller, Director of Information Management,[7] and his coauthors point out, OM is in the middle of its value chain. The supply side begins with raw material suppliers who sell to manufacturers (such as Johnson & Johnson), who sell to OM (the distributor), who then sells to health care providers (such as hospitals), who sell to patients. In this field, distributors compete for contracts between manufacturers and health care providers.

In the mid-1990s, OM bought a competitor, doubling OM's size to $3 billion. However, merging the two cultures proved so difficult that OM recorded its first loss. This loss spurred management to implement a new three-part strategy:

1. Achieve operational excellence
2. Follow and support patient care
3. Turn information into knowledge and then into profit

This strategy depended on building a leading-edge IT infrastructure and an IT R&D culture, which it did. Here is what OM has done.

Achieving Operational Excellence with e-Business Solutions

OM augmented its ERP system to automate order forecasting, which improved inventory turns, reduced ordering rates from five times a week to once a week, and improved customer service. OM also installed an activity-based costing system to separate the cost of its products from the cost of delivery. Thus, customers, such as hospitals or purchasing groups, could pay just for the delivery service they wanted. Some wanted delivery to a loading dock; others wanted delivery to an emergency room. Some customers saved large amounts of money with this new option, and OM increased its sales. A new warehouse management system that uses handheld devices also increased OM's operational efficiency.

Following and Supporting Patient Care

OM implemented an Internet-based order entry and product information tool for hospitals and health systems, called OM-DIRECT. Customers could order

(*Case Continued*)

online, even using handheld devices. For example, when a hospital signs up for this service, it can ask OM to place bar codes on the products and establish replenishment levels. Then, when a hospital employee scans the bar code with, say, a Palm device, enters the on-hand inventory of that product, and uploads the data to OM's system, the system automatically reorders the product, if needed. Some 1,100 customers signed up for OM-DIRECT during its first two years.

To serve smaller customers and suppliers, such as physicians' offices, small hospitals, and small specialist suppliers, OM teamed up with trading exchanges to provide online marketplaces for these members to buy and sell products and even use OM-DIRECT. The exchanges have encouraged these customers to start using the Internet for ordering, even though they only offer 1,700 of OM's 150,000 products.

Turning Information into Knowledge and Profit

Most interestingly, OM initiated a data-warehousing and decision-support initiative, building one subject area at a time (sales, inventory, accounts receivable, and so on), and permitting queries across the subject areas. During the first year, much of the work was handled by a system integrator familiar with building data warehouses. After that, it became the responsibility of a 12-person OM team that included a director, a manager, three developers who add new subject areas and load data, one data administrator, and six business analysts, who work with the users.

Initially, the warehouse was for internal use only. Within the first 30 months, some 500 OM employees in sales, marketing, supply-chain management, finance, and other departments had learned to use the Business Objects tool to make queries or create reports from the warehouse, report Stoller et al.[7]

For several reasons, the warehouse team then investigated offering decision support over the Web. Customers were asking sales reps for more information; some requesting up to 30 reports a month. Why not let the customers serve themselves? Also, the Web would allow casual users, such as customers or executives who do not want to learn Business-Objects, to access the data in the data warehouse. Furthermore, OM realized that customers and suppliers were asking for information to run their own businesses because they did not have the systems or technology in-house. Delivering this information over the Web could give OM a competitive advantage by strengthening its relationships with trading partners, giving it a market-leading feature to entice new customers, and even turning the data warehouse into a new service; in fact, a new source of revenue.

To assist its trading partners, OM created an extranet and asked a pilot set of customers and suppliers to list the kinds of information they needed to, say, reduce their costs or better manage their inventories. From these lists, the OM warehousing team created queries and let these partners pilot test the system for four months. During that time, OM debated whether to offer this service for free or for a fee. It decided to charge money, reasoning that the information would appear more valuable if it had a price. Furthermore, the fees would be reasonable, especially compared with the

(*Case Continued*)

up-front data-warehousing costs partners would be able to avoid.

When the service, called WISDOM, was rolled out, it became the first "e-business intelligence application" in the medical and surgical supply distribution industry, state Stoller et al.

All users have a profile of the information they can access. Every access is checked by the security system. Every query contains the user's account number so that the system knows which information can be used to answer the query. The browser interface is easy to use; people point and click on over 50 predefined queries, or, more recently, make ad hoc queries.

OM has continued to improve the service. Suppliers and customers can now add external data, such as data from other manufacturers, into OM's data warehouse so they can study more relationships and perform more "what if" investigations.

For example, a typical-size hospital spends $30 million a year buying all its medical and surgical supplies. Hospital groups can have a difficult time analyzing purchases across all their hospitals, because each has a disparate system. Rather than invest in consolidating the systems themselves, hospital groups would rather purchase data about their own transactions from, say, a distributor, who is well placed in the value chain to have that information.

OM has thus become an important "infomediary," note Stoller et al., because hospital purchasing staffs may have a much easier time getting the purchasing information they need from OM than from their own hospital. They can then discover, for instance, which purchases were "on contract" with OM, and thus had the lower contract price, and which were not. Oftentimes, up to 40 percent of hospital purchases are off-contract, which costs these hospitals money they need not spend. Furthermore, purchasing managers can see how many suppliers they use for the same product and negotiate higher-volume discounts from just one or two. They can also see ordering frequency and optimize it by increasing order volumes, perhaps. In addition, they can more easily spot delivery problems.

OM's WISDOM service turns out to be equally valuable to suppliers, such as Johnson & Johnson. WISDOM has over 30 queries and 90 exportable reports for suppliers to watch their products move out to consumers. They can analyze their market share in specific regions, analyze product shelf life, coordinate shipping from several locations, see on-contract purchasing (and help customers increase the levels), analyze drop shipments (which are more expensive than OM distribution), and so forth.

WISDOM has become a valuable service to both OM suppliers and customers, and it becomes more valuable the more sales or purchases go through OM rather than through other distributors. In fact, WISDOM led to over $60 million in new business in one year because it is providing visibility throughout OM's value chain. Because partners pay for its use, there is constant pressure to keep it market leading, note Stoller et al.

The next step is to turn the data warehouse into an industry-wide warehouse by asking suppliers and customers to place all their data there. If this occurs, conceivably, other distributors might become paying customers of WISDOM

(*Case Continued*)

as well. Or, as OM and three competitors have agreed, they will establish an independent, neutral health care information exchange.

With DIRECT, WISDOM, and a number of new online solutions, MediChoice, OM-Solutions (supply-chain consulting and outsourcing solutions), CostTracks (activity-based management for healthcare providers), and others, Owens-Minor earned distinguished recognitions from the IT industry. In 1999, it won an award for its industry-leading e-business infrastructure. In 2001 and 2003, *Information Week* magazine ranked OM first among the Top 500 Technology Innovators & Influencers across all industries. ■

Document Management

Now we turn to managing document-based information. Management of internal document-based information has traditionally rested with the vice president of administration, who has traditionally overseen records management (document records, not data records). Technologies used to manage documents have included micrographics (microfilm and fiche) and computer output microfilm (COM), generally in stand-alone systems. That is, until the Internet arrived. Now corporate intranets house many former paper-based internal documents.

External document-based information, on the other hand, has generally been the responsibility of corporate librarians. Yet, as the amount of such external information grows and as more of it has become computerized, it is increasingly being included in IS executives' jurisdiction. Again, it has been the Web that has brought these external documents to the attention of CIOs, yet many of them consider documents to be the least manageable form of information.

Even in today's Internet-rich world, paper still plays a major role in most enterprises. And while paper is around, there is a need to move seamlessly between digital and printed versions of documents; hence the importance of document management. The field of electronic document management (EDM) uses new technologies to manage information resources that do not fit easily into traditional databases. EDM addresses organizing and managing conceptual, descriptive, and ambiguous multimedia content.

Using IT to manage documents is a challenge for enterprises because most of their valuable information is in documents, such as business forms, reports, letters, memos, policy statements, contracts, agreements, and so on.[8] Moreover, most of their important business processes are based on or driven by document flows. While computer systems have mostly handled facts organized into data records, far more valuable and important are the concepts and ideas contained in documents. Reports drawn from computerized databases fill important roles in status assessment and control. Oftentimes they must be accompanied by a memo or textual report that explains and interprets the report. Meetings, phone conversations, news items, written memos, and noncomputerized reports are usually rated more important by managers. Technology applied to handling documents promises to improve these forms of communication.

A document can be described as a unit of "recorded information structured for human consumption."[9] It is recorded and stored; therefore, a speech or conversation for which no transcript is prepared is not a document. 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. Information previously represented primarily by text is now also represented by graphical symbols, images, photographs, audio, video, and animation. Documents previously created and stored on paper are now digitally created, stored, transported, and displayed.

Applying technology to process traditional documents changes what documents can accomplish in organizations. A definition more oriented to technology comes from *Byte* magazine.[10]

A document is a snapshot of some set of information that can

- *incorporate many complex information types;*
- *exist in multiple places across a network;*
- *depend on other documents for information;*
- *change on the fly (as subordinate documents are updated);*
- *have an intricate structure or complex data types such as full-motion video and voice annotations; and*
- *be accessed and modified by many people simultaneously (if they have permission to do so).*

It is hard to think of anything more pervasive and fundamental to an organization than documents. The impact of applying emerging technologies to document management is potentially significant. EDM promises to advance the management of conceptual information, thereby improving the levels of support and productivity for managers and professionals. With documents as the primary vehicle for business processes, EDM contributes to business process redesign and quality improvement. Numerous EDM applications generate value. In this section, we will examine three:

1. To improve the publishing process
2. To support organizational processes
3. To support communications among people and groups

The concept of just-in-time (printing, publishing, and forms processing) pervades the design philosophy in all three areas.

Improving the Publishing Process

Technology enables a major restructuring of the process of publishing and distributing paper documents. For those organizations that produce documents as a product or as support for a product, this change is reengineering their document production processes. The stages of the traditional process, designed primarily for high-volume and high-quality documents, are shown in Figure 7-5. The document is created, generally with the use of electronic tools, and a photographic plate is made for an offset printing press. The offset press requires long print runs to amortize the extensive setup costs.

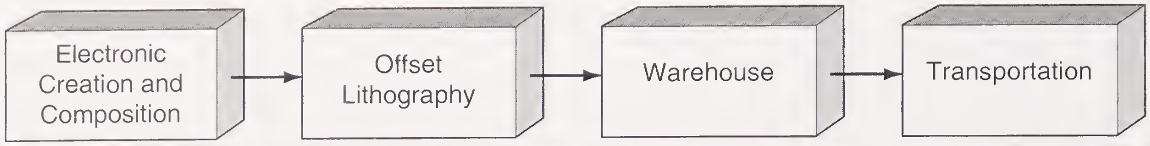


FIGURE 7-5 Traditional Publishing Process

Thus, a large quantity of documents is produced and stored in a warehouse and then documents are shipped to their destination when they are required. R. R. Donnelley & Sons Company, the country's largest publisher, estimates that 60 percent of the total cost of delivering these documents is in storage and transportation.

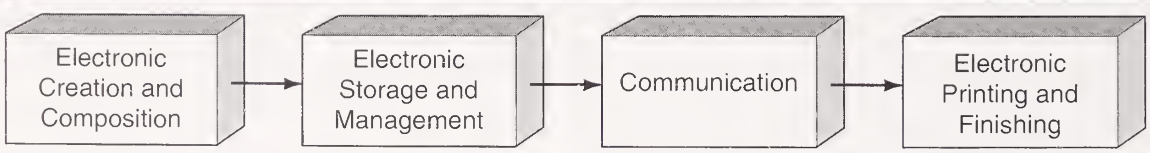
Figure 7-6 shows the steps in the revised publishing/distribution process using newer technologies. Documents are stored electronically, shipped over a network, and printed when and where they are needed. The major benefits result from reducing obsolescence (revisions are made frequently to the electronically stored version), eliminating warehouse costs, and reducing or eliminating delivery time.

Here is an example of how a traditional printing process has been changed by emerging technologies.

Supporting Communications Among People and Groups

The value of documents is that they transfer information across time and space. Of course, the Internet can handle such communication, but when all members of a group do not have Internet access, or do not use it frequently, companies may need to continue to rely on paper documents. EDM can be used to facilitate such communications among people and groups. In the broadest sense, all EDM applications support this function. The following case illustrates using various technologies to communicate with customers via paper and ensure that each customer gets the right pieces of document.

FIGURE 7-6 Reengineered Publishing Process



CASE EXAMPLE

TAPIOLA INSURANCE GROUP

www.tapiola.fi

Tapiola is a customer-owned group of four companies with headquarters in Espoo, Finland, a suburb of Helsinki. By Finnish law, an insurance company can sell only one type of insurance; therefore, each of Tapiola's four companies sells

(*Case Continued*)

either life, nonlife, pension insurance, or asset management. Tapiola calls itself "an insurance department store." Its 2006 insurance premium income reached 623 million Euros.

Some 90 percent of insurance in Finland is sold by five insurance groups; Tapiola is the fourth-largest group. It has 14 percent of the market with 1.5 million customers and 3 million policies. Each year its mailroom sends out 4 million letters, so printing is an important and expensive part of its operation.

Formerly, the Tapiola group offered 150 kinds of insurance policies and had 300 different insurance policy forms. Half of the forms were in Swedish and half were in Finnish because both are official languages in Finland. The policy forms were preprinted by an outside print shop, generally on sprocket-fed computer paper. Then the forms were filled in by printers connected to their IBM mainframes.

This mode of operation presented several problems. If a change was made to a form, the inventory of old forms had to be discarded. Reprinting new forms often took weeks. That time represented possible lost revenue. Also, the computer printers could print on only one side of each sheet of paper. Finally, for more complex policies, Tapiola had to use large-size computer paper that was often unwieldy to handle and mail.

Document-Processing Goals

The production manager and the insurance applications development manager looked around for an alternate way to print policies and statements. They had several goals. One was, of course, to reduce costs. A second goal was to stop using preprinted forms. Their third goal was to give Tapiola marketing people new ways to advertise insurance products by making computer-generated letters to customers more flexible. The fourth and most important goal was to make Tapiola "the most personal insurance company in Finland." These two systems managers wanted their computer-generated correspondence to prospective and current policyholders to appear more "human," as if a Tapiola employee had used a typewriter to write a personal reply to an inquiry or request for information.

Centralized Solution

To overcome the computer-generated appearance of their output, they switched to plain paper printers from Rank Xerox, the European subsidiary of Xerox Corporation. Xerox is best known for its photocopiers, but it is increasingly creating products for electronic document processing where a document can include text, data, images, and graphics. Conversion of the output equipment at Tapiola took 15 months, during which time it reduced its 300 preprinted forms to 4.

Four New Forms

The four new forms are actually four types of standard European A4-cut paper. (In the United States, the equivalent would be the 8½ × 11 sheet of paper.) The first form is a plain white A4 sheet of paper. It is used for internal communications within Tapiola.

The second form is the same blank white paper with four holes punched along the left-hand side to fit in the standard European four-ring binder. (In the United States, the standard is a three-ring

(*Case Continued*)

binder.) This form is also mainly for internal use.

The third form has the Tapiola logo preprinted in green in the upper left-hand corner, and both sides of the paper have the word "Tapiola" printed in tiny, faint green letters over most of the page. This form is the standard company stationery, and it has become one of Tapiola's standard computer printout forms for communicating with the outside world.

The fourth form is the same as the third except that it has a 4 × 6-inch (10 × 15-cm) perforated area in the lower right-hand corner. This form is used for all their insurance policy bills. The tear-off portion can be paid at any bank; the money and information about the payment go directly from the bank to Tapiola.

Programming and Conversion

Reprogramming the IBM applications was extremely easy, because only the output routines needed to be changed. That programming took two work years of application programmer time. In addition, one systems programmer spent six months working with Xerox on the IBM-to-Xerox system software interfaces. One forms designer spent 15 months redesigning all 300 preprinted forms into 240 printing formats for the application programmers. About 60 forms disappeared altogether because they were found to be unnecessary; the remaining 240 forms are not all different because one-half of them are in Swedish and the other half are in Finnish.

The conversion was done in two stages. First, customer policy statements were printed in a form-like manner on two sides of the new-size paper. These looked somewhat like the old forms so that policyholders could understand the changeover. Then, the terse, table-like data was replaced with text to make the statements look more like personal letters.

Envelope Stuffing

Interestingly, these redesigns of customer documents were the easy part of the conversion. The more difficult and sensitive part was making sure that each envelope contained the correct pieces of paper. Because Tapiola was now using smaller sheets of paper, each envelope often needed to include several sheets, and, of course, Tapiola did not want to put a cover letter for one policyholder into the same envelope as a statement for another policyholder.

To solve this problem, the company found an envelope insertion machine made by PMB Vector in Stockholm, Sweden. This machine contains a microprocessor that can read an eight-dot code printed at the top of each sheet of paper. Thus, the Xerox printer not only prints the correspondence but, at the same time, it prints a code at the top of each sheet of paper—one code for all pages to go in one envelope. The Vector insertion machine makes sure that each envelope only contains pages with the same code.

Decentralized Expansion

This document-processing conversion was just one part of the effort to improve and humanize customer correspondence. In the midst of the document redesign, Tapiola also decided to move some printing of customer correspondence to its 62 branch offices.

To illustrate how a remote printer is used, consider the case of a female

(*Case Continued*)

policyholder who has received medical care. She can mail the medical bills to Tapiola or visit her local office in person. If she visits them and presents her bills to a Tapiola employee, that employee uses a desktop machine to access the policyholder's data from the central database. If she has brought all the proper documents needed for reimbursement, the employee can initiate a direct electronic payment from a Tapiola bank account to her personal bank account, no matter which bank they both use.

Once a day, Tapiola transmits all such electronic transactions to its bank, and those transactions are cleared that same day. (The five major Finnish banks have collaborated and created a sophisticated and fast banking system.) The employee then gives the policyholder a letter verifying the transaction. That letter is generated by the central IBM computer but is printed on the local Xerox printer. If the policyholder is missing some information, the employee can create a personalized letter explaining what is missing by assembling phrases stored in the central database and then printing the letter on-site.

The people at Tapiola Data recommend that other IS organizations become involved in electronic document management by first looking at the output their computers are generating. It was not difficult to mix traditional host computing with document processing technology.

A poll of Finnish citizens showed that Tapiola is seen as a dynamic company, and it has the best reputation among young people of all the insurance groups. The people at Tapiola Data believe their use of document-processing technology is helping to build and reinforce this image. ■

Supporting Organizational Processes

Documents are still the vehicle for accomplishing many processes in organizations. Typical examples include processing a claim in an insurance company, hiring a new employee, or making a large expenditure. The documents are primarily forms that flow through the organization carrying information, accumulating input and approval from a sequence of people. Many such workflow systems still rely heavily on the physical circulation of paper forms.

Using IT to support these processes generates significant value in reducing physical space for handling forms, faster routing of forms (especially over geographical distances), and managing and tracking forms flow and workload. Two trends in organizations have increased the importance of workflow systems: total quality management and business process reengineering.

In addition to improving transaction-oriented business processes with EDM, many organizations are improving the management processes of reporting, control, decision making, and problem solving as well. Several EIS now supply documents to supplement the more traditional data-based reports. Organizations with a custom-developed EIS also add so-called soft information in the form of documents.[11]

To give an example of how one organization improved a work process via a new document management system, consider the Tennessee Valley Authority.[12]

CASE EXAMPLE

TENNESSEE VALLEY AUTHORITY

www.tva.gov

The Tennessee Valley Authority (TVA) is the largest public supplier of power in the United States, serving some 8.7 million customers in seven southeastern United States by generating energy using fossil, hydroelectric, and nuclear fuels. Its total operating revenues for the first nine months of the 2007 fiscal year were $6.6 billion. Not long ago, the nuclear division, which has three facilities, revamped its maintenance management system—a system that relies on documents, such as manuals from vendors, drawings, and work instructions, that are regulated by government.

TVA spends more than $48 million a year creating maintenance work orders and then planning and performing the work. One plant alone annually processes 14,000 work orders and approximately 5,000 procedure changes. Government regulations that oversee the documentation of this work contribute significantly to TVA's high maintenance costs.

The improvement project was handled by a team from various parts of the nuclear operation. They analyzed and charted the existing work processes, determined which improvements were most needed, and investigated how those improvements could be achieved. They spent 350 hours interviewing people and looked at 15 other utilities. The improvement process was as follows:

- ***Identifying reasons for improvement:*** The paper-based manual system was too labor intensive and costly.
- ***Analyzing workflows and exploring ways for improvements:*** Total cycle time was studied to eliminate inefficiencies, and all related workflows, business practices, and application software were scrutinized.
- ***Researching new paradigms or ideas:*** The maintenance management, procedures management, and workflow system need to be integrated. All hard-copy procedures must be converted to electronic media.
- ***Redesigning the process:*** Data flow diagramming techniques were used to map out more effective workflows with improved review and approval routing procedures.
- ***Piloting the redesigned process:*** Intensive testing of retrieval times, routing efficiencies, and data transmission rates on a test network at a site was conducted to resolve problems before implementation.

(*Case Continued*)

- ***Implementation:*** Detailed implementation plans were developed for hardware installation, document conversion to electronic format, data migration from mainframe to a client/server architecture, procedure revision, and user training.

One thing they discovered was that the work orders were inextricably linked to document workflow and the ways procedures were managed. Previously, the three areas—work order management, document workflow, and procedure management—had been viewed as separate, and thus managed separately. Upon investigation, the team realized that every work order included accompanying diagrams, documentation, and procedure instructions. However, the three were not always in sync. For example, a work order might be planned several months in advance, but in the meantime, procedures might be changed, yet those changes were not noted when the work order was about to be performed.

The redesigned Procedures Control Process uses IT to store all procedures on-site, and routes them to authorized personnel. The electronic document management system also allows users to make changes or markups at their desks using conventional editing practices—readlines, highlights, lineouts, and parallel routing. The new process designed by TVA electronically combines maintenance orders in one system with procedural document management in another system and eliminates a number of existing systems that did not talk to one another. Maintenance workers can now access documentation on equipment, parts, and records as well as work instructions from desktop machines. Work orders are generated electronically and then routed for approval with the most current drawings and procedures electronically attached. Electronic signatures are used for approvals. In addition, the documents are indexed by, say, piece of equipment, and the three plants now use the same systems. Thus, maintenance people can review past activity and better plan for the future.

When the system was first introduced, it ran on a relational database with 3,500 users at three different locations. The system later was upgraded to a three-tier LAN and WAN environment with more than 800 PCs.

The system has been successful. Lost work documents were reduced to near zero. Duplicate work order preparation was eliminated. There were fewer standalone databases. The average amount of human time spent processing a work order has decreased by almost half, from 39 hours to 23 hours; labor savings are large. More importantly, maintenance workers now have captured data for improving processes. However, the team underestimated the change management effort needed. They did not realize they had to bring many employees up-to-speed on using computers; some had not used keyboards. In addition, the team realized they should have set expectations differently. Rather than emphasize the benefits of the new systems to each employee (because sometimes the new systems required more work of some employees), the team should have emphasized the benefits of the system to TVA, which were significant. Overall, the effort realized 42 percent cost reduction and 53 percent cycle time savings. Perhaps the most beneficial

(*Case Continued*)

and intangible benefit of an effective document management system for a public company is the ability to make its operations transparent to the public thanks to a well-organized, well-documented workflow. ■

Content Management

We now turn to the other form of document-based information: content management.

To create a content management strategy, states Tucker in a Gartner EXP report,[6b] companies need to understand the three phases of the content management life cycle and the goals for each one. As shown in Figure 7-7, the three phases, which can be viewed as input–process–output, are:

1. Content creation and acquisition
2. Content administration and safeguarding
3. Content deployment and presentation

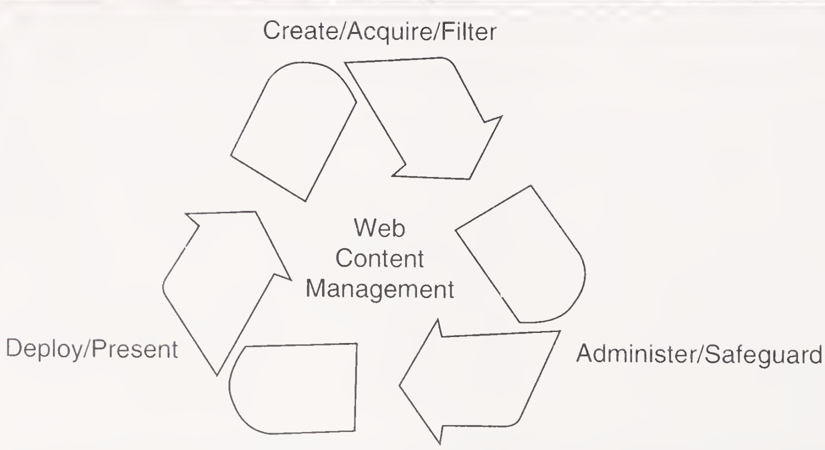
Managing Content Creation and Acquisition

Each phase needs a different emphasis to be effective. Content creation and acquisition, for instance, needs to focus on creating content quality. That is why it might be wise to buy some content from specialists, which is called syndicated content, rather than create it in-house. For example, why create a stock ticker or a weather report or a news feed? Draw on the ones that already exist.

High-quality in-house content comes from subject matter experts and local employees. Thus, the best organizational structure is to distribute content creation and maintenance to employees in HR, marketing, sales, and field offices. They should be responsible not only for creating their content, but also for keeping it updated and fresh.

To avoid anarchy, though, these dispersed experts should be directed centrally and use centrally created formats and an automated workflow system that moves their

FIGURE 7-7 The Web Content Management Life Cycle



Source: Adapted from Chuck Tucker, *Dealing in Web Currency*, Gartner EXP, 56 Top Gallant, Stamford, CT, June 2001.

work along. The system might even send them reminder e-mails of publishing deadlines. Finally, to improve content quality, it is wise to create a feedback loop so that comments from Web site visitors reach these content creators. Then these creators know what types of content attract visitors and customers.

Content Administration and Safeguarding

The emphasis in this phase, like any operational phase, is efficiency, states Tucker. The goal is to achieve the most with the least effort. As discussed later, content management software tools can help. These tools are used to identify types of content and the business rules that apply to each type. For example, publication of press releases on a Web site should follow business rules that state that each release will first be approved by the manager of corporate communications, each press release will use the standard press release format, and each release will move to the archive file one month after being published. Business rules form the heart of content administration. They present the parameters for the automated workflow for each type of content, thus relieving the Webmaster bottleneck.

So, whereas content creation should be distributed, content administration should be centralized, which is the same type of federal structure noted in Chapter 2 for managing IS. This structure permits overall central guidance of distributed creative efforts. However, it does present some vexing challenges. One involves the approval process of foreign-language content. Companies that create an approval process believing that all content will be in, say, English, create translation bottlenecks for themselves if they expect all drafts to be translated into English for approval and then translated back into the original language once the document is approved. Companies need to consider multilanguage issues when creating their workflows, selecting their content management software, and designing their Web sites.

Content Deployment and Presentation

The third phase of the content management life cycle is the output phase, distributing content to Web site visitors. The emphasis in this phase should be on effectiveness, that is, presenting the content so that it attracts visitors, allows them to navigate the site easily, and leads them to the desired actions.

Because this phase can determine the success of a firm's e-commerce efforts, it is best to design a Web site beginning with this phase, then move on to ensuring content quality and processing efficiency. The Eastman Chemical Company example that follows illustrates this outside-in viewpoint; most companies take an inside-out view. Eastman redesigned its site to take its customers' point of view rather than its internal organizational point of view. The change had a major positive impact.

Web Content Management

Using the World Wide Web, managing Web content typically consists of the following tasks: create, store, publish, control, manage versions of documentation over the Web. The documentation may include press releases, news articles, users' manuals, technical manuals, and third-party reviews. As noted earlier, many corporate intranets now house documents that used to be paper based. In some cases, these documents appear in PDF form on the intranet, which is like taking a photograph of the pages so that the pages cannot be changed.

The question for CIOs has become: How should we manage all the internal and external contents on our Web sites? The field that addresses this question is called content management. It deals with managing Web-based content of all types, writes Chuck Tucker in the Gartner EXP report entitled *Dealing in Web Currency.* A major reason content has become important to CIOs, he notes, is because it is a core management discipline underlying online business. Without production-level Web content management processes and technologies, large-scale online business is not possible. The content on Web sites attracts customers, answers questions, and handles transactions. If the content is not refreshed frequently, perhaps as news occurs, or if it is full of errors, or if it cannot handle transaction volumes, a company's Web channel will stave off rather than attract customers.

Content is no longer static; it is active or live and action-driven. An underlying reason is the adoption of XML. XML is used to put tags on data that give that data meaning. Computers use the meanings to manipulate the data and perform work. In essence, use of XML moves Web content from being in a human-only readable format to being in a computer-readable format. Thus, the content can be passed to back-end transaction processing systems and cause an action to take place, such as ordering a book or configuring a recently ordered computer.

The IS department should put together an editorial staff, one that is similar to that of a newspaper organization or a television station, although at a much smaller scale. The staff should develop a publication workflow and use a document management system that can handle multimedia content.

Two Web development features, personalization and localization, are used to attract and keep visitors. Personalization means allowing Web site visitors to customize how they view the page. For instance, some visitors to consumer sites may want lots of sports news but little international news. On the other hand, business visitors to corporate sites might want the site to open to the products they buy or recent news pertinent to their industry. Web content software gives site builders the ability to offer site visitors viewing options. Once selected, the choices are stored in the users' profile and referenced every time they visit the site. Companies can also use personalization to offer complementary products, such as corkscrews to wine buyers or take into account a customer's past buying record.

Localization, on the other hand, means tailoring a site to a culture, market, or locale. For instance, a site may be designed to present its content in the language of the country or region of the visitor. Likewise, localization may mean making appropriate currency conversions automatically. Localization is crucial for companies involved in global e-commerce.

Finally, a growing issue in deployment is multichannel distribution; that is, being able to display the site in the manner appropriate to each type of device, from PC to cell phone. Ideally, the information comes from a common repository, rather than existing in several places, and is put in the appropriate form when requested. Otherwise, if the same content is stored in several places, it can get out of sync. Central storage is important to maintain content quality.

In summary, the way to manage content is to understand the goal of each phase of the content life cycle—quality, efficiency, or effectiveness—and design the phase with that goal in mind. In addition, there should be a feedback loop, so that Web site visitors can tell Web site content creators which content is most useful to them. Such a loop can then drive continual improvement on the Web site.

To illustrate how one company is managing its Web content, consider Eastman Chemical, whose story appeared in Tucker's report entitled *Dealing in Web Currency.*

Selecting Web Content Management Tools

Content management software has much improved since Eastman Chemical's effort. Earlier practice required handcrafted HTMC code on text editors and FTP transmission to the Web site. Content was mostly static text, links, and graphics. Today, there is a wide range of off-the-shelf software, from free and open-source software to commercial systems with prices starting from a few to dozens of thousands of dollars. Despite some overlapping features, content management products vary in functionality and price. We propose below a few important selection criteria to consider.

- ***Digital asset management:*** The system should be able to help keep track of media assets, such as documents, graphics, and videos.
- ***Information rights management:*** Some sensitive or proprietary documents should be encrypted and made available only to authorized users.
- ***Ability to handle full range of digital content types:*** The product should support all the current and planned content types, from graphics to Java code.
- ***Versioning:*** Content updates should be tracked easily, with roll-back features to go back to the previous versions.
- ***Workflow and approval routing:*** Before content is posted, it needs to be created, reviewed, and approved by many people located at different locations.
- ***Web publishing platform:*** The most common publishing platform is the Web site. For large and complex deployment of content, the content management software should be able to connect with the organization existing file or database-management systems (MySQL, SQL Server, Oracle, Informix, etc.), and to deploy the information through multiple sites. Other platforms include PDAs, Web-enabled phones, and other dedicated wireless appliances.

As discussed earlier, the goal is to provide the right information to the right user at the right time and in the right format. The ideal Web-based content management system is one that simplifies the operations to greatest extent possible: maintain control over the creation, update, access, and destruction of documents. High-end tools support integrated site visualization and customization, allows three-tier architecture (Web developers, site managers, and contributors), rapid site deployment with reusable templates, and multilingual support for multinational sites.

CASE EXAMPLE

EASTMAN CHEMICAL COMPANY

www.eastman.com

Eastman Chemical Company, which is located in Kingsport, Tennessee, is a global manufacturer of chemicals, fibers, and plastics. Founded in 1920 to make chemicals for Eastman Kodak, it was spun off in 1994. As a Fortune 500 company and the world's largest producer of PET polymers for packaging and major supplier of cellulose

(*Case Continued*)

acetate fibers, Eastman employs approximately 11,000 employees with an annual sales of $7.5 billion in 2006.

Management considers the company a leader in using IT. Eastman.com was operational in 1994, several years before most companies had Web sites. Originally the site was used for HR and recruiting. Over time, as more content was added, the site became a hodge-podge of different sections targeted at different audiences, structured like Eastman's organization chart. The site posted excess content, with many duplicate descriptions of chemical products, and had inconsistent navigation making it difficult to find the desired information. The content management process was cumbersome and scattered.

Redesigning the Web Site to Take the Customer Viewpoint

In mid-1999, Eastman initiated a company-wide effort to become more customer focused and launched a major e-commerce program. This was the catalyst for rethinking the Web site design. The redesign was championed by the vice presidents of e-commerce and corporate communications because their departments jointly managed content.

The e-commerce group provides the tools and processes for employees to create and update Web content. The corporate communications department enforces corporate content policy and approves all Web content for correct use of trademarks, brands, terminology, and so on.

In line with the corporate refocus, the two groups decided to change the Web site structure from presenting an inside-out view based on Eastman's corporate structure to presenting an outside-in view with sections devoted to the markets the company serves.

A packaging customer who bought plastics from two Eastman operations formerly had to search the site to find who supplied plastics. Once found, each section had a different navigational system. In the redesign, a single section on food packaging was created for all Eastman operations dealing with packaging.

Eastman worked with a Web design company on the new site architecture, site map, and layout. Later, it added innovative features—that have become today a design standard—such as technical help, FAQs, and localized contents.

Upgrading the Content Management Software

At the same time, Eastman searched for content management software to replace home-grown software in use since 1994. The flat HTML files created a maintenance bottleneck because each page had to be updated separately and required a programmer to translate the content into HTML.

Eastman selected a content management product to create preapproved templates for employees to use, then forward the pages to corporate communications for approval. This approach eliminated the manual process, thus reducing the programmer bottleneck. The software manages employees' rights to update, add, and publish content. Each user ID has a security level and permissible functions associated with it.

Pulling all the business content together for the new site turned out to be a massive effort. Once the content had been compiled, cataloged, and approved, moving from the old system and server to

(*Case Continued*)

the new system and new content proved to be a second major undertaking.

Benefits of the Site Redesign

The benefits of the redesign were far greater than expected. Within six months, overall traffic doubled, and hits to the new market sections, where Eastman sells its products, increased from 30 percent to 60 percent of total hits. Today, traffic has tripled, and 70 percent of the hits are in the market sectors. Adding new content significantly helped increase traffic, but so, too, did the customer focus.

Eastman underestimated the value of the technical product data sheets published on the site, especially to people outside the United States who previously were unable to get this information easily or quickly. More than 50 percent of the site traffic is from outside the United States. Customers report that the technical data have also significantly accelerated their internal decision-making processes.

To manage the technical data, Eastman uses an internally developed product catalog. Formerly, a data sheet could exist in multiple locations, which led to quality problems, because each had to be updated separately. With the product catalog, the data are stored once and are pulled into a data sheet when needed. Thus, Eastman can ensure that everyone sees the same data on a chemical, even in two different markets.

The site has a public part that anyone can access and a protected part for customers only. Once customers are registered and have a user name and password, they can place orders, look at their order history and status, and browse the product catalog in this protected part. They can also personalize their view of the site to some extent and create their own catalog of the products they normally order.

Since the redesign, Eastman has continued to expand the site. It improved search capabilities and added a synonym directory, which has proven important because site visitors often use different names for the same product.

Moving Forward: Globalization and Localization

Globalization and localization are major issues. Eastman has a presence in more than 30 countries and sells in all major regions of the world. A significant portion of sales comes from overseas, so the company wants to allow a site visitor to choose one of, say, eight languages and see the relevant content in that language. If it had treated English as a foreign language during the 1999 redesign, it could add other languages easily. Thinking globally in all content management decisions is a necessity.

Another major challenge is finding a workable global approval process. Checking for adherence to content policies by corporate communications is quick today because all content is in English. However, translation into multiple languages and adaptation to local cultures can significantly complicate and lengthen this approval process. Retranslation into English for corporate approval is too expensive to be feasible. The e-commerce and corporate communications departments are currently working on creating a workable translation and approval process for content originating in other languages.

Eastman has learned that it is best to push content management to the source as

(*Case Continued*)

much as possible so as not to create bottlenecks at central control points. It also learned the value of consistent organization throughout the Web site. This helps present a cohesive image of the company to site visitors. Having the content management system pull information from the product catalog also ensures data consistency. ■

Managing Blogs

The term "blog" is short for "Web log" or "Weblog." A blog is a Web site where an individual makes intermittent Web postings. It is akin to a personal online journal. People write and post on blogs as a form of self-expression. What do they write about? They write about whatever comes to mind. They may write about their private life or their work life. Most blogs also invite comments from others, which appear on the blog as well. Blogs are a different form of Web content, but they still need to be managed. Enterprises need to establish guidelines for employees who choose to blog.

Blogs are powerful tools for democratizing online expression, notes Dan Farber.[13] According to Farber, "Combine blogs with social networks and presence services (such as instant messaging and global positioning), and you have a new person-to-person, information-sharing connection fabric." In short, individuals can compete with major media via blogs, and they can have major impacts such as influencing politics or company policies. Some forward-thinking companies have recognized the power of this immediate form of publishing and communication. One corporate use of blogs is for crisis management. A blog can be more appropriate than e-mail in managing a crisis.

What readers seem to trust about blogs that they do not trust about conventional media, is their opinionated and personal nature. These characteristics present both opportunities and challenges to organizations.

Employees who are not careful about the information they blog can find themselves in trouble. A hypothetical case study of a blogger who works for a disposable-glove manufacturer is presented in the September 2003 issue of the *Harvard Business Review*.[14] Known as "Glove Girl," her highly popular blog has increased sales of a company glove, but she has also talked about competitors' products, potential deals, and industry statistics—all from her own point of view, not the company's. This case poses the question to four experts: "What should company management do about Glove Girl?" It's a question all top management teams should be asking themselves.

One of the experts is Ray Ozzie, chairman and CEO of Groove Networks, a company that provides software for group collaboration. He notes in his comments that he believes employee blogs are "more often than not" good for companies. But companies need policies to guide employees in expressing themselves via Weblogs or Web sites, while both protecting the company and reflecting positively on it. He notes that in 2002 his company developed such a policy, shown in the following case example, to address four concerns:

1. That readers would see blogs as official company communications rather than personal opinions
2. That confidential information would be disclosed, intentionally or not
3. That a party—the company, an employee, a customer, or other—could be disparaged on a blog
4. That a blog might violate the quiet period imposed by securities regulations, during which time a company cannot discuss an upcoming securities-related event

Ozzie's advice in the case, and to executives in general, is to create a policy for their firm and to become more familiar with blogging—even perhaps write their own blog, as he does at www.rayozzie.spaces.live.com, to "communicate convincingly with employees, markets and shareholders."

Understanding the value of informal information exchange in organizations, IBM adds blogging capabilities to its workplace collaboration and development software. The software allows blogs to add links to other Web pages, posting comments and forwarding specific documents to other people. With advanced search functions, IBM also promotes management for multiple blogs, with customed security functions, and the ability for customers to subscribe to their favorite blogs. Today, most blogging software has, more or less, the same capacity—one that allows users to express their thoughts in free format.

CASE EXAMPLE

GROOVE NETWORKS

www.groove.net

Employee Guidelines for Personal Web Site and Weblogs[15]

In general, the company views personal Web sites and Weblogs positively, and it respects the right of employees to use them as a medium of self-expression.

If you choose to identify yourself as a company employee or to discuss matters related to the company's technology or business on your Web site or Weblog, please bear in mind that, although you and we view your Web site or Weblog as a personal project and a medium of personal expression, some readers may nonetheless view you as a de facto spokesperson for the company. In light of this possibility, we ask that you observe the following guidelines:

- Make it clear to your readers that the views you express are yours alone and that they do not necessarily reflect the views of the company. To help reduce the potential for confusion, we would appreciate it if you put the following notice—or something similar—in a reasonably prominent place on your site (e.g., at the bottom of your "about me" page):

  The views expressed on this Web site/Weblog are mine alone and do not necessarily reflect the views of my employer.

(*Case Continued*)

If you do put a notice on your site, you needn't put it on every page, but please use reasonable efforts to draw attention to it—if at all possible, from the home page of your site.

- Take care not to disclose any information that is confidential or proprietary to the company or to any third party that has disclosed information to us. Consult the company's confidentiality policy for guidance about what constitutes confidential information.
- Please remember that your employment documents give the company certain rights with respect to concepts and developments you produce that are related to the company's business. Please consult your manager if you have questions about the appropriateness of publishing such concepts or developments on your site.
- Since your site is a public space, we hope you will be as respectful to the company, our employees, our customers, our partners and affiliates, and others (including our competitors) as the company itself endeavors to be.
- You may provide a link from your site to the company's Web site, if you wish. The Web design group has created a graphic for links to the company's site, which you may use for this purpose during the term of your employment (subject to discontinuation in the company's discretion). Contact a member of the Web design group for details. Please do not use other company trademarks on your site or reproduce company material without first obtaining permission.

Finally, the company may request that you temporarily confine your Web site or Weblog commentary to topics unrelated to the company (or, in rare cases, that you temporarily suspend your Web site or Weblog activity altogether) if it believes this is necessary or advisable to ensure compliance with securities regulations or other laws. ■

CONCLUSION

We live in an era of information abundance, with terabytes of data and billions of Web pages. As can be seen by the wide-ranging discussion in this chapter, the job of managing information resources is widening significantly. Not only must IS departments get corporate data in shape, but they must also create and build an infrastructure for managing the full range of information types. In some ways, the Internet helps because it gives companies an easily accessible place to store information. On the other hand, the Internet contributes mightily to the information glut we all face. We continue this discussion of information resources in Chapter 13 where we discuss supporting knowledge work. That is where we discuss managing knowledge and issues surrounding intellectual capital. What readers seem to trust about blogs, that they do not trust about conventional media, is their opinionated and personal nature. These characteristics present both opportunities and challenges to organizations.

QUESTIONS AND EXERCISES

Review Questions

1. How do data, information, and knowledge differ?
2. Describe the three-level database concept. What are its advantages?
3. What are four database models?
4. What is the main problem in managing data?
5. Why was ERP a driving force in getting data into shape in many companies?
6. What are the four types of information?
7. What is a data warehouse?
8. What is metadata?
9. Why is O&M's WISDOM service valuable to suppliers?
10. What three electronic document management applications generate value?
11. Give the four goals of Tapiola Insurance Group's EDM project.
12. Why is XML important?
13. What are the three phases of the content management life cycle, according to Tucker, and what are the goals of each one?
14. Why did Eastman Chemical Company redesign its Web site?
15. What are the Weblog guidelines Groove Networks gives its employees?

Discussion Questions

1. In this chapter, the assertion is made that IS departments should concentrate on getting data right rather than getting systems up and running quickly. Discuss the pros and cons of this argument.
2. Technology does not change culture. Agree or disagree? Explain your point of view.
3. Do you agree that the IS department should take the lead in developing EDM? Why or why not?
4. If your answer to question 3 was yes, how can IS motivate other departments? If no, who do you think should coordinate the development of the systems and how?

Exercises

1. Find two articles on data management. Present any new ideas in these articles to the class.
2. Find an example of each of the four kinds of information presented in Figure 7-3. They may be from company documents, the Web, or public publications. What new ideas on the (a) corporate authority, (b) technologies used, and (c) information sources did you gain from where you found these items? Did you find any evidence of a merging (or a diverging) of the management of these different types of information?
3. Visit a local company with a data administration function. Talk to the data administrator and find out:
   a. What kinds of data does the IS organization control and not control?
   b. What types of data problems is the group trying to solve?
   c. What progress is the group having in bringing data under control?

4. Visit a local company with a Web site and talk to the person who oversees content management and find out:
   a. What information technologies are used to store, catalog, and retrieve content?
   b. What kinds of information sources are used to supply the content?
   c. What is the organizational structure for managing content?
   d. What are the main content management issues today?

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CHAPTER

8

MANAGING PARTNERSHIP-BASED IT OPERATIONS

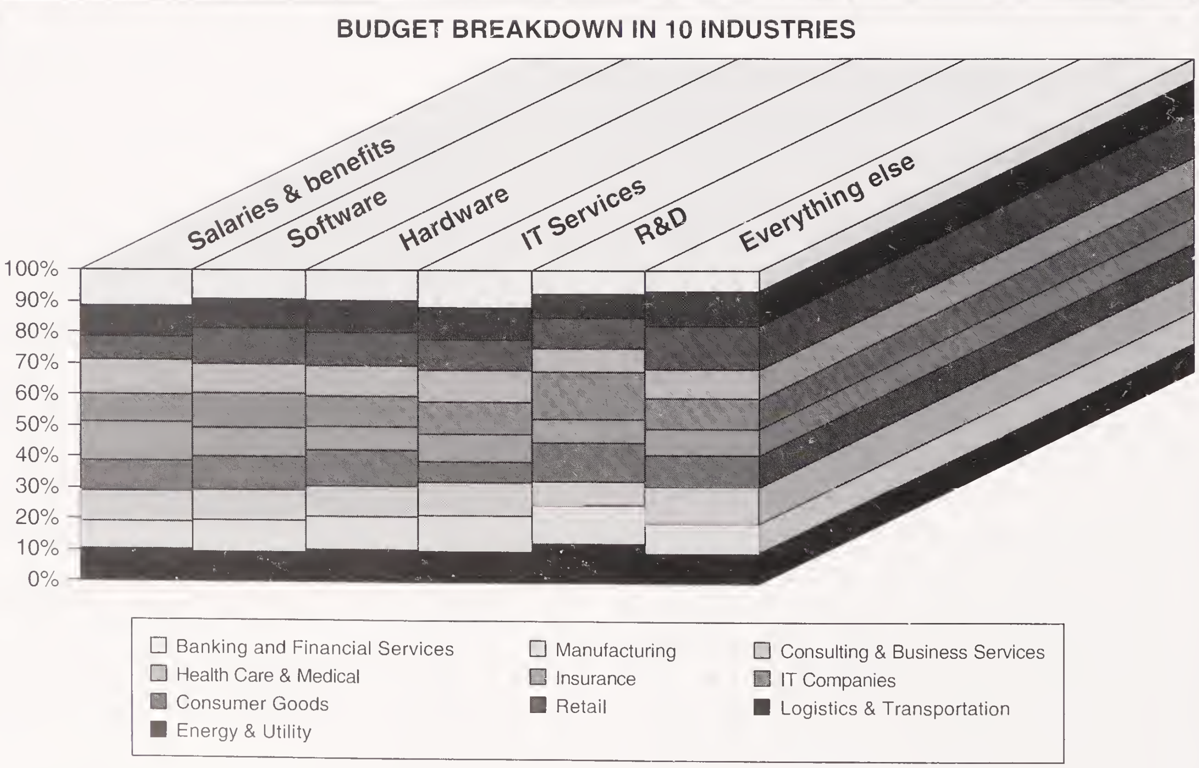
INTRODUCTION

According to itmweb.com, a Web site that runs an online IT budget allocation scoreboard based on major and credible industry source, the "typical" budget of an IT department looked as follows, in 2003:

- Administrative and planning: 20%
- Systems development: 16%
- Systems enhancement: 9%
- Maintenance: 11%, and
- Technology, networks, PCs, etc.: 44%

In 2006, InformationWeek.com ran a national survey involving 500 major firms in 10 industries. As shown in Figure 8-1, salaries and benefits, new hardware and software acquisition, and activities to support IT services are, on average, more or less evenly split on the budget; each category accounts for about one-third of the budget. The survey also indicated that U.S. companies planned to devote between 25 and 79 percent of their IT budget to new projects. It is also worth noting that the manufacturing, retailing, IT, and health care sectors allocate a significant amount of resources for global supply chains. As the U.S. economy is expected to perform slightly better, IT industry analysts predict that the 2008 budget will be approximately 7 percent higher than the previous year, with a similar budget breakdown. Salaries and benefits remain high, and

FIGURE 8-1 Budget Breakdown in 10 U.S. Industries, 2006



Source: Information Week Records Survey, 2006.

many organizations plan to upgrade their hardware/software platform following the usual replacement cycle.

Of course, these numbers are only benchmarks or references. They do, however, indicate the importance of cultivating a culture of best practices in IT management in a number of critical and diverse areas. As discussed in the previous chapters, the job of IT management is to ensure that the IT infrastructure runs cost effectively, and to participate in the organization's quest for technology-enabling business opportunities. This task is even more challenging nowadays because of demanding requirements and expectations from users, and budget constraints for IT spending.

In this chapter, we recommend that, in order to effectively manage IT operations, management should:

- Consistently apply management practices to manage IT portfolio. Any spending on IT should show credible return based on sound investment principles; any IT project should be managed according to rigorous project management principles. The focus should be on improving the productivity, timeliness, and quality of IT products and services.
- Involve all interested in IT-related operations and hold them accountable for their decisions and actions. With limited resources and the variety of organizational IT needs, managing operations requires facilitation, mediation, trade-offs, and consensus within and beyond the IT department. Collaboration is a critical success factor and accountability is also required to ensure that IT-related investments yield satisfactory returns to the organization.

Another theme in this chapter is to look at managing operations from a partnership perspective. The move toward open-source computing, multiplatform collaborative systems, cross-border supply-chain management, and insourcing and outsourcing dictate for a fresh view of dealing with daily management of IT resources and assets. The organizational boundaries have become transparent, and management should look at operations management from a global perspective where tasks can be performed by teams of partners in the most cost-effective manner.

SOLVING OPERATIONAL PROBLEMS: A PORTFOLIO APPROACH

Systems operations problems are obvious to the entire company: Response times are slow, networks are down, data are not available or inaccurate, and systems are prone to malicious attack. What can be done to improve operations? To increase response time, one solution is to buy more equipment. As equipment costs drop, this solution might appear the most cost effective, unless you run out of room for the equipment. Another option would be to regulate the workload by rearranging priorities, allowing mission-critical activities to get executed first. However, this solution only moves the problem of poor management from one hot spot to another. The third solution is to continually document and measure what you are doing to find out the real problems, not just the apparent ones. Then redesign business processes set standards and benchmarks for operations. It is needed no matter who runs operations, the in-house staff or an outsourcer, and no matter whether the systems are legacy transaction systems or new Web-based front ends.

Operational Measures

Operational measures can be both external and internal. External measures are what customers see: system and network uptime (or downtime), response time, turnaround time, and program failures. These aspects directly relate to customer satisfaction. Internal measures are of interest to IS people: computer utilization as a percentage of capacity, availability of mission-critical systems, resource utilization (e.g., disk storage, printer paper, ink, personnel time), job queue length, number of jobs run, number of jobs rerun due to problems, age of applications, and number of unresolved problems.

Problems reported by the external measures can generally be explained by deviations in the internal measures. To help uncover problems related to equipment capacity, quality of applications, or improper use of systems by users, numerous vendors sell monitoring software and devices. Other measurement systems log performance of computer and telecommunications equipment. Storage management systems manage space more efficiently. Schedulers schedule jobs. Library management systems keep track of versions and backups of files and programs. Plenty of tools are available to help IS organizations measure how their equipment is being used.

As discussed in Chapters 1 and 2, operational measures should be based on the concepts of efficiency and effectiveness. In simple terms, efficiency refers to "doing the thing right" (for example, minimizing the operations costs buy using low-performance processors), and effectiveness to "doing the thing right" (for example, setting an application system to support the mission of the organization). Indeed, being efficient does not necessarily lead to being effective.

Another important concept to set up operational measures is the trade-off between local optimization versus global optimization. When a business unit within an organization acts to optimize its own business objective, it could reduce the effectiveness/efficiency of another unit.

The Importance of Good Management

Tools are useless, however, unless IS management has created a culture that recognizes and values good operations. It is hard to find good computer operations managers because the absence of prestige (and sometimes pay) does not attract individuals with the proper combination of skills and training. This reality is unfortunate, because in a good environment, an operations job can be particularly rewarding, both financially and professionally.

The skills required of an operations manager are similar to those needed in a factory or oil refinery. The factory manager must schedule work to meet promised delivery dates, monitor performance as work flows through the key pieces of equipment, and respond quickly to production breakdowns. In a well-run factory, the manager can usually recover from one or two individual problems. In a badly run factory, a manager faces many little problems and often does not know where to start to fix the problems. The same is true in computer and telecommunications centers where the "factory equipment" is the disk drives, database machines, host computers, servers, network gateways, network routers, and the like.

In conclusion, CIOs need to be concerned about operations by putting the proper operations environment in place. The key to managing operations is the same as in any management job: Set standards, or better yet, desirable goals, and then manage to those standards by finding an outstanding operations manager.

What's New in Operations?

Over the past few years, several changes have taken place in operations.

Companies Have "Cleaned Their Operational House"

Y2K and the Internet forced companies to "clean house" in their data and network center operations, says Rosemary LaChance of Farber/LaChance,[1] a company that provides consulting on automating data-center operations.

In the late 1990s, companies were fearful that their old computer applications could not handle processing in the year 2000 because many of the programs left out the digits "19" in, say, "1993." Once the millennium hit, these programs would think the year 2000 was the year 1900, yielding erroneous results.

Y2K forced companies to not only look at their existing software, but also their computer operations; in particular, their standards and policies. Formerly, operations were managed reactively. They upgraded hardware but they rarely updated processes. Companies would not spend the money to improve procedures, thinking, "If it ain't broke, don't fix it."

Y2K, and then the Internet, required management to think about the processes that computer operations supported and ask, "How are we going to do what we say we will do? How will we be able to add services or outsource operations? Will we be able to support e-commerce?" The resulting changes have led to far better operational structures because management took the time to define the rules for operations and put better policies and procedures in place.

"Had they not gone through Y2K, most companies would not have been operationally prepared for the Internet," says LaChance. Although automation provides discipline, the rules must be in place to automate. Y2K forced companies to define such rules as how to gain access to systems. They also got rid of such outdated procedures as transferring data via tapes (moving to more efficient and less costly online data transfers), and distributing reports on paper (moving to making them available via the company intranet).

In short, Y2K gave computer operations the attention it needed but had not gotten. Companies were forced to move from a survival mode ("Let's just get this job run") to a planning mode ("What do we need to support e-enablement?"). The very fact that there was no widespread disruption caused by the Y2K bug is a success of the IS community in dealing with a potential harmful situation. However, challenges remain. Computer operators still cannot link identified problems with changes, so they still have integration and change management problems. That piece of the operations structure is still missing.

Managing Open Source

As discussed in Chapter 5, open source can give businesses new options to develop cost-effective applications thanks to cost sharing across the user community. Popular technologies include Linux, Apache, and MySQL. However, a major issue with open source is to deal with the existence of multiple versions of open source technology. As it is rather challenging to predict which version of open source will survive in the near future, it is important for the organization to carefully select an open source project. Free technology is not exactly free. Best business practices for system development should be enforced: good documentation, professional technical support, and thriving and stable user community.

Getting Serious with Security

With the proliferation of insecure networked-based systems, hacking tools are becoming more prevalent and easily available. Corporate servers where databases are installed have been a favorite targets for attackers. Over the last few years, popular database management systems (DBMS) such as Oracle have reinforced their security features. In the meantime, hackers relentlessly work on new tools. Furthermore, recent adoption of VoIP or Internet telephony has raised a new area of concern for security experts. The big black hole in the current technology seems to be in the Session Initiation Protocol (SIP) trunking area. SIP trunking allows an organization to bypass the public switched telephone network and use the corporate Internet connection to hook up with a VoIP service provider. Due to the new technology, the SIP trunking is a newly found area of security vulnerability.

Large-scale Data Warehousing

Less than a decade ago, a common measure of business intelligence was the size of data warehouse. For a business, the larger its data warehouse, the more "intelligent" it can be. Only large multinational firms had single-digit terabytes of data in their repositories. Only a few—AT& T, Bank of America, Visa, Wal-Mart, and the likes—belonged to the "1-terabyte club." Today, a terabyte drive costs less than $300, and commercial data warehouses contain several hundreds of terabytes of data. Hewlett-Parkard has over 500 terabytes of distributed in 750 data marts. Some U.S. federal agencies process more than a petabyte (1,000 terabytes) of data. The issue is therefore not the lack of data, but the quality and usefulness of available data with respect to a variety of information needs spanning across several business units. Content management will become a critical daily operation that requires sound management. Like most of cutting-edge technologies, large-scale data warehousing could become a bleeding technology, one that might end up expensive and counterproductive.

Enforcing Privacy

In this text, we emphasize the need to enforce privacy in a networked economy. The issue here is for the business to strike a right balance when disseminating data within its organizational structure. On the one hand, it is critical to provide the right information to the right employee at the right time to help support his decision making. On the other hand, untraced information release could expose the business to privacy-related problems.

Dealing with Talent Shortage

With the globalized economy as the backdrop, tight immigration policies in many countries and inadequate quality of local education could negatively affect the quality of domestic IT workers. The supply of IT workers has also become an increasing area of concern in developed countries, in particular, the United States. Due to the uncertainty of the labor market (i.e., offshoring, stress due to constant technological innovation), many college students are advised not to choose an IT career. Companies should take a proactive approach to deal with their IT human capital. They need to invest in continuing training to retain talented workers. They also need to constantly redefine the job description of IT personnel to take advantage of new skills, possibly new employees' locations and new supporting industries.

We will address many of these issues in separate chapters.

More Operations Managers Are Managing Outward

The 2007 survey by *InformationWeek* suggests that the "inward" view remains by and large critical for most businesses. However, as the next section on outsourcing points out, a growing number of companies are turning to a third party to run their data centers. Even more are contracting with a network provider to manage their networks. These changes do not mean that CIOs relinquish responsibility for operations. It just means they need to ensure that their people are properly managing the selected service providers.

Even for companies keeping their own data centers, an increasing number are taking advantage of operational services provided by third parties, especially for Internet-based operations. For example, some host their Web site at a company that specializes in Web hosting. Offloading Web operations allows enterprises to forgo large equipment and facility investments, expensing operational costs instead. Furthermore, they offload the job of finding the needed talent to the specialist. Finding qualified employees can be an acute problem in the IT field. It is easier to attract and retain IT talent when a company's core business is IT because staff can see a career path, the company is more likely to buy the latest tools and equipment, and the culture is more likely to be IT-friendly.

Operations Are Being Simplified

Another trend is to simplify operations by centralizing applications in one place rather than distribute them on PCs. Programs are then downloaded when requested. This practice is called server-based computing and was discussed in Chapter 5.

Certain Operations Are Being Offloaded

Yet another trend in operations is to offload certain kinds of operations or certain aspects of computer and network operations. Often, these relate to the Internet. For example, a relatively new area is Web-event management, which means hosting a real-time event on the Web. When successful, such events, called Webcasts, lead to huge spikes in Web site hits. To avoid being swamped and having the Web site crash, companies offload the operational aspects of these events to third parties that specialize in hosting such activities. Here is an example of such a Webcast.

CASE EXAMPLE

MICROSOFT

www.microsoft.com

When Microsoft officially announced a new version of Windows, it did so not only at a major launch event in San Francisco, California, but also via a public Internet broadcast and a private Webcast to 6,000 original equipment manufacturer (OEM) system builders in 83 countries.

This private global Webcast to OEMs was handled by Akamai. Akamai specializes in providing e-business infrastructure

(*Case Continued*)

through 12,000 edge servers in 66 countries. They are called edge servers because they are at the edge of the Internet; that is, close to end users. This approach gives users in far-flung locations fast downloads of Web content, streaming media, and applications from Web sites hosted on these servers. Like the Internet, Akamai's global distributed system has no central control; therefore, if a server, data center, or even a major network link (a backbone) fails, data can be routed around these failures. Having no single point of failure makes the network fail-safe.

Akamai has also gotten into hosting broadcasts of live events via its customers' Web sites—Webcasting—which requires high-bandwidth capabilities to accommodate streaming media; that is, live audio and video. In addition, Akamai's Netpodium service allows such events to be interactive with dispersed audiences.

The Microsoft Webcast for the system builders was the largest online seminar Microsoft had held. It originated at Microsoft's headquarters in Redmond, Washington, and began with an introduction by Microsoft's OEM team. The Webcast then joined the San Francisco event with an on-site commentator and special presenters.

At their sites, the system builders could use Netpodium to send questions to the presenters. They sent some 1,800 and received real-time responses. In addition, Netpodium was used by the presenters to poll the system builders at several points during the event.

Microsoft was pleased with the private Webcast because it set a record for attendance, global reach, and audience participation.

According to a survey by ON24.com, a provider of Webcast solutions to B2B media companies, the number of live Webcasts continues to increase for online publishers. A 33 percent increase in 2006 from the year before. The 2007 survey also reports that video Webcasts grow faster than their audio-only counterparts. The next push is the use of mobile technologies, such as the iPod or the Internet-based mobile phone to broadcast information to interested parties. Today, many large organizations join Microsoft in using Webcast as an Internet-based broadcasting medium to reach out to their business partners. ■

In conclusion, the focus of CIOs in operations is changing. Their attention used to be focused on ensuring that they had the in-house expertise to keep systems and networks up and running. Their attention now is toward determining where best to perform the various kinds of operations, in-house or with a third party, and then manage accordingly. In an increasing number of cases, the choice is to use an outside specialist; that is, outsourcing IS functions.

OUTSOURCING IS FUNCTIONS

In the IT world, *outsourcing* means turning over a firm's computer operations, network operations, or other IT function to a provider for a specified time; generally, at least a few years. In 1989, outsourcing became a legitimate management strategy by CIOs.

Until that time, the only companies that outsourced their IS operations were those that were poorly run. However, in 1989, Kodak outsourced its well-run IS operations to become a more competitive company. That surprising move caused top executives around the world to consider the use of outsourcers, and has become a classic case study of IT outsourcing. Today, CIOs are expected to investigate outsourcing sufficiently to satisfy executive management that their IS operations are as efficient and effective in-house as they would be if they were outsourced; otherwise, they should outsource what they do not do well. According to a online report by Forrester Research (forrester.com accessed 7/9/2008), companies that outsource IT functions save between 12 and 17 percent of the cost of doing the work in-house. As discussed below, this appears to be the first driving force.

Another significant trend is the reverse direction in outsourcing. In 2007, Wipro Technologies, a $4-billion-a-year company, best known for offshore application development services and India's third-largest IT outsourcing company, paid $600 million to a U.S.-based infrastructure management provider and planned to open a software development center in Atlanta that could employ 1,000 people in the near future. Wipro is looking for higher-value, higher-margin work, and its management argues that, the United States is an innovative economy capable of providing the type of labor force it needs. Infosys and Tata Consultancy Services, Wipro's most important competitors, employ about 15,000 non-American citizens in the United States. This is more evidence of a global and mobile trend in the IT labor market.

The Driving Forces Behind Outsourcing

According to Mel Bergstein of DiamondCluster Int'l.,[2] outsourcing descended on IS departments as a follow-on to the merger and acquisition activities in the 1980s. In the 1960s, only 10 percent of the U.S. economy had global competition. In the 1970s, that rose to 70 percent. In response, companies had to focus on core businesses in the 1980s, which led to the huge amount of merger and acquisition activity. This activity was also driven by a new market for corporate control. High-yield bonds allowed a few people to buy a company and leverage it with debt. Companies were priced based on their shareholder value; that is, their discounted cash flow.

These two drivers—focus and value—are still leading companies to restructure and focus on core businesses by asking themselves, "Where do we really add value?" As examples, some apparel companies no longer cut, sew, manufacture, or distribute goods because they see their core businesses as design and marketing. Likewise, some publishers no longer manufacture books. They manage and finance projects, and outsource everything else.

Thus, outsourcing is part of the drive for focus and value, and it is not solely an IT issue, says Bergstein; it is a business issue. Because top management must stress value, they must consider outsourcing in all their functions. Another view is from Paul Strassmann. In his 1995 financial study of the top U.S. firms that pioneered outsourcing, most of them were in financial trouble. From the period prior to the outsourcing decision (1991–1994), their Economic Value-Added index (i.e., profit-after-tax minus compensation to shareholders for equity capital) decreased significantly while personnel layoffs were massive. In retrospective, the major motivation for outsourcing in the 1990s was to save costs and get out of financial trouble.

Changing Customer–Vendor Relationships

IS outsourcers perform the same activities for a company that an IS organization performs in-house. Over time, the amount of work done by outsiders has increased, says Bergstein, as the following expansion in customer–vendor relationships illustrates.

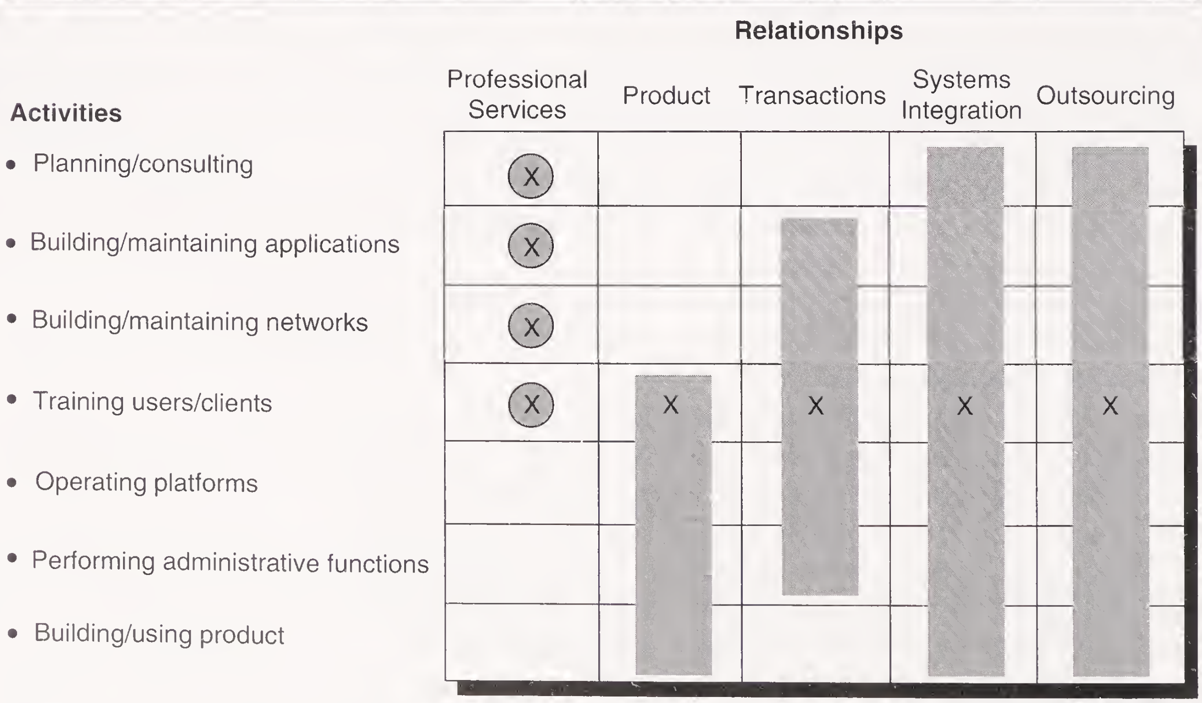
Traditionally, IS organizations bought professional services, such as planning (or consulting), building or maintaining applications, building or maintaining networks, and training. They also bought products, which may or may not have included training. They also bought transactions, such as payroll check processing from a service bureau or credit reports from a credit rating service. Purchasing transactions allows buyers to shift fixed costs to variable costs and gives sellers higher margins because they take on the risks.

With the high use of packages and the need to integrate them to create integrated systems, companies have contracted with systems integrators. They generally handle the entire life cycle—planning, development, maintenance, and training—for major systems projects. Finally, the most bundled approach to contracting for IT services is outsourcing, where the outsourcer contracts to handle all or most of certain IT activities. The main difference between the latter two options is that systems integration is project based, whereas outsourcing is time based.

This five-option continuum, shown in Figure 8-2, demonstrates how the IT field has moved, says Bergstein. As the organization moves from the more traditional professional services category (on the left) to outsourcing (on the right), four changes occur in the vendor–customer relationship:

1. IS management loses an increasing amount of control because more of the activities are turned over to outsiders.
2. Providers take more risks as they offer options on the right.

FIGURE 8-2 Customer–Vendor Relationships



Source: Mel Bergstein, DiamondConsultants.com.

3. Providers' margins improve as they offer services on the right.
4. The importance of choosing the right provider becomes more important to the right, because more is at risk in using an outside source.

Outsourcing's History

In 1989, essentially only one kind of outsourcing involving IT was available. Since then, the field has expanded significantly. Here is a glimpse of its history, based largely on attendance at the semiannual conferences of the Sourcing Interests Group, founded and led by Barry Wiegler since 1991.[3a,b]

IT Outsourcing

IT outsourcing essentially began with "big bang" deals, or mega-deals, which consisted of outsourcing all of a company's data center operations for up to 10 years. These deals involved selling existing equipment to the outsourcer, transferring all software licenses, moving significant numbers of in-house IS personnel to the outsourcer's payroll, negotiating how the outsourcer would help in the transition and which party would carry which costs, establishing desired service levels and ways to measure performance, and specifying every single service to be provided—because if it was not in the contract, it would be an added cost.

In those early days, the goal of these large data-center contracts was purely financial. Companies wanted to remove the huge IT infrastructure investments from their books and shift those fixed costs to variable costs; and they wanted to save money, generally about 15 percent. The deals were front loaded, with the outsourcers losing money or breaking even the first year or two, but then becoming profitable after that as the costs of technology dropped, as they leveraged licenses across clients, as they shared expertise across clients, and as they invested in productivity tools that made them more efficient.

Several problems occurred, though. An "us versus them" mind-set often set in because neither the clients nor the outsourcers handled the transition well. A lot of finger-pointing took place as outsourcers tried to charge for services clients thought were included in the contract. In addition, service levels did not always live up to expectations or interpretations of the contract language differed.

Furthermore, cultures clashed. Former employees might have kept their same desk, but once they became an employee of the outsourcer, they became a provider and were treated differently. Users had higher expectations of outsourcers than of their IS organizations. In short, companies learned that managing the relationship was really the tough job. Formerly, they had thought that negotiating the deal was the difficult part, so they had not carefully defined governance structures; that is, how the relationship would be managed.

Today, the IT outsourcing industry has matured. Providers have learned that heavy-handed treatment of clients can backfire. They are much more careful in transition planning. Clients' attorneys have learned what is important in a contract and where the pitfalls lie. Those early contracts have been renegotiated, and although the clients may not have changed providers, they have generally become more adept at renegotiating because they now know what they really need.

Of course, not all outsourcing deals were mega-deals, but even the small deals felt like a big bang to the employees who moved to the outsourcer.

Transitional Outsourcing

In the early 1990s, a new type of computing arose: client-server computing, as noted in Chapter 5. IT outsourcing had been around for a few years, so CIOs with their hands full supporting legacy systems looked into using outsourcing to transition to client-server computing. They chose one of two routes. Either they outsourced maintenance of their legacy systems so their staff could concentrate on building new client-server systems or they outsourced client-server development to specialists and kept maintenance in-house. In either case, once the new systems were brought in, the legacy systems they replaced were shut down.

Then, in the late 1990s, when the immense size of Y2K compliance surfaced—to retrofit old applications so they would work after the year 2000—most companies outsourced as much of their Y2K work as they could. Because of the enormous volume of work, offshore outsourcing to India, Ireland, and other countries grew significantly. Unlike traditional IT outsourcing, however, contracts were generally shorter and did not include operations. This project-based outsourcing has been called transitional outsourcing.

Best-of-Breed Outsourcing

All through the 1990s, IS departments outsourced different pieces of their work—mainly infrastructure support, as noted in Chapter 2 and IS Lite. However, CIOs learned that although selecting one outsourcer with broad capabilities might be easiest to manage, no single company was best in class in all areas. Thus, selective outsourcing began, where one outsourcer handled desktop operations, another data-center operations, and a third network management. Even though the concept was good for getting best-of-breed providers, coordination among the multiple providers became a nightmare.

A more recent trend has been collaborative outsourcing, where one company becomes the prime contractor for numerous facets of IS operations but some of the work is provided by other ESPs. Often an operations partner, a development partner, and a telecommunications partner collaborate to bid on the work, but one is the prime partner. Thus, teams of large ESPs bid against other teams for contracts. In some cases, these contracts take on quite a bit more than simply operations; the work includes development of new systems as well. Best-of-breed outsourcing has perpetuated the tradition of long and complex outsourcing contracts.

Shared Services

When IT outsourcing began to gain credibility, executives wondered, "Can we get the same economies of scale by pulling disparate noncore functions together into one shared services group?" In many cases, they felt they could. So they "insourced" to themselves, creating a shared services organization to handle such functions as IT, legal, facilities management, real estate, mail room, finance, and on and on. The goal was to improve efficiencies and save money. Generally, companies created a center of expertise in each area, with all the centers reporting to one shared services vice president.

IT was not always included, but, as in the case of MeadWestvaco Corporation (see Chapter 1), it was. Some executives believe having IT in shared services gives them the ability to leverage the IT underpinnings of the other services. Shared services also centralize the management of outsourced functions because, in many cases, the functions are centralized and then outsourced. Shared services groups have become adept at negotiating and managing contracts and supplier relationships because these tasks are a main part of their job.

Business Process Outsourcing

As the IT outsourcing field matured, data-center outsourcing, desktop outsourcing, and other standard IT outsourcing areas have become commodity services; hence, profit margins dropped as the number of competitors rose. To move into higher-margin services, ESPs began specializing in specific functional areas, offering to handle specific business processes as well as their IT underpinnings. This business process outsourcing (BPO) is defined as outsourcing all or most of a reengineered process that has a large IT component.

Improving a noncore process by tapping the expertise and investments of a provider that focuses solely on that process (rather than cut costs) has been the main goal in BPO. Companies are outsourcing logistics, customer service, and many other essential, yet peripheral, functions to the experts.

Balboa Travel,[3a] a travel agency in San Diego, California, handed over its ticket accounting to Unisys. Each week, travel agencies must report the tickets they have sold to the Airline Reporting Corporation. The process is important, yet burdensome, and the president of Balboa Travel did not want to hire a programmer to maintain such a reporting system, which is what he would have had to do if he had not outsourced the work. Unisys provides him a more sophisticated service than he could afford in-house. It lets him offer his clients—corporate travel departments—reports about their employees' travel habits via an extranet. Balboa is also able to do data mining on its ticket sales to uncover trends that will help it offer new and better travel services.

As is obvious, BPO moves IT-based outsourcing out beyond the IS organization; it involves business units as well. BPO outsourcing is often quite a bit more complex than IT outsourcing because it requires clients to change their business processes to fit with the processes of the service provider. Furthermore, some clients want to retain parts of a process, so complex coordination may be necessary between the two firms as well.

BPO has brought a mind-set change to the field. Whereas IT outsourcing moves suppliers and customers closer to one another in terms of working together, the two parties still do not have the same goals. Clients want to save more money, whereas outsourcers want to make more money. In BPO, though, when providers take over an entire process, they can be measured and paid based on outcomes rather than transactions. Outcome-based outsourcing gives the two parties common goals. The client focuses on "what" needs to be done; the provider focuses on "how" to do it. Trust, joint financial investments, and partnering are part of the deal.

As an example of BPO, consider ANZ Banking Group and its outsourcing of its procurement function, as described in a Sourcing Interests Group research report.[3b]

CASE EXAMPLE

ANZ BANKING GROUP LTD.

http://anz.com.au

ANZ is Australia's third-largest bank, and is among the top 50 banks in the world. With AU$335.7 billion in assets, ANZ devises a unique geographical presence in Asia Pacific. It targets markets with high economic growth, yet "underbanked." By 2007, ANZ was operating in 28 countries and had approximately 13,000 staff.

To get to its competitive position today, the bank's challenge in outsourcing procurement was not to improve service levels to its widely dispersed client base and increase the operations scale, without adding costs. ANZ outsourced its entire procurement operation, except strategy, in Australia and New Zealand, to PwC (now part of IBM Global Services) in May 1999 for five years, with a two-year option to continue. ANZ moved fixed asset management and accounts payable into strategic sourcing at the time; neither of them has been outsourced yet. The contract was worth AU$850 million in 1999; as of 2002 it was worth AU$950 million.

The benefit objectives of outsourcing to PwC were to leverage PwC's already global capability, reduce transaction costs (which has occurred), and better manage ANZ's spend information (which was poor at the time).

Lessons Learned

Peter Donald, general manager of Strategic Sourcing at ANZ, recounts a number of lessons he has learned in outsourcing procurement.

Be Prepared to Change the Contract As Your Environment Changes. At ANZ, the total number of contracts managed by procurement has risen from 600 to 900, and could well rise to over 1,000. Furthermore, a new goods and services tax in 2001 has forced new issues into the relationship.

Originally, ANZ and PwC had the stretch goal of saving AU$100 million over the five years. That goal changed to save AU$130 million over just two years' time—a substantial change. Donald thus recommends reviewing the arrangement regularly and being prepared to change it.

Make Step Changes in Technology and Processes to Save Time and Money. ANZ moved to Web-enabled PeopleSoft; 50 percent of the activity now goes through this e-procurement system. This step change was made easier because ANZ had outsourced to PwC, giving ANZ management the time to concentrate on strategic issues. Formerly, the bank had spend leakage of AU$50 million to AU$100 million a year to maverick buying and such. Over the next 12 months, due to the PeopleSoft front end and PwC's operations, ANZ stopped much of that leakage.

Focus on Having an Effective Transition. The transition should be managed so that there is little or no noise from the business units. Some people look for ways to make noise. ANZ experienced some early problems, but PwC recovered

(*Case Continued*)

quickly, actually more quickly than Donald expected. The lesson was to understand beforehand how a provider can recover, so they can do so quickly.

Do Your Best to Make the Outsourced Group Appear Seamless to Employees. Some employees look for ways to find fault. Seamlessness can be difficult to achieve if the provider's staff advertise themselves to employees. This is not a good idea. It is always nice to get a pat on the back, like the one Donald received from a line manager who had prepared a requisition for office supplies on his desktop on Friday at 4:00 p.m. and received the supplies Monday morning. His note to Donald: "Congratulations."

Focus Early on What You Want, and Don't Get Sidetracked. Everyday operations are going well, so Donald is pleased with the service delivery. The outsourcing gives him and his staff more time to manage strategically to capture the AU$130 million in savings. Thus, he wants more strategic input from PwC than he has been receiving. He wants PwC to push him and his staff to improve. His advice to others is to be sure global input is reaching you, if that is what you want.

Along the same strategic lines, Donald wants PwC to work closely with ANZ on large projects. Thus, PwC has moved its commodity management people closer to ANZ's business so that they better understand the procurement strategy being developed with the business units on large projects.

Keep Incentive Mechanisms Simple and Transparent. When incentive mechanisms are excessively complex, too much effort is required from both sides. Complex incentives may also promote the wrong behavior. For instance, the provider may focus on the stretch targets rather than the daily bread-and-butter issues.

PwC receives a fixed but declining management fee over the term, so there is an incentive to lower ANZ's cost base. There are other incentives as well, which are working fine, says Donald. For instance, PwC risks 50 percent of its profits when it fails to meet the stated minimum service levels. This has only happened in one quarter of the last 19.

Be Able to Benchmark Performance. Benchmark data are important in evaluating the outsourcing of procurement. Donald uses CAPS, which provides very good data. However, because he reports to the market every six months, he needs those data more frequently than once a year or once every two years.

Understand, to a Fair Degree of Detail, the Value Chain You Plan to Embrace. Little things can catch you up. For example, information security issues need to be addressed so that third parties in ANZ's supply chain have access through its firewalls.

In 2004, the ANZ banking group wanted to expand its offshore outsourcing of technology in Bangalore and India despite the opposition of some local unions. Its cost-to-income ratio steadily improved from 63.1 in 1997 to 45.6 in 2006. Three years later, it is ranked as a leading global bank based on the Dow Jones Sustainability Index, and *Money Magazine* named it the 2007 Best Bank of the Year. ■

E-Business Outsourcing

With the arrival of business use of the Internet, outsourcing enabled companies to quickly get Web sites up and handling business. In large companies, e-business outsourcing started with marketing departments outsourcing the development of their corporate Web site. Once developed, IS took over operations. However, in dot-coms and Internet-based operations, outsourcing all or most of the IS function has been the preferred mode of operation for several reasons.

Outsourcing allows a company to move fast. When a firm cannot spend a year developing a system, outsourcing the e-business infrastructure can help it get a site up and running within months, perhaps weeks. Furthermore, companies can remain flexible, which means focusing only on a few mission-critical functions that they possess unique expertise and know-how. Generally, IT has not been seen as a core differentiating area when tailorable, off-the-shelf products and services have been available. Last but not least, outsourcing does not tie up a firm's funds in computer and networking equipment, which could become obsolete fairly soon. A company can rent rather than buy. It can draw on best-of-breed as well as change course quickly if need be, swapping out one ESP and swapping in another, to keep pace with the market.

Unlike traditional IT outsourcing, with e-business outsourcing, machines do not need to be purchased from the client, personnel do not have to be moved, and software licenses do not need to be transferred. The outsourcing starts from scratch. For the same reasons some large companies have followed this route as well to get into e-business. For small B2Cs, there are a number of e-commerce hosting services that provide a wide spectrum of e-business services at relatively low costs, from free Web hosting to fee-for-service e-commerce solutions. For example, Yahoo.com offers Web hosting services for less than $40/month, with a free domain name, unlimited e-mail storage, virtually unlimited Web pages, and 24-hour toll-free customer support. More advanced e-business solutions include sponsored search, e-payment, traffic analysis, and the likes.

Utility computing. E-business outsourcing and IT outsourcing are combining into a new form of managed services outsourcing that is being referred to by various names: utility computing, on-demand computing, virtual data centers, autonomic (self-healing) systems, and grid computing (a take-off on the term "electricity grid"). The idea is that computing power can be treated like electricity: You plug in and only pay for what you use.

Numerous vendors, especially IBM, HP, and Sun, are promoting access rather than ownership. By supplying computer processing, network bandwidth, and applications on demand, they are selling the idea of turning clients' fixed IT costs into variable costs. Clients can then scale their IT infrastructure or handle spikes in computing demand without having to buy more IT assets.

Thus, in 15 years' time, IT outsourcing has expanded significantly, from outsourcing data-center operations to outsourcing business processes and from domestic outsourcing to offshoring, which is discussed shortly.

Managing Outsourcing

Numerous aspects to managing outsourcing need to be handled well to create a successful working relationship. Here are just four—organizational structure, governance, day-to-day working, and supplier development. All are based on research reports published by the Sourcing Interests Group.[3c, 3d]

Organizational Structure

Managing outsourcing is different from managing internal staff because, for one thing, it is a joint effort between parties that may not have the same goals, as noted earlier. Therefore, during contract negotiations, the two parties need to figure out and negotiate how they are going to jointly manage the contract they sign. In fact, governance needs to be explicitly addressed in the contract.

Typically, parties establish layers of joint teams. A top-level team of a couple of executives from each firm generally has the final word on conflict resolution. An operational team with members from both companies oversees day-to-day functioning. They hold a formal meeting, say, once a week to once a month; but they are generally in daily contact. Also, some joint special-purpose teams may be created from time to time to deal with pressing issues. Some companies have ongoing standing committees, such as a pricing committee or a change management committee, to oversee the use of formal change management procedures.

Although joint committees are a common management structure, each side needs a single executive in charge of its side of the relationship. On the client side, this executive is the relationship manager. This job position has not been prevalent in IS departments, but we believe it is going to become the norm as companies move toward IS Lite. Needless to say, the skills of a relationship manager are far different from those of a data-center manager. A relationship manager needs to be good at negotiating, cajoling, and being an effective liaison between end users and service providers.

To illustrate how one company has managed its outsourcing, we look at Eastman Kodak Company because it created a thoughtful and effective governance structure. The following description comes from the Sourcing Interests Group; it focuses on the outsourcing between Eastman Kodak and IBM Global Services.[3e]

CASE EXAMPLE

EASTMAN KODAK COMPANY

http://kodak.com

Eastman Kodak Company, with headquarters in Rochester, New York, is an international manufacturer of imaging and chemical products. In 1989, the company rocked the IS world by announcing strategic relationships with four suppliers to manage significant portions of its IS organization. Until that time, outsourcing had been viewed as a desperation move to improve poorly run IS departments. Because Kodak's unit was well run, and benchmarked accordingly, its pioneering stance caused many IS executives—and a few CEOs and CFOs as well—to seriously reconsider outsourcing.

Kodak announced that one ESP would operate its data centers and networks, another would manage its telecommunications, a third would handle PC support, and a fourth would manage

(*Case Continued*)

voice messaging. Initially, the agreement with IBM to manage the data centers was U.S. based; it was later expanded to include Canadian operations, other U.S. divisions, and eventually six international sites. Kodak encourages IBM to leverage its data center for both Kodak and other companies' work for improved efficiencies. Due to efforts on both sides, the Kodak–IBM relationship has worked well. They developed trust and good processes. When issues arise, the relationship has effective processes to deal with them.

Outsourcing Management Structure

Kodak views its outsourcing management role as exercising leadership, staying in control, and managing the high value-added functions for flexibility. Kodak sets the tone for its key IT relationships. The key themes have been collaborative (not adversarial), long-term mutual benefits (not short-term), and making systemic improvements on a global basis (not local). The management structure has six elements: a management board, an advisory council, a supplier and alliance management group, a relationship manager for each relationship, ad hoc working groups, and client surveys.

Management Board. This board meets twice a year and includes senior management from both companies. It focuses on strategic issues in addition to any policies or practices on either side that are getting in the way of mutual success. It has dealt with international strategies, IT architecture, telecommunications directions, disaster recovery plans, and so forth.

Advisory Council. This council meets monthly and has 15 members. It handles technical and operational issues by focusing on what Kodak wants, not on how the services currently are delivered. Kodak's trust in IBM has grown; thus it leaves more of the "how" details up to this ESP. The advisory council reviews service levels, usage measurements and forecasts, tactical plans, migration objectives, business recovery plans, and the like.

Supplier and Alliance Management Group. This group manages the longer-term outsourcing relationships as well as other contracts with large IT suppliers. It works closely with IS management. This group of 10 people includes a manager, the relationship manager for each primary alliance, plus support staff and supplier management for other IT sourcing. Initially, this group managed only the alliances. Contracts with major vendors were handled in other groups. Eventually, all these functions were brought together to increase their focus, leverage global agreements, and align the management of alliances and suppliers. About one-half of the staff have IS backgrounds; the other half come from purchasing.

Relationship Manager. This manager is key to the success of a strategic relationship, Kodak believes, because this manager is the focal point between the company and its ESP. The job of each of Kodak's four relationship managers is to ensure that Kodak receives more than just delivery on the contract. Thus, they also manage value creation. The relationship managers negotiate, coordinate, and manage agreements and ensure that service level agreements (SLAs) are established. SLAs are very precise descriptions of each service to be delivered, when, by whom, for what price, and such. Relationship managers also assist in pricing and billing strategies.

(*Case Continued*)

Working Groups. These groups were not part of Kodak's original outsourcing management structure; they were added to deal with specific technology areas. They are chartered by the advisory council. Their goals are to facilitate changes in processes, promulgate standards, achieve business recovery in case of disruption, and promote effective use of IS services. They have proven to be effective vehicles for talking about important issues, such as the timing and appropriateness of upgrading to new releases of software. The groups are represented mainly by operational staff. For example, database administrators from the major sites are in one working group.

Client Surveys. These surveys are sent out twice a year to nearly 5,000 internal users of the services. Feedback on quality, cycle time, and product and service leadership are assessed and shared with the ESPs. Improvement plans are mutually developed to close perceived performance gaps.

Because Kodak's outsourcing has such a large scope, draws on four main suppliers, and covers a large geographic area, the company has discovered that it needs all of these forms of coordination for effective supplier management.

From a strategic perspective, Eastman Kodak has now seen outsourcing as a means to effectively engage its partners in executing the firm's daily operations. As another example of partnership-based operations management, the New York film and camera company renewed its outsourcing deal with Nortel Network in 2006. Started in 1995, Nortel will continue to manage Kodak's network of PBXs and telephone services through 2008. ■

Governance

The foundations of governing an outsourcing relationship are laid out in the contract, which can be hundreds of pages long (with appendices). A major governance item in the contract is the service level agreements (SLAs) because they are used to gauge supplier performance. For every contracted service, its SLA spells out responsibilities, performance requirements, penalties, bonuses, and so on. Completeness is an important attribute of good SLAs; generally everything should be detailed, perhaps even with times of deliveries, who will deliver what to whom, and so on.

Another important component of SLAs is metrics. An SLA needs to be measurable to be of use. Establishing metrics can be tricky because, in many cases, IS departments have not kept good measures of their own performance. In BPO, the situation is even worse; companies do not know how many people are in the process, departmental costs do not reflect overhead or IT costs, and so on. Measures are needed to establish benchmarks against which vendors want to demonstrate improvements. Clients also need metrics to negotiate better deals. Clients who do not know their own performance levels negotiate from weakness; they know less than the vendor because they have not tracked details, and vendors are not apt to correct mistaken impressions. Furthermore, clients are likely to overlook important details, which will later cost them money.

- Service levels must stay in the top 25 percent as benchmarked against the client's peers.
- Escalation of problems becomes more painful as it goes higher to encourage early resolution.
- The supplier is the grand project manager and is responsible for managing multiple vendors.
- Work style is based on respect and confidence; there should be no personalization of problems.
- Add significant value.
- Aim to operate in an "open book" manner, sharing key operating information with each other.
- New services can be put out for bid.
- No exclusive agreements.
- Meet our standards.
- Let us know about potential problems before they happen.
- Spend our money as if it were your own.

FIGURE 8-3 Examples of Outsourcing Governance Rules

Source: Reprinted with permission of Sourcing Interests Group, www.sourcinginterests.org.

In addition to SLAs, parties establish governance rules to be used when either party is making a decision so that both are "singing from the same hymnal." Most parties in strong relationships say they put the contract in the drawer after it has been signed and work from trust and agreed-upon rules. It is only when trust in one another breaks down that they turn to the contract. Figure 8-3 lists some governance rules from a number of different enterprises.

Day-to-Day Working

The Sourcing Interests Group[3c,d] reports provide advice from outsourcing executives on how to manage day-to-day interactions between two parties. Here are a few of those recommendations.

Manage expectations, not staff. The outsourcer's staff is no longer under the purview of the client, so command-and-control is not a wise option—it only results in an acrimonious relationship. Facilitation becomes the mode of working. Rather than say "do this," the approach becomes "how can we solve this together?" Furthermore, relationship managers have the important role of influencing users' expectations so that delivery meets business objectives.

Realize that informal ways of working may disappear. More formality is inevitable as outcomes are measured and are more tightly controlled, especially if the relationship is handled strictly by the book, which happens in some cases. This increased formality can be a shock to people who are used to, say, getting a small job done by calling their friend "Joe" in the IS department. Once Joe works for the ESP, he may no longer be able to provide that service; he must follow the work authorization process defined in the contract. This change can cause unhappiness as users see providers as "them," making them the scapegoat. The two parties need to find ways to reduce this tendency.

Loss of informal ways of working can add rigor. Rigor frequently improves work quality. Users may think twice before requesting changes and prepare better definitions of what they want. Furthermore, better processes can streamline work, improve effectiveness, and potentially reduce unnecessary work. Service providers do introduce new discipline; the client should prepare employees for this change and assist them in adapting because it is generally best to use the provider's processes. This is one reason why transition planning is so important: to help client personnel move to new procedures with the least disruption and disgruntlement.

Integration of the two staffs requires explicit actions. Integration does not happen naturally. Explicit policies are likely to be needed. Some examples are to (1) grant outsourcing staff access to appropriate work areas, not unduly restrict them; (2) hold joint celebrations and social events; (3) invite each other to meetings; and (4) perhaps even have a client executive move to the provider for two years to learn how they work internally. However, integration generally can only go so far; the client still needs to remain in control and guide the relationship. Furthermore, the more side-by-side the parties work, the more likely they will experience scope creep in which the provider takes on more work.

The best way to manage day-to-day is to communicate frequently. One executive said he carried around a top-10 list in his shirt pocket, which he revised every week. They were the most important items he had to handle. The list kept him on focus and turned out to be his best informal management technique.

Supplier Development

A topic that is receiving increased attention in the production sourcing arena—that is, buying parts and services that go into one's own products and services—is supplier development. It means assisting one's suppliers to improve their products and services, generally by improving their processes. Although supplier development has not been prevalent in IT outsourcing, we think it will be. It will likely be prevalent in BPO.

Offshoring

In the late 1990s, when labor markets were especially tight and IS organizations needed to retrofit their systems to make them Y2K compliant, the use of offshore outsourcers to maintain IT applications grew dramatically. Offshore, of course, is relative. For U.S. companies, near-shore means outsourcing to Canadian and Mexican companies, whereas offshore means Ireland, India, the Philippines, and other countries. For European companies, near-shore is Ireland, Poland, and other Eastern European countries.

Companies turn to offshoring to tap lower labor costs and an ample supply of qualified people. During the recent economic downturn, and now with increased global competition, offshoring give companies a way to cut costs. The trickle of IT jobs in the late 1990s has turned into a steady stream of white-collar work going offshore. Application maintenance and development, call centers, customer service, back-office processing, BPO, claims processing, and other functions can all be moved offshore.

Offshoring has become a political issue, because companies are not expanding their domestic labor force as rapidly as some had expected. There's an outcry that offshoring is taking jobs away from domestic workers. Politicians are trying, at the very least, to "shame" companies into not moving domestic work abroad. But as with manufacturing jobs in the 1980s, offshoring is unstoppable because the economics are so strong. Once one company in an industry lowers its costs by moving work to lower-wage countries, its competitors need to reduce their costs as well. That may mean that they, too, need to offshore. India, for example, has recently outsourced many of its programming activities to China and Vietnam, where labor cost is significantly lower than that of the Bangalore aera.

For all the "this is terrible" talk, offshoring might actually be good for developed countries, because increasing the living standards in other countries increases their citizens' demands for consumer products that can, in turn, be supplied by highly efficient companies in developed countries.

Furthermore, white-collar offshoring has been inevitable, argues author Daniel Altman,[4] because service sector productivity in the United States has not kept up with manufacturing sector productivity. In the early 1950s, each service sector employee produced about $39,000 in output (in 2000 dollars), he notes; in manufacturing, the output was $48,000. Now, 50 years later, service productivity has increased to $54,000 (a 47 percent increase), whereas manufacturing productivity is at $207,000 (a 330 percent increase)!

Manufacturers have faced international competition, whereas service firms have not. Manufacturers have been forced to increase their productivity to stay in business—mainly by increasing the quality of their products, notes Altman. It should come as no surprise that service companies are tapping cheaper sources of labor now because of globally available telecommunications technology, he notes. This global competition in services will force American companies to increase the productivity of their workforce in the same way and increase the quality of their services, Altman believes.

Offshore outsourcing differs in some unique ways from domestic outsourcing. In two reports, the Sourcing Interests Group (SIG) explores IT offshoring and the areas CIOs and their staff need to consider.[3f] Here are four points from those reports.

Offshoring Options Are Broadening

India has become the premier IT and BPO offshoring country because its huge, highly educated workforce speaks English and is hard working. College graduates in India apply for jobs that only high school graduates will apply for in the United States, such as working in a customer service center. Hence, the quality of work is often higher, while the labor costs are lower. Furthermore, in IS, all of the major IT outsourcers in India have achieved the highest level (Level 5) in the Capability Maturity Matrix, which means their processes produce high-quality software. Most IS organizations in the United States and in other developed countries are not even up to Level 3. So the quality of software from these Indian firms is very high—as long as the specifications for the work are clear and truly what the customer wants.

After having good initial IT experiences in India, client companies are offshoring higher-value, white-collar work beyond short-term software maintenance projects to ongoing software maintenance work, new development projects, and even BPO. The types of firms offering offshore options are also broadening. The United States outsourcers are building their own offshore capabilities or acquiring existing offshore providers, often in India, sometimes in China, to lower their own costs. Client companies not wanting to deal directly with unfamiliar overseas providers can now tap offshore resources through onshore outsourcers. In fact, as noted in the SIG reports, all large IT outsourcing deals will likely have an offshore component. Global sourcing is becoming the norm. As offshoring activities mature, many U.S. companies acknowledge that they start to see benefits of outsourcing beyond cost-savings. Partners in offshoring countries are getting more sophisticated. The level of education and business background is at par with their partners, and innovative ideas have emerged more frequently.

Both Parties Need Cultural Training to Bridge Cultural Differences

Offshoring does bring cultural differences into sharp relief, which can hinder success unless properly handled. Outsourcers and offshore advisory firms (who advise clients on the offshore marketplace) now realize that both parties need cultural training to overcome management and communication gaps.

For clients, offshorers now routinely put client employees who will deal with the offshore employees through a cultural integration program. Here is a brief description of the program at Syntel, a large U.S.-based IT provider that uses an offshore (India) model, as recounted in one of the SIG reports:[3f]

> *We initially hold a 1.5-day workshop, and then a follow-up orientation a few months later. We find that clients often restructure their operations during the first few months, sometimes bringing in new people. These new people need the orientation, also, which is why we repeat the orientation.*
>
> *In the workshop we talk about how lifestyles and cultures differ between the U.S. and India. In fact, we tailor each workshop to the client's location because Midwest employees differ from New Yorkers, for example. We illustrate, for instance, how the same words have different meanings in the two countries. We point out differences in dress, foods, even eating times. We show a video of these differences, we have people wear the native dress, and we demonstrate how Indians prepare a lunch, which we then serve. We have learned that U.S. employees often have a third-world view of India that is not accurate. Our goal in the orientation is to familiarize them with today's modern India.*

On the provider side, offshorers often put their own employees through an accent neutralization program if they have an accent the client country will find difficult to understand. This practice is especially prevalent for Indian providers with American clients. Providers also teach their employees about the client's company culture (going so far as to hang the same posters on the walls as the client has on its walls) and the client country's culture (going so far as to familiarize employees with holidays and keep them up to date on sports teams and major sporting events).

Communication Issues Need to Be Addressed from the Outset

Different cultures have different communication norms, even when they speak the same language. These differences show up immediately when people from two cultures try to negotiate an offshore contract. The differences need to be addressed, beginning with the negotiations.

Here is just one example. The word "yes" in Asia typically means, "I hear what you are saying," whereas in the United States it means "I can do what you ask" or "I agree with you." When conversing, an Indian might nod his head "yes," which an American might misinterpret as an agreement. The American is then surprised at the next meeting when there has been no agreement after all.

There are substantially more risks in negotiating offshore than onshore contracts because of such communication misunderstandings, notes the global law firm of Mayer, Brown, Rowe & Maw LLP in a SIG report.[3f] The firm uses many mechanisms to mitigate these risks. Here are just five:

- Avoid colloquialisms, such as sports analogies ("we've got to punt on this"), because these statements do not bridge cultures.
- Simplify communications by using short, concise sentences with common words, rather than the typical legal practice of lengthy, convoluted sentences and paragraphs.
- Have the offshore provider write a "statement of work," to gauge their understanding of what they think they are being asked to do.
- Get all commitments in writing.
- Include a person on the client negotiating team who knows the offshore country culture so that he or she can explain the country's norms to the client team as issues arise and prevent the offshorer's team from holding side discussions in their own language at the bargaining table. A "country-wise" member can significantly change negotiating dynamics.

Communication Issues Continue Throughout Offshore Relationships

This is why migrating the work, which is often fairly quickly defined in onshore contracts, can require lengthy discussions in offshore deals. Common understandings do not exist, so every step in moving work from one country to another, and who pays for what, must be agreed upon. Furthermore, country laws and norms must be taken into account.

Country Laws Need to Be Followed

Offshoring contracts must bridge a myriad of differences between cultures. To preclude dealing with some legal issues, offshore vendors now typically sign their contract in the client's country. For example, as noted earlier, Syntel is a U.S. company. Its contracts with U.S. clients are signed in the United States, and are governed by U.S. law.

Even so, clients need to be aware of data privacy laws, which may not allow customer data to leave its home country or enter certain other countries. The European Union (EU), for instance, does not allow personal data to be moved outside of EU countries. Likewise, clients need to understand the enforceability of intellectual property laws in the outsourced country. Lack of enforceability may preclude moving some IT work to a country, such as China, which does not have enforceable intellectual property laws. Likewise, taxation, employment, immigration, and other laws can significantly affect an offshoring arrangement. All of these must be taken into account.

The list of issues in offshoring can be truly mind-numbing. However, as the trend continues to grow, common practices are arising that make the negotiating task less daunting and the resulting arrangement less risky and more likely to succeed. As an example from the SIG report[3f] of a company using offshoring for its IT maintenance work, consider Hewitt Associates, which is itself an example of a BPO company. It manages human resources for other firms.

CASE EXAMPLE

HEWITT ASSOCIATES

www.hewittassociates.com

With more than 70 years of experience, Hewitt Associates is the world's largest global provider of multiservice human resources outsourcing and consulting services. The firm consults with more than 2,300 companies and administers human resources, health care, payroll and retirement programs. Located in 35 countries, Hewitt employs approximately 24,000 employees. In 2003, Hewitt acquired Exult Inc., to strengthen its lead in the human resource provider industry. Before the merger, Exult Inc. provided full-service human resources (HR) outsourcing to Global 500 companies. In this case example, we briefly describe how this Human Resource Business Process Outsourcing provider became a leader in the field. The range of administrative processes Exult provided can be grouped into four main areas. One, Exult maintains and manages employee data and HR records, thereby facilitating various HR functions for clients. Two, Exult manages clients' payroll, compensation, and benefits processes. Three, it provides recruiting and flexible staffing services. Four, Exult provides learning, global mobility, and relocation services to help clients deploy their people most effectively.

Exult is mature in outsourcing relationships because outsourcing is its primary business. Furthermore, most Exult executives were either on the buyer or seller side of outsourcing before joining the company.

In October 2001, Exult signed two contracts with two Indian companies to maintain its core HR computer systems, which include both PeopleSoft and SAP platforms as well as systems built on those two platforms. This was the first time Exult outsourced any IT services.

"We chose to outsource application maintenance to India for three reasons: to garner cost savings, to increase system quality, and to achieve scale (that is, increase our access to resources as we grow our business)," says Steve Unterberger, executive vice president of business model architecture at Exult. He is responsible for Exult's service delivery model.

Exult chose two providers rather than one to ensure that resources could be scaled up as needed. Having only one provider could constrain growth. Management also wanted a fallback position, so that one provider could back up the other if need be. Finally, having two providers would let Exult migrate work offshore faster, moving one client to one provider and another client to the other provider. There would be no single point-of-capacity limit.

Choosing the Providers

"We led the project, but we called on two advisors: neoIT to do the detailed review and content, and TPI to structure the contract," says Unterberger. He continues, "We contracted with neoIT because of their experience contracting with

(*Case Continued*)

Indian firms. Our goal was to get the best arrangement for ourselves and our clients. To do that, we needed to understand the Indian market and its practices. NeoIT helped us achieve that."

The Exult internal outsourcing team was composed of Unterberger and Exult's top people in sourcing, IT management, application management, IT connectivity and infrastructure, and IT security and privacy.

Early in the considerations, Exult and neoIT made a four-day trip to India and visited nine providers. "Our goal for that first trip was to meet as many companies as we could, to see first-hand how they compared. We knew the only way we could expect to have a clear view of the Indian marketplace was to personally visit India. There are five or six main cities where the major providers are located, so it's easy to see many companies in a short time. We met management, walked around operations, and chose employees at random and talked to them. They showed us real customer service reporting, work processes, and quality measures. We were able to accomplish a lot very quickly because we were clear about what we needed. We knew the specific skills, competencies, and commitments we needed because these are spelled out in our contracts with our clients. So we were able to quickly direct conversations to get to the points we wanted to cover. We looked for a demonstrated ability to scale, a track record for managing people, and good IT maintenance processes," says Unterberger.

He continues: "That trip taught us that India has an incredible number of people who are very disciplined and highly motivated. In the end, we came away convinced that many companies could satisfy our needs. I returned from that trip with a real zeal, believing that anyone who is not investigating Indian providers is doing their company a disservice."

Following the trip, neoIT and Exult ranked the providers and selected two using neoIT's neoQA process. "NeoIT was a very good advisor during this whole process, in two ways. First, they suggested other companies for us to consider—companies not typically on the big list. That was helpful because it kept everyone on their toes. Second, they knew where to push and not push, and they were able to distinguish for us the areas specific to Indian-based firms that we might have overlooked without their guidance," says Unterberger.

Negotiating the Deals

The negotiations were straightforward, and neoIT did help Exult avoid some pitfalls in pricing, taxes, staffing commitments, and telecom. "The providers have standard things they will do, but they do not volunteer them. You have to know to ask," says Unterberger. He states, "Telecom is one of those areas because, while the people costs in India are lower than the U.S., telecommunications costs are on a par with the U.S. We had also been forewarned that interconnecting would be the pacing factor in getting up and running—and, in fact, it was."

The agreements with the two providers are expected to be for five years, but each statement of work aligns with an Exult client and that client's agreement with Exult. These client relationships range from 5 to 10 years in length. The contracts specify service level commitments.

(*Case Continued*)

"All the companies have a similar model for training and knowledge transfer, so there is a well-known discipline in migrating the work. Our transition went according to plan. We transitioned client by client; some clients went to one provider, some to the other," states Unterberger.

"Data privacy was managed through extensive planning and review. We built upon the commitments in our own client contracts. The data is only accessed remotely from India, and the development environments work only with encrypted data. Backup data is stored in the client country, as are business resumption facilities. We spent a lot of time working through these data privacy issues to ensure there were no misunderstandings," says Unterberger.

Migration and Ongoing Management

The current split of IT maintenance work is as follows:

- Seventy percent of the staff members are offshore in India; they handle most of the ongoing maintenance of the HR systems.
- Fifteen percent are provider employees and work onshore at Exult; they handle quick turnaround work and coordinate change control and testing with the offshore staff.
- Fifteen percent are Exult employees who work onshore; they handle client communications and specifying system requirements.

Exult has the ability to influence key positions, and the providers are quick to rotate people when issues arise.

"The offshore companies are very good at engineering discipline. Taking advantage of that capability, though, requires U.S. buyers to work within those highly disciplined Indian maintenance processes rather than try to change them," says Unterberger. Exult had to transition its retained IT managers to:

1. Shift from managing people to managing outcomes
2. Take the time to learn how the Indian staff work and think
3. Be open to suggestions from the Indian staff on how to improve the quality of our HR software

"Transitioning IT managers to manage offshore work requires new skills because they are familiar with having direct control over their people. They need to become more general managers and know which levers to pull to obtain results from afar Exult also draws on neoIT in managing the relationships day-to-day. NeoIT has a person who acts as our eyes and ears in India because we are not there every day," says Unterberger. ■

Use Offshoring to Advantage

A main criticism of offshoring is that it decreases the skills and know-how of the client's IS organization. This need not be so. Kate Kaiser of Marquette University and Stephen Hawk of the University of Wisconsin-Parkside[5] describe an eight-year arrangement between an unnamed financial services firm in the United States and an unnamed IT outsourcer in India. In their recent article in *MIS Quarterly Executive*, the two authors note that the U.S. firm wanted to reduce its system development costs but also increase its in-house IS staff's knowledge—a fairly unusual dual goal. To do so, the two firms have evolved their relationship to "IT cosourcing," which Kaiser and Hawk define as "when the vendor and client collaborate so closely that the vendor can replace or augment the client's IT competencies." In essence, resources from both firms are used to meet the client's needs. Project teams are mixed, and team leadership can come from either firm—both of which require the vendor to have a large on-site presence. Two mechanisms, in particular, have ensured that the U.S. firm's IS staff gain competencies rather than lose them: formalized knowledge transfer between the two firms and a dual project-management hierarchy.

To formalize knowledge transfer from the Indian staff to the U.S. staff, U.S. staff members are sometimes formally assigned to projects to learn from an Indian mentor. The two firms initially made such assignments informally, but that approach did not improve skills. So the two firms formalized learning-oriented mechanisms, such as mentoring. At the U.S. firm, each IS employee has a development plan, which includes career goals and steps to achieve the needed skills. For the Indian firm, job assignments with the U.S. client include such tasks as mentoring a specific U.S. team member in specific areas. The cost of mentoring is included in the cost of the project.

To create the dual project management hierarchy, the hierarchies of the two firms now mirror each other to improve communication across them. Furthermore, the tiers of leadership in projects can come from either firm, depending on the circumstances. The Indian firm may lead to provide mentoring. The U.S. client may lead for business reasons. Again, the roles of each job are formally agreed upon, and mentoring or other knowledge-transfer skills are part of the cost of the project.

Both mechanisms increase the cost of outsourcing, note Kaiser and Hawk, because, for one thing, dual leadership requires more Indian staff to be located in the United States. But the additional cost improves the in-house staff's technical and application skills, which the firm believes is well worth the added expense, because they highly value their employees' career development.

Redefine Services Using Offshoring, Automation, and Self-Service

Uday Karmarkar,[6] research director of UCLA's Center for Management in the Information Economy, like author Daniel Altman,[7] believes that outsourcing of services is inevitable and that the real concern of service firms should be their loss of competitiveness, not the loss of jobs in their own country. He believes that the service economy is in the midst of restructuring itself, which is terribly painful when it happens in any industry. Offshoring, automation, and self-service are all combining to cause "the industrialization of services," he believes. Like manufacturing firms before them, service firms therefore need to find new ways to add value. He suggests looking in five places for determining new strategies for surviving and using offshoring, automation, and self-service to execute these strategies.

Understand customers. Companies that understand niches of customers, and serve them well, will themselves do well, believes Karmarkar, especially as they move their services to the Web. Edmunds, a company that has published books for car buyers for many years, now focuses on its car-buyer Web site. The site has been so well designed that it has won numerous awards. Edmunds understands its customers and caters to them, states Karmarkar.

Understand demographics. Look for underserved niches, like Wells Fargo Bank has done in offering specific services to the Hispanic population in the western United States. The bank opens 22,000 Hispanic accounts a month by understanding and catering to this growing group, notes Karmarkar.

Stay in touch with customers. Do not outsource customer service. Many have done it and found that they lose touch with their customers. Some have realized the effect and brought the function back in-house. A far better strategy is to deliver responsive and error-free service, he believes.

Offer end-to-end service. Customers are most interested in buying services from firms that offer end-to-end services. For example, Virgin Atlantic Airways provides its business-class passengers with limousine service to the airport and drive-through check-in. People are willing to pay for such pampering to relieve themselves of hassles. This is an important strategy some service firms are delving into by using data mining to understand preferences of customer clusters and then catering to those preferences.

Dominate the screen. As information moves online, companies are vying to control "the screen," that is, where the information ends up. Service companies have a shot at dominating the screen, because the design of the service and the interface (rather than the technology or the appliance) will determine success, states Karmarkar. For example, NTT DoCoMo, the telecommunications company in Japan, knows how to sell content on cell phones and appliances—from service providers to consumers. Due to this skill, NTT has claimed a disproportionate degree of control over the information chain; it dominates the screen. In short, service companies need to understand what kinds of information various clusters of customers want and cater to them. For many service firms, that catering will be via the Web and mobile devices, using offshoring, self-service, and automation where each can contribute the most value.

In conclusion, outsourcing has become a strategic alternative. With the rapid pace of business change, the best hope of many enterprises is to tap the expertise of companies that are keeping pace rather than trying to do everything themselves. That is why so much inter-company collaboration is taking place. However, outsourcing does not mean relinquishing responsibility. In fact, taken to its extreme, it can mean devoting resources to assist suppliers in improving their processes. We believe it is a coming focus in the world of IS Lite.

Insourcing

We could not finish this chapter without discussing an opposite phenomenon of outsourcing. Insourcing is widely understood as the delegation or contracting of operations or jobs within a business to an internal—mostly independent—entity as a subcontractor. The company sets up its own IT unit as a subsidiary in another country, and "outsources" its IT operations to this offshore unit. The key motivation is for the business to maintain tight control of the execution of the contracted jobs, both from the point of view of product quality and organizational processes while taking advantage of the benefits of offshoring. Another key reason for insourcing is to protect the organization's intellectual property and business know-how. Many American banks and high-tech companies set up the independent offices in India and the Philippines to take care of the call centers or customer services. The overseas subsidiaries are under control of their parent company.

As such, insourcing can be seen as a different form of partnership-based management of operations. Most of the best practices related to offshoring remain relevant though.

CONCLUSION

In this chapter, we highlighted a number of important issues related to the management of IT operations. We started the chapter with a summary of three fundamental principles:

- While it is important to align the resources of the IT department to the overall mission of the organization, it is important for CIOs and CEOs to encourage a substantial part of IT resources for creating or assisting the creation of new and high-impact strategies.
- Management should strike a balance between efficiency and effectiveness when deploying its IT assets, and
- Given a variety of activities from network management to customer support, management should monitor IT operations so that local optimizations do not take precedence over global (organization-wide) optimization.

The subject of managing computer operations is, perhaps surprisingly, at an all-time high because of the emergence of e-commerce, the increasing use of outsourcing, news-grabbing computer viruses, attacks on major Web sites, and terrorism. Outsourcing, security, business continuity—all are important operational issues. As enterprises increasingly rely on computing and telecommunications to work closely with others, they open themselves up to more threats by electronic means. In short, the view of operations is shifting from managing inward to managing outward, on all fronts. Whether operations take place in-house or are being outsourced/insourced to an overseas location, the mode of operations of an IT department is complex and based on partnership. The success or failure of managing IT operations depends on how well management can manage and control the relationships between units involved in the daily management and use of IT resources.

QUESTIONS AND EXERCISES

Review Questions

1. What has been the main shift in the operations viewpoint?
2. What are three solutions to operations problems?

3. How did Microsoft manage its special OEM Webcast?
4. How thoroughly are CIOs expected to investigate outsourcing?
5. What are the driving forces of outsourcing, according to Bergstein?
6. What are IT outsourcing, transitional outsourcing, best-of-breed outsourcing, shared services, business process outsourcing, and e-business outsourcing?
7. What management elements has Kodak put in place to manage its outsourcing relationships?
8. What is supplier development?
9. What are five ways to reduce miscommunications in negotiating an offshore outsourcing contract?

Discussion Questions

1. Discuss the qualifications of the operations managers in the IT department.
2. Outsourcing offloads a burdensome technical responsibility and allows management to focus on its core business. Outsourcing strips a company of an important core competence—IT know-how. Which statement do you agree with? Why?
3. Discuss the role and impacts of cultural differences when a company adopt offshoring.

Exercises

1. Read a few articles about outsourcing. What did you learn about outsourcing that is not mentioned in this chapter? Relay your findings to the class.
2. Read three articles that describe the negatives of offshore outsourcing and three that present the positives. Present both sides to the class.

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PART III

MANAGING SYSTEM DEVELOPMENT

Part III of this book consists of three chapters that deal with developing enterprise-based systems; that is, system development. As noted in the following figure, system development has traditionally been aimed at procedure-based work. Procedure-based activities are large-volume transactions where each transaction has a relatively low cost or value. These activities, which consist mainly of handling data, are well defined, and the principal measure for gauging their performance is efficiency. Information systems were, in most cases, first built to automate this kind of work, beginning initially with accounting, and then progressing into manufacturing, administration, sales and marketing, and so on. Development of these systems has been handled by IS professionals.

Chapter 9 begins by describing the foundations of system development, which are the technologies and methodologies that form the basis of today's approaches. Then it discusses two areas of current importance: system integration and Internet-based systems. We conclude the chapter by discussing project management—the underpinning of successful IT projects, especially large ones.

Chapter 10 discusses a number of management issues that surround system development: IT staffing, managing the change that surrounds system implementation, what to do about legacy systems, and measuring the benefits of systems.

Information security has become the top priority concern for businesses. In Chapter 11, we expand the concept of risk management and mitigation to data thefts and argue that any knowledge-based organization should acquire security competency.

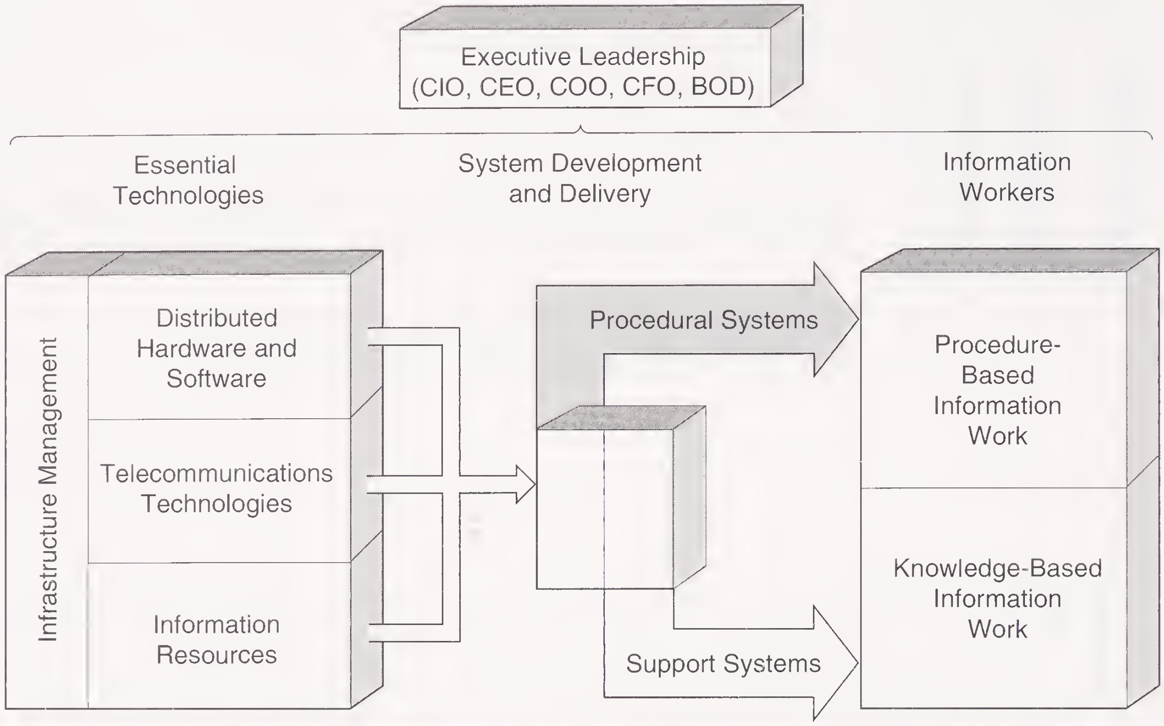

FIGURE P3-1 A Framework for IS Management

CHAPTER

9

TECHNOLOGIES FOR DEVELOPING EFFECTIVE SYSTEMS

INTRODUCTION

One of the toughest jobs in IS management is developing new systems. Given that each organization has its own culture and way of conducting business and the need of differentiating the use of IT to achieve competitive advantage, it is virtually impossible to have a universal commercial-off-the-shelf system that is ready to deploy. Developing new business systems seems to be an area in which Murphy's Law—if anything can go wrong, it will—reigns supreme. In spite of the increasing complexity of system development, the IT field has made significant progress in improving the process of building systems. The traditional approach, with variations, of course, appears in many textbooks and professional books.

During the 1970s, a relatively well-defined process called the system development life cycle emerged. This life cycle improved the development process significantly. However, continued backlogs, cost overruns, and performance shortfalls underscored the difficulty and complexity of the system development process.

The 1980s saw progress in more friendly languages and automation of portions of development, such as code generation. Yet, maintenance continued to eat up 70 to 80 percent of the system development resources in most companies.

The 1990s began with the promise of significantly increasing developer productivity and reducing maintenance by relying more on packages and by building systems by linking together components. The business process reengineering movement spawned the growth of integrated enterprise systems and the widespread adoption of ERP systems. Then, all of a sudden, in the late 1990s, e-business and Internet-based systems appeared.

In the 2000s, the Internet brought the need for faster system development and integrated enterprise systems; that is, systems that pull together various aspects of the enterprise. New tools for rapid development became available; they relied on reusable components and open systems architectures. As a result, application development projects became application integration projects; systems were built by integrating pre-built components.

As repeatedly mentioned in this text, every application today is a network application. The network is becoming the system. Web-based applications were the first generation of Internet-centric computing. The new field, Web Services, is touted as the second. In it, as described in Chapter 5, small modules of code perform specific functions and can be called by other modules to perform that work, all via the Internet. The Web Services world is upon us. In addition, the trend toward increasing the interconnectedness of supply chains is leading companies to build inter-organizational systems, which is a far more complex undertaking than single-company systems. This chapter reviews the evolution of system development to provide an understanding of the underlying principles of building applications.

SOLVING THE SOFTWARE CRISIS

During the last two decades, organizations have witnessed a phenomenon now known as the software crisis. Software costs continue to have spiraled dramatically, becoming the largest cost item in IT. Delivery schedules are seldom kept. As software grows rapidly to meet more complex requirements and tight delivery deadlines, quality has become a nontrivial issue. Academic researchers and software vendors have long sought for solutions to the software crisis.

First, programming language has significantly evolved. From the first generation of programming language that consists of machine code—a system of step-by-step instructions and data that tell the computer's Central Processing Unit (CPU) how and what to execute—today's organizations are provided with highly integrated software development platforms at a significantly high level of abstraction. Thus, instead of given a step-by-step instruction to the computer (e.g., go to a memory cell, get the data stored in this memory cell; and go to another memory cell, get another data store in there, do an addition, put the result of the addition to another memory cell, and print the result in the display at a certain location), software developers develop databases at the high level and use screen and report generators to create customized inputs and outputs (e.g., DBMS and advanced e-commerce applications). Thus, development productivity has increased significantly.

Second, developers have adopted a number of new approaches to systems development. From the most popular versions of systems development approach is the waterfall model, many organization are exploring with prototyping to agile software development.

The search for the best practices is still on, however. The software crisis continues, now at a different level. Technology is a moving target, with likely more disruptive technologies. Organizations will continue to be faced with issues related to multigenerational systems: interoperability, training, maintenance, and replacement. Applications are getting more complex in an open platform environment. Security has become more critical. The issue for IT management remains the same though: Are we producing the software right (that is, is it built efficiently and on time)? And, are we developing the right application software (that is, is it useful to the users)?

FOUNDATIONS OF SYSTEM DEVELOPMENT

In the early years, system development was considered a "craft." Application software was created by a single person, or a team led by a strong, charismatic project leader. No system looked alike. Developing a system was more like art than science. Since then, the goal has been to make it more scientific. In the 1970s, structured system development emerged to make the process more standard and efficient. It was characterized by the following elements:

- Hand coding in a third-generation language (3GL) such as COBOL, C, Java
- A structured-programming development methodology
- An automated project management system
- A database management system
- A mix of online and batch applications in the same system
- Development of mostly mainframe applications
- Programming by professional programmers only
- Various automated, but not well-integrated, software tools
- A well-defined sign-off process for system delivery
- User participation mainly in requirements definition and installation phases

This development approach supposedly followed the famous "waterfall" approach, shown in Figure 9-1. However, says Bob Glass,[1] this unidirectional waterfall was much touted but rarely used in its literal sense. Development did not proceed in a straight line from requirements through operation; a lot of backtracking and iteration occurred. Developers really always followed the spiral approach which is generally attributed to Barry Boehm.

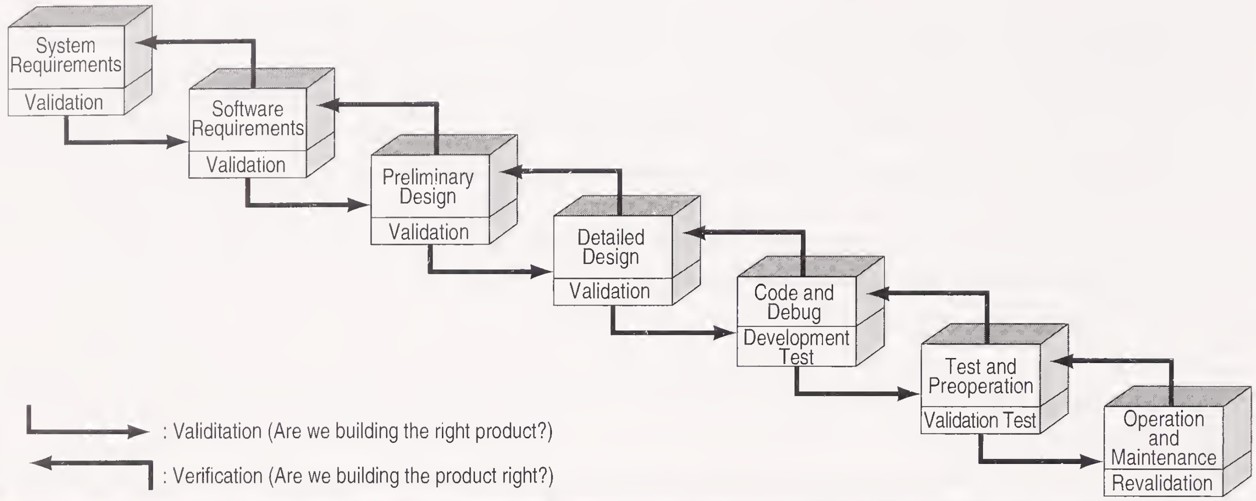

FIGURE 9-1 The "Waterfall" Development Life Cycle

Source: Barry Boehm, *Software Engineering Economics* (Upper Saddle River, NJ: Prentice Hall, 1981).

Structured Development

Structured development methodologies accompanied this system development life cycle and were meant to handle the complexities of system design and development by fostering more discipline, higher reliability and fewer errors, and more efficient use of the resources.

More Discipline

By establishing standards for processes and documentation, the structured methodologies attempted to eliminate personal variations. At first they seemed to threaten programmers' creativity, but their discipline did increase productivity and permit developers to deal with greater complexity. The complexity was handled through successive decomposition of system components, coupled with preferred practices for conducting analysis, design, and construction. The result was a more disciplined system development process.

More Modularized

As the scope of applications gets bigger, developers decompose the software applications in interconnected but independent modules. This divide-and-conquer approach helps notably reduce the complexity of the development process.

Higher Reliability and Fewer Errors

The structured methodologies recognized that mistakes of both omission and commission were likely at all stages of system building. One of the main tools for coping with this tendency was (and still is) inspections, performed at every development stage and at every level of system decomposition. The goal has been to catch errors as early as possible. The methodologies also recognized that iteration would be required to redo parts of a system as mistakes were uncovered.

More Efficient Use of Resources

The project management approaches usually included in the structured methodologies contributed to cost savings, increased productivity, and better allocation of human resources. By imposing a time and cost control system, the classic approach decreased (but did not eliminate) the tendency for system development efforts to incur cost and time overruns.

Fourth-Generation Languages

In the early 1980s, two major developments occurred. One was the availability of fourth-generation languages (4GLs); the second was software prototyping. Fourth-generation languages are really more than computer languages; they are programming environments. 4GLs are created to reduce programming effort, the time it requires to develop it, and more importantly, to allow developers to focus more on problem solving (for example, creating a report, or implementing a business heuristics such as customer's management policies). 4GLs let the developers focus more on the system design and attempt to minimize the coding effort. Their major components are listed in Figure 9-2.

The heart of a 4GL is its DBMS, which is used for storing formatted data records as well as unformatted text, graphics, voice, and perhaps even video. Almost as important is the data dictionary, which stores the definitions of the various kinds of data. The language that programmers and users use is nonprocedural, which means that the commands can occur in any order, rather than the sequence required by the computer. The commands can be used interactively to retrieve data from files or a database in an ad hoc manner or to print a report (using a report generator). The screen generator allows a user or programmer to design a screen by simply typing in the various data input field names and the locations where they are to appear or by choosing graphics from a menu.

To further improve the speed of developing systems and reduce the tendency to "reinvent the wheel," most 4GLs are domain specific, a common practice in software development. These are built to be used in specific application areas. Some 4GLs

FIGURE 9-2 Features and Functions of Fourth-Generation Languages

- Database management systems (DBMS)
- Data dictionary
- Nonprocedural language
- Interactive query facilities
- Report generator
- Selection and sorting
- Screen formatter
- Word processor and text editor
- Graphics
- Data analysis and modeling tools
- Library of macros
- Programming interface
- Reusable code
- Reusable software components and repositories
- Software development library
- Backup and recovery
- Security and privacy safeguards
- Links to other DBMSs

include statistical packages for calculating time series, averages, standard deviations, and correlation coefficients. Some others are specially dedicated to data analysis and reporting.

Previously, developers only had third-generation languages, such as COBOL, ALGOL, PL/1, or C. The advent of 4GLs allowed end users to develop some programs and programmers to use a different development method: prototyping. Formerly, system requirements were fully defined before design and construction began. With prototyping, development could be iterative.

Software Prototyping

"A prototype is a software system that is created quickly—often within hours, days, or weeks—rather than months or years." Franz Edelman, a pioneer in the use of software prototyping, described the process of software prototyping as "a quick and inexpensive process of developing and testing a trial balloon." Its purpose is to test out assumptions about users' requirements, about the design of the application, or perhaps even about the logic of a program.

With only conventional programming languages, such as COBOL, it was much too expensive to create both a prototype and a production version. Therefore, only production systems were developed. With end-user tools, people can get prototypes up and running quickly. The prototype is relatively inexpensive to build because the language creates much of the code.

Prototyping is an iterative process. It begins with a simple prototype that performs only a few of the basic functions. Through use of the prototype, system designers or end users explore new requirements using a working model, experiment with ways to satisfy them, and continue to refine or incorporate more requirements in each succeeding version. Each version performs more of the desired functions and in an increasingly efficient manner.

A typical prototyping methodology consists of the following steps:

- Form a users team consisting of experienced personnel to work with the software developers.
- Establish in-house development teams to work closely with experienced users.
- Decompose "to-be" systems into functional subsystems and development increments.
- Gather iterative requirements using simulated screens and interface requirements focusing on user-friendliness and extensive online help.
- Perform quick design with all the simulated screens put logically in sequence to provide users with a complete walk-through of the intended system functionalities.
- Build prototype using a database-driven or model-driven application generator.
- Evaluate and refine requirements involving the users team.
- Engineer the product through an adaptive process that eventually converges on a production version that closely meets the users' needs.
- Gather users feedback from a larger base of users.
- Maintain product by using the same process used in the initial development with adaptive change along user needs.

Both 4GLs and prototyping have proven to be important underpinnings for today's application development world. Prototyping enables systems to exceed "pre-defined"