
MODULE (Overview): The Big Picture and Case Studies

Chapter 1: e-Business and Distributed Systems – From Strategies to Working Solutions

Chapter 2: Case Studies and Examples

<p><u>e-Business Applications, Architectures, Integration</u></p> <p>MODULE (APPLICATIONS): e-Business Strategies and Applications: Chapter 1: e-Business - From Strategies to Applications Chapter 2: e-Business Applications (CRMs, ERPs, eMarkets, SCM, ASPs, Portals) Chapter 3: From Strategies to Solutions -- A Planning Methodology Chapter 4: IT Infrastructure -- Overview of Enabling Technologies Chapter 5: Applications State of the Practice, Market, and Art</p> <p>MODULE (ARCHITECTURES): Solution Architectures Through Components Chapter 1: Solution Architecture Overview Chapter 2: Enterprise Application Architectures -- Component-based Approach Chapter 3: Enterprise Data Architectures in Web-XML Environments Chapter 4: Implementing Architectures -- Concepts and Examples Chapter 5: Architectures State of the Practice, Market, and Art</p> <p>MODULE (INTEGRATION): Enterprise Application Integration and Migration Chapter 1: Integration with Existing (Including Legacy) Applications -- An Overview Chapter 2: Enterprise and Inter-Enterprise Application Integration (EAI/eAI) Chapter 3: Data Warehouses and Data Mining for Integration Chapter 4: Migration Strategies and Technologies Chapter 5: Integration State of the Practice, Market, and Art</p>	<p><u>Background and Management</u></p> <p>MODULE (OVERVIEW): The Big Picture Chapter 1: e-Business and 3G Distributed Systems --From Strategies to Working Solutions MODULE (EXAMPLES): Case Studies & Examples Chapter 2: Case Studies and Examples</p> <p>MODULE (MANAGEMENT): Management and Security Chapter 1: e-Business Management in Practice Chapter 2: Management Platforms for Network and Systems Management Chapter 3: Security Management - Approaches and Technologies Chapter 4: Security Solutions -- Using Technologies to Secure Systems Chapter 5: Management State of the Practice, Market, and Art</p> <p>MODULE (TUTORIALS): Tutorials and Detailed Discussions on Special Topics Chapter 1: Network Technologies -- A Tutorial Chapter 2: Object-Oriented, Java, and UML -- A Tutorial Chapter 3: Database Technologies and SQL -- A Tutorial Chapter 4: Web Engineering and XML Processing -- A Closer Look Chapter 5: CORBA -- A Closer Look</p>
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1 e-Business and Distributed Systems -- From Strategies to Working Solutions

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Opening Vignette

Pete has a PC Shop in Ann Arbor, Michigan. He started selling PCs and electronic equipments ten years ago after getting a degree in electronics. He has been mainly doing repairs and reselling. He has done rather well and has opened several stores that are now assembling brand new PCs. Buoyed by his success, Pete is now diversifying into a wide range of related products (e.g., software, video games, and networking hardware/software). He is partnering with retail stores and manufacturers in the Ann Arbor area. The parts and components will be brought in from suppliers located in the Far East. Pete has also acquired a chain store and wants to design, build, sell, and repair custom built devices and computers.

Pete has so far stayed away from using the technology he sells (other than using the telephone). But he has been attending management seminars on e-business and its benefits. He does not completely understand it but he is convinced that it is something very good (they would not be teaching courses in this area if it was not good!). In addition, he is completing his MBA on a part-time basis and cannot wait to put everything he is learning about business to work. Pete is thinking big. He wants to be like Dell and Compaq. He especially likes the idea of real-time enterprises where he can monitor his business activities continuously. He wants to embark on a major corporate wide e-commerce/e-business effort. His plan is to start with a Web site that will be used to market the company products and services. He then wants to expand this Web site so that the customers can directly order and purchase the company products and services through the Web site. His goal is to eventually become a major real-time digital corporation that will serve as a storefront for multiple shops so that potential customers will order a variety of products through him. Pete will receive the orders, and try to fill them, if he can. Otherwise, he will route the order to one of his business partners.

Pete has no idea how to get there from here. However, as part of his MBA education he has gone through several case studies (so what is new!) that give him hope. He has learned through these case studies that several companies such as IBM, Staples, Federal Express, Proctor and Gamble, General Electric, Cisco, Dell, Amazon.com, and others have effectively used Internet and the Web to reach more customers, reduce time to fill orders, improve customer relationships, and increase profit margins. He is also fully aware that hundreds of Dot-Com companies have failed and Dot-Com stock prices collapsed after many of these companies could not generate enough revenue to stay in business (he also looked at the Web site startupfailures.com). He wants to be aggressive but cautious.

Pete has been talking to his nephew, Bob, who has graduated from the University of Michigan with an MS in computer science. Bob talks endlessly about the elegance of distributed systems and the beauty of Web technologies, XML, Java, business components, and wireless networks. Bob wants to impress Pete so that Pete will hire him. Pete and Bob have trouble communicating with each other. Pete wants to succeed in business but Bob wants to try every neat thing he has learned. Pete does not know much about information technologies and Bob has no respect for business types (he still cannot tell the difference between credit and debit). They are both driving each other crazy and wish they could find some way of interrelating business with technology. Pete wants a technical type who understands business and Bob wants to talk to a businessman who can spell XML.



The Agenda

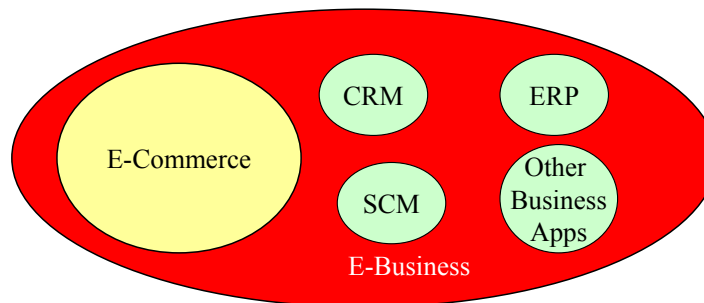
- Overview
- Evolution of e-Business & Distributed Computing
- Book Roadmap

1.1 Introduction

1.1.1 What is e-Business and How is it Related to Distributed Computing

Let us start with a definition of e-business, also known as ebusiness and electronic business, and discuss how it is related to e-commerce, also known as ecommerce and electronic commerce. Simply stated, *e-commerce (EC)* is buying and selling over the network (mostly Internet) while *e-business (EB)* is conducting business, including buying/selling, over the network (mostly Internet). Thus, $EB = EC + \text{other activities such as conducting meetings, developing software, and managing customer relationships}$. Thus EB subsumes EC (see Figure 1-1).

Let us look at EC and EB in more detail. e-commerce can also be defined as "The buying and selling of information, products, and services via computer networks" including the "support for any kind of business transactions over a digital infrastructure" [Block 1996]. E-business is defined as "An organization that exploits the Internet and IT to transform all of its core activities in order to increase efficiencies, reach new markets, and gain strategic advantage" [IBM]. Basically, companies are incorporating the Internet into every process, from sales and marketing to manufacturing and procurement to supply chain management and new product development. This new business structure is e-business - it extends its operational focus beyond the four walls of the organization to automate and streamline communications, transactions, and collaboration with customers and supply partners. As a result, e-Business operates not as a single company but rather as a node on an integrated supply network, which leverages the Internet to exchange and process information in a manner that enables rapid response to customer requirements.



E-Commerce: buying and selling over the network (mostly Internet)

- Advertising
- Browsing/selection
- Purchasing
- Payment/payment settlement

E-Business= E-Commerce + Other business activities conducted electronically

- Conducting meetings for geographically distributed parties
- Software development and delivery across multiple organizations
- Delivering on-line instruction and training
- Customer relationship management (CRM)
- Supply chain management (SCM)
- Enterprise resource planning (ERP)
- Knowledge management

Figure 1-1: e-Commerce Versus e-Business

The main idea is that e-business is concerned with delivering business services to its customers as well as its partners, electronically. Thus we will stay with our simple definition, (i.e., "e-business is conducting business, including buying/selling, over the network (mostly Internet)"). For example, use of the Internet to conduct meetings, develop and deliver software, provide library services, and support customer relationship management systems is all considered as part of e-business -- plus, of course, any of the traditional e-commerce activities of buying/selling over the Internet (see Figure 1-1). Since e-business subsumes e-commerce, we will primarily discuss e-business (EB), unless e-commerce (EC) needs to be distinguished explicitly. Here are a few examples to illustrate the diversity of e-business:

- Many sites such as vertical.com, works.com, drugstore.com, and MSN.com tie multiple organizations transparently over the Internet to conduct business.
- Telebank.com, a Virginia based virtual bank, provides ebanking services to a large user base.
- Dell Computers uses virtual operations across multiple suppliers to exercise its well-known "build-to-order" model (the computers are assembled in plants that are in close proximity to the just-in-time parts suppliers).

- Many small and large organizations (e.g., GM, Intel, The Limited clothing store) are adopting the real-time enterprise model where the business activities are monitored and managed in real-time instead of relying on monthly and weekly reports.
- Amazon.com has formed partnerships with multiple suppliers (publishers, bookstores) that participate over the Internet to conduct business transactions (i.e., when you buy a book from Amazon.com, bookstores close to the shipping address participate in fulfilling the order).
- Virtual Phone Companies (VPC) and Telecom trading hubs (e.g., www.telezoo.com) offer internet plus residential phone services, including spare bandwidth, without owning any physical assets.
- National Industrial Information Infrastructure Products (www.NIIP.org) supports product building across a large number of partners over the Internet.
- Virtual Parts Supply Base (VPSB, <http://www.vpsb.com/>) supplies hard to find parts for the US Government.

e-Business systems have to be architected, built, deployed, and managed within the budgetary, security, and performance goals/constraints of organizations. These *e-business engineering* activities naturally span business and technology. This is where distributed computing enters the picture. e-Business systems are essentially distributed computing systems that are designed specifically to support business activities. A *distributed computing system (DCS)* interconnects many autonomous computers to satisfy the information processing needs of users. An example of DCS is the Internet because it ties millions of computers over thousands of physical networks for widely distributed users. We will use the following basic definition throughout this book:

A ***Distributed Computing System (DCS)*** is a collection of autonomous computers interconnected through a communication network to achieve business, entertainment or other functions. Technically, the computers do not share main memory, thus the information (knowledge) between the computers is exchanged only through messages over a network¹.

Advances in computer and communication technologies have made possible DCSs of different sizes, shapes and forms since the 1970s. Distributed computing has gone through several generations over the years, as shown in Figure 1-2 (we will discuss this evolution in more detail in Section 1.2.3). Our interest at present is in the Third Generation (3G) Distributed Computing Systems that provide a collection of technologies (e.g., next generation Internet, next generation Web, broadband networks, distributed component-based software, application integration platforms, and mobility) to support e-business.

Let us take a quick look at the underlying technologies. A DCS consists of several building blocks (networks, middleware, applications, and management support). Figure 1-3 shows a Reference Model that establishes the interrelationships between the key building blocks of DCS and e-business (e-business is concerned with business processes and applications while DCS mainly provides the enabling infrastructure). This model will be used as a roadmap that we will use throughout this book -- the building blocks will be covered in different modules. Note that this book does not cover the traditional computing platform issues such as computing hardware and operating systems.

The highest layer of this model concentrates on business models, business processes and business services. These business activities are supported by the information systems (ISs). In e-business, these systems are largely automated (computer-based information systems -- CBIS) and consist of applications and services such as electronic marketplaces, supply chain management, customer relationship management, enterprise resource planning (ERP) systems, and digital payment systems.

¹ From a programming point of view, the information cannot be transferred through global variables if the computers do not share main memory. Thus you cannot store a customer number in a program variable and let the other program read it -- you have to send it explicitly over a network.

MODULE (OVERVIEW)

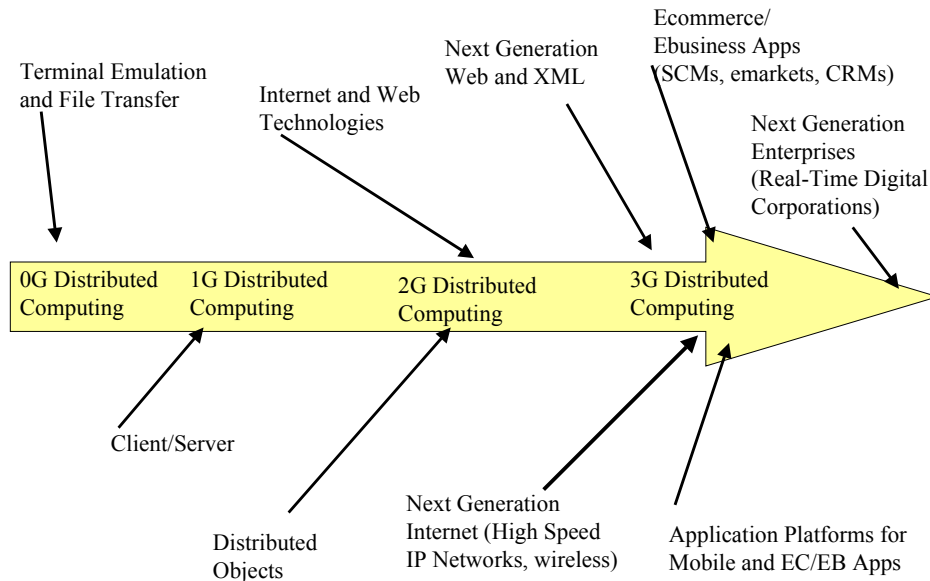


Figure 1-2: Evolution of Distributed Computing

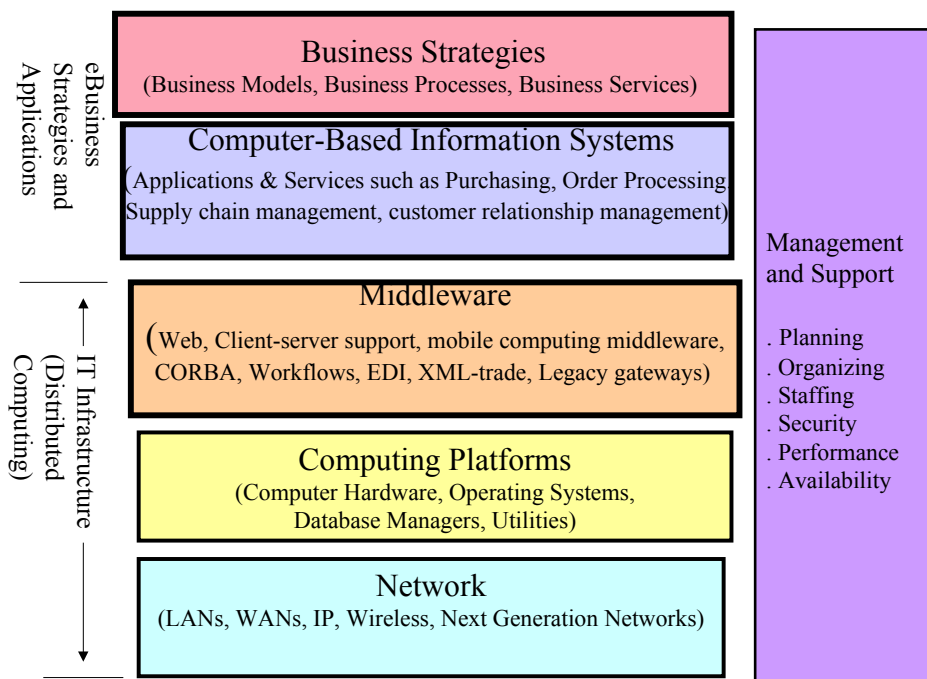


Figure 1-3: A Framework for Discussion

A variety of IT infrastructure services are needed to support the e-business applications and services. At a conceptual level, the IT infrastructure consists of the following building blocks:

- Networks that provide the network transport between remote parties and are responsible for routing and flow/error control. The networks may be the private value added networks (VANs), Public Internet, and/or Extranets that utilize the wired or wireless transmission media.
- Computing platforms that provide the computing hardware and software support with components such as CPUs, disk drives, operating systems, programming languages, database managers, etc. The applications themselves reside on one or more computers that are interconnected through a network.

- Middleware to support interactions between remotely located, including but not restricted to, EB partners. Middleware components are business/industry unaware software modules that provide a variety of services such as Web services, directory services, email, remote data services (e.g., bulk data transfer and access to remote databases), remote application services (e.g., interactions between remote objects), distributed transaction services, and legacy system access/integration software.

Management and support services are needed for administering the e-business applications as well as the underlying IT infrastructure. Examples of these services include planning, organizing, staffing, and operational management (e.g., fault management, performance management, and security management).

Basic Definitions

- **Information System (IS):** A formal system that collects, stores, processes, updates, and displays information. An IS can be computer-based or manual.
- **Computer-Based Information System (CBIS):** An automated system that collects, stores, processes, updates, and displays information. A CBIS typically consists of a user database (a pool of data), a set of programs to access and manipulate the database, and user interfaces to invoke the programs.
- **Application System:** An automated information system. Thus an application system = CBIS. Our focus is on business application systems, also frequently referred to just as "applications", that support business functions. Business applications are business aware and represent the business aware functionality and data.
- **Information Technology (IT):** A collection of computer and communication technologies that are used to build, deploy and use the CBIS and other automated systems. These technologies consist of the networks, the computers, the operating systems, the middleware and many other components such as directories, programming languages, database managers, etc.
- **Distributed Computing System:** A collection of autonomous computers interconnected through a communication network to achieve business, entertainment or other functions.
- **Strategy:** It is a game plan to win. There are different types of strategies. For example, a legal strategy is a game plan to win legal cases, a battlefield strategy is a game plan to win battles, a business strategy is a game plan to win in the marketplace, and an e-business strategy is a game plan to win in e-business.
- **Working Solution:** A system (software + hardware) that satisfies the technical as well as organizational requirements (functional, security, performance, budgetary) and can be deployed, installed, operated, and managed. In our case, a working solution consists of the application system plus the enabling IT infrastructure.

1.1.2 Why So Much Activity in e-Business – The Promises

In just a few short years, the Internet has permeated nearly every aspect of the economy - from media and retail to financial markets and healthcare. Despite the current economic slump, EB/EC is slowly but surely restructuring traditional trading relationships, enabling information exchanges, and supporting buyer-seller interactions on a level that would be unimaginable and cost prohibitive in the physical world. The main reason is that EB/EC offers buyers as well as sellers a wide range of options. While the early emphasis has been on how the Internet might be applied to consumer-oriented activities, the Internet will have the most profound impact on how businesses interact with each other. By fostering information exchange and interactions among a vast number of trading partners, the Internet has spawned a new breed of business processes and commerce activities. Not surprisingly, the Internet has also given birth to new competition; increased customer expectations; and renewed emphasis on cutting costs, improving productivity, and speeding process cycles.

e-Business activity is fuelled by several business factors such as the following:

- **Economic reasons.** These are the main drivers, naturally. For example, labor costs traditionally keep going up and more staff is needed to market and support products. However, e-business lowers cost of labor due to the replacement of labor with web-based advertising and purchasing. In particular, Web-based advertising allows companies to reach a much wider customer-base without expensive marketing personnel. In addition, online-purchasing can provide 24X7 purchasing of goods without any sales personnel. For example, by using the Internet to interact with customers, Proctor and Gamble has cut its marketing research costs by 50 to 75 percent. Numerous companies such as General Electric, Cisco, Dell, Northwest Airlines (in fact, most airlines), and Amazon.com, effectively use Web-based advertising and purchasing to reach more customers around the clock at more sites but with lower costs.
- **Possible improvements in business processes.** Significant improvements in procurement and order fulfillment are driving several companies to e-business. For example, IBM found that the time to fill orders dropped from 30 days to 1 day and the contract negotiation time dropped from 6 months to one month by using e-business (see Figure 1-1). Survival is pushing many companies to move to e-business also because if they do not, they could be annihilated by the competition.
- **Reduction of transaction costs.** Business transaction cost is the cost incurred by a firm when it buys in the marketplace what it cannot make itself. Using markets is expensive because of costs such as locating and communicating with distant suppliers, negotiating contracts, monitoring contract compliance, etc. Over the years, firms like General Motors have attempted to minimize transaction costs by doing things themselves and buying many of their supplier companies -- thus getting bigger [Williamson 1985]. e-Business with automated supply chains and e-markets reduces transaction costs dramatically. For example, HP developed an automated supply chain that reduced the time to build a PC to 48 hours. This eliminated the need for HP to keep PC inventories on hand.
- **Facilitate quick adaptation.** Businesses need to adapt quickly (i.e., enter new markets, redefine focus), reduce cycle time (i.e., setup a new large scale business in 6 months), improve responsiveness, give better financial and operational flexibility, and improve utilization of resources. This is becoming increasingly possible with the Internet.
- **Significant reduction of paperwork.** For example, Staples has gotten out of the business of paperwork by using e-business. According to an August 26, 2002, Wall street Journal advertisement, 3.3 million corporate end-users of Staples use real-time order information on over 80,000 items. This has significantly reduced paperwork. The items are available at the Staples Web site (www.staples.com) that displays on-hand inventory instantly and handles customer orders.
- **New and improved organizational structures.** e-Business impacts organizational structures by changing hierarchy of decision making and reducing need for middle management and clerical support. Different levels of managers can interact directly through a corporate Intranet. In addition, firms can exist entirely or partially on the Web leading to *virtual enterprises*. These enterprises tie suppliers to consumers and eliminate a complete organizational structure. For example, Corolla is a virtual flower shop that gets online orders for flowers from customers and routes the orders directly to the farmers. This "flower shop without any flowers" eliminates the need for a flower store where the farmers bring their flowers to be sold.
- **Reaching new customers.** Companies rely on e-business to expand services and reach new customers. For example, Dell Computers used e-business to reach customers directly and to deliver custom-built computers by adopting a "build-to-order" model. This completely changed the dynamics of the PC industry and took big players such as IBM and Compaq by surprise.
- **Market Differentiation.** e-Business services provide market differentiation to many companies. For example, Amazon.com provided a market differentiation by offering around 1.5 million book titles while average bookstores offered about 50,000 book titles. Keep in mind, however, that these market differentiations can also quickly disappear.
- **Increased outsourcing options.** Outsourcing through the Internet (i.e., utilizing the Internet to move business services and functions outside the corporation) saves operational and support costs in installation, repair, shipping, and inventory management. Numerous ASPs (Application Service Providers) such as Corio host a complete set of business applications to facilitate partial or complete outsourcing of business information systems.

- **New business partnerships.** Business partnerships are being formed at function level because competition has moved to business function (service) within a company instead of company business. For example, if company A provides a better call center but company B builds better software quickly, then partnering with A for call centers and with B for software development makes better business sense.
- **Potential of eMarkets.** Electronic marketplaces and trading hubs (i.e., virtual internet “stores” offering products and/or services from many vendors) became popular to provide improved services for the buyers. Examples exist in business-to-consumer (e.g., Amazon, MSN), consumer-to-consumer (e.g., eBay), and business-to-business (e.g., FastParts, COW). Interesting examples of emarkets can be found in the Telecom eMarkets such as Arbinet and Band-x. Although not fully realized, emarkets have a great deal of potential, especially if systems supporting business functions such as inventory, supply chain, network design, etc. are integrated with electronic markets.

Procurement (Total savings: \$6.2B)

<i>Results</i>	Before	Now
Purchase order processing time	30 Days	1 Day
Contract cycle time	6-12 Months	30 Days
Average length of contracts	40+ Pages	6 Pages
Rate of "maverick buying"	30%	Less than 2%
Internal satisfaction with procurement	40%	More than 85%

Fulfilling Orders

<i>Results</i>	Before	Now
Time to obtain commit date	Hours to Weeks	Real Time
Time to enter customer order	30 Min	5 Min
Time to respond to inquiries	15-20 Min	Real Time
% orders manually shipped	75%	0%
Invoice accuracy	70%	98%

Additional Benefits

- Integrated supply chain has netted IBM \$1.7B in savings
- Have reduced development cycles from 4 years to 12 months on average
- Customer satisfaction and loyalty up by 5.5% points

Figure 1-4: Impact of Ebusiness (source: IBM)

DELL COMPUTER – A Well-Known e-Business Success Story

Dell Computer is the world's leading direct computer systems company – it claimed to be the number one computer systems supplier in the United States and number two worldwide in April 2000. Dell was founded in 1984 by Michael Dell on a simple concept: that by selling computer systems directly to customers, Dell could best understand customer needs and efficiently provide the most effective computing solutions to meet those needs.

Headquartered in Austin, Texas, Dell's climb to market leadership is the result of a persistent focus on delivering the best possible customer experience by directly selling computing products and services based on industry standard technology. This direct business model eliminates retailers that add unnecessary time and cost, or can diminish Dell's understanding of customer expectations. The direct model allows the company to build every system to order and offer customers powerful, richly configured systems at competitive prices. Dell also introduces the latest relevant technology much more quickly than other companies that have slow-moving, indirect distribution channels, and average four days for inventory turnover. The business problem addressed by Dell is:

- Provide next-business-day-service to the majority of its customers.
- Manage a global service inventory that changes rapidly due to component substitutions, upgrades, and engineering change orders.
- Enhance product demonstration and customer experience on the company's Website.

Dell led the commercial migration to the Internet, launching www.dell.com in 1994 and adding e-commerce capabilities in 1996. The company is increasingly realizing Internet-associated efficiencies throughout its business, including procurement, customer support and relationship management. The company exploits Internet and associated technologies to support its global customers and suppliers and ties suppliers, customers, and internal operations electronically.

More than half of Dell's more than \$25 billion revenues come from online sales. At www.dell.com, customers may review, configure and price systems within Dell's entire product line, order systems online, and track orders from manufacturing through shipping. The main weapon of Dell Website is the Premiere Page program that serves the largest of Dell's corporate, government, and educational accounts. When Dell wins an account with more than 400 employees, it builds a Premiere Page for the new account and links it directly to Dell's system for quick order placements and configurations. More than \$30 million worth of Dell computers are ordered per day this way.

Dell suppliers are also tied into Dell extranet to help them coordinate their inventories and activities around Dell order activity. At valuechain.dell.com, Dell shares information with its suppliers on a range of topics, including product quality and inventory. Dell also uses the Internet to deliver industry-leading customer services. For instance, approximately 113,000 business and institutional customers worldwide use Dell's Premier Dell.com Web page to do business with the company online.

Dell implemented the XelusPlan – a demand forecasting, inventory planning and material deployment software solution from Xelus (<http://www.xelus.com>). This package was used by Dell to forecast, plan, and track forecasting accuracy against actual demand while providing a single, centralized database and standardized planning procedures.

The 2002 implementation of EON's Solution revolutionized the on-line buying experience for Dell's customers by providing them with an easy way to access the necessary information for making online decisions. The content solutions from EON allowed Dell to visually display key features and instantly show the configuration of accessories.

Dell has enhanced and broadened the fundamental competitive advantages of the direct model by applying the efficiencies of the Internet to its entire business. Today, Dell is operating one of the highest volume Internet commerce sites in the world. The company's Website receives 750 million page requests per quarter at 80 country sites in 27 languages/dialects and 40 currencies. Revenue for the last four quarters totaled \$31.2 billion and the company employs approximately 34,600 team members around the globe. The financial success of the company is due in great part to its e-commerce site, which Dell continues to support by implementing new site features and using innovative technology solutions to enhance its Website.

Using the XelusPlan to manage inventory and service levels, helped Dell to:

- Reduce excess and obsolete inventory
- Increase use of lower-cost repairable parts
- Optimize inventory cost versus service level trade-offs

With EON's Solution, Dell was able to realize several key benefits:

- Increased online viewing during the initial 90 days – received 49% higher viewing online for the EON converted products than other e-Retail sites during comparable launch period
- Product sell-through is positive
- Provided a compelling buying experience for customers -- they were able to see a product demonstration and visual configuration of accessories online before the actual purchase of the product
- Reduced customer support costs for participating vendors because with EON's solution Dell was able to

provide 24 by 7 access to step by step visual installation and trouble shooting information

Sources:

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1.1.3 What Can and Does Go Wrong – The Pitfalls and The Risks

Although EC/EB offers organizations a wealth of new opportunities, it also presents several risks, pitfalls, and challenges. Many new Internet business models have not produced profits and Web-based businesses have permeated far-reaching organizational changes. The 2001-2002 stock market downward spiral has impacted how organizations view and evaluate e-commerce and e-business. As we all know, hundreds of dot-com companies have failed and dot-com stock prices collapsed after many of these companies could not generate enough revenue to stay in business. For ongoing discussion on dot-com failures, see the Web site startupfailures.com. Consequently, the venture capitalists now evaluate e-commerce proposals more cautiously. For fear of being "left behind," many organizations jumped into the digital economy with unrealistic expectations and/or unclear business models. Companies also ignored or did not understand the shortcomings of the Web and complexities of conducting large scale businesses over the Internet. The potential pitfalls span business as well as technical issues. Examples of the key business pitfalls are [Jackson 2001, Laudon 2003, Lee 2003, Shea 2003, Siegle 2003, Turban 2002]:

- **Unproven and unclear business models.** Simply stated, a business model is how you make money. In the zeal of becoming another dot-com, many companies forgot who will be willing to buy all the things becoming available online. For example, just how many people want to buy live lobster and Purina Dog Chow online anyway -- even if these and other items were sold online by using the most appealing technology. Many companies have assumed that the Web has unlimited potential, thus it is good to over-invest in online operations. This thinking is quite unrealistic and can lead to large investments with no returns.
- **Misunderstanding of customer behavior.** For example, many companies assumed that once customers use their Web site, they will be so captivated that they will always return, thus ensuring profitability. It is well known in the traditional brick-and-mortar sales that repeat business is never assured and organizations must continuously strive to retain existing customers. Repeat business is especially difficult in Web-based purchasing because if it is easy for the customers to do business with you over the Web, it is equally easy for them to shop somewhere else. To build customer loyalty, the businesses have to provide increased customer contact (e.g., happy birthday e-mails) and/or allow personalization at their Web sites.
- **Lack of understanding of Web costs.** Doing business over the Internet can be expensive and the costs need to be managed with the traditional business methods. While virtual retailers may not need costly storefronts and retail workers, they still have to pay for Web site development and marketing. Businesses with unclear on-line strategies can waste thousands and even millions of dollars building and maintaining a Web site that does not deliver the desired results.
- **The myth of Web's unlimited potential.** Based on this myth, organizations may over-invest in online operations. This practice is quite unrealistic, and often leads to disappointment and/or failures. Some companies also felt that Web sites can eliminate the need for call center staff. While the Web sites can minimize post-use assistance, they cannot eliminate all levels of support. In several cases, human contact is the best way to satisfy customer needs.

- **No attention to business process changes due to the Web.** Online purchases over the Web require careful orchestration of the firm's divisions, production sites, and sales offices with customers, suppliers, and business partners. Several business processes need to be redesigned and traditional boundaries between departments and divisions need to be re-defined. Use of online-business activities forces companies to act rapidly (customers will typically not wait for 3 months for an item to be shipped if they used the Internet to place their order quickly).
- **Possible channel conflicts.** On-line sales and marketing through the Web may create channel conflicts because the firm's sales force and distributors may fear that their revenues will drop as customers make purchases directly over the Web. Using alternative channels created by the Internet requires very careful planning and management. Different companies deal with channel conflicts differently. For example, Milacron Inc. pays full commissions to its sales reps for on-line sales made in their territory, even if they had not done any work on the sale or met the buyer. Other companies are offering only a portion of their full product line on the Web to avoid problems. Some companies have integrated Web with other sales channels effectively. For example, when Chapters Inc., Canada's largest bookseller decided to sell books online, it created the threat of channel conflict (Web sales could take business away from its own stores). Chapters decided to integrate its Web site with its stores to give customers good experiences regardless of which channel they chose (see [Laudon 2002, chapter 4] for details).
- **Legal and privacy issues.** Several legal and privacy issues are raised in EC/EB because the laws governing e-commerce are still being written, especially at the international level. For example, how to settle the legality of e-mail contracts and enforce restrictions when items are sold in the US via a Web site located in Italy with suppliers in Singapore and Hong Kong. Whose law would apply? Security and privacy in such a global environment is a serious issue because all information, including credit cards and e-mail, passes through many computer systems on the Internet where it can be monitored, captured, and stored.

In addition to business and management challenges, there are also numerous technical challenges. The main technical challenge is that e-business environments are large and complex distributed systems that are not easy to build, deploy, and manage. Specifically:

- **There is more "behind the scene" complexity** of most EC/EB systems. This is due to multiple applications, databases, computing platforms and networks of different vintages and types that need to work together. For example, a medium scale online purchasing system requires inter-working between more than a dozen systems that may range from Web-based new catalog systems to legacy inventory and payment systems
- **Many infrastructure components (e.g., middleware and application servers)** are becoming available from a wide range of suppliers. For example, according to a Gartner Group report [Gartner 1999], there are more than 20 *types* of middleware components in use regularly and well over 100 suppliers of these infrastructure components exist in the marketplace. This leads to many interfaces, standards and protocols. It is difficult to build systems in these environments without sound architectural principles (we will see this in the Architectures Module).
- **Increased interdependencies and points of failures** between numerous components arise because distributed applications are more complex. In addition, several disciplines need more coordination (databases, networks, middleware, applications, operating systems) for an e-business system to operate. This makes the task of security, performance and interoperability nontrivial.
- **Many difficult management and support challenges** arise due to the underlying complexity of the e-business systems. For example, there are many hidden costs such as software and staffing costs that can be higher due to multiple licenses and environments, especially for middleware. In addition, how to plan, organize, staff, and monitor these complex systems is not well understood.

In their zeal for glory, many companies ignored these issues and warnings. For example, an article written by Kathryn Jackson entitled "The Holy Grail of E-Commerce" [Jackson 2001] lists common e-commerce pitfalls. Generally speaking, the author warned companies not to overestimate the ease and impacts of e-commerce. Jackson identifies seven common myths about e-commerce and online operations (most of these myths have been included in the above discussion). Warnings of this nature were largely ignored. Overall,

the author indicates that companies should invest in e-commerce. However, before investing, organizations should establish realistic objectives and develop a solid plan to meet the objectives.

To summarize, e-business is not dead. For every limitation, a tremendous benefit is possible if the pitfalls are not ignored. To succeed, organizations must learn from the past successes and failures to evaluate e-business decisions more completely and more intelligently. The potential of e-business exists as much today as it did in 1999. Companies just have to be more cautious and smarter when it comes to investing in this area. Michael Porter [Porter 2001], a well known management scholar, argues that companies need to use Internet to create economic value (price minus cost) and concentrate on business basics instead of flashy Internet applications. My own management experience, discussions with several managers, and a survey of a large number of case studies indicate that successful solutions exploit the promises of new technologies but carefully understand the business drivers and manage the risks while the others do not (see Figure 1-5 and Figure 1-6). The sidebar "What Went Wrong – Two Examples" illustrate this point. We will visit these issues in more detail as we go along. The book by Severance and Passino [Severance 2002] has many practical insights and guidelines from a management point of view based on extensive interviews with company executives.

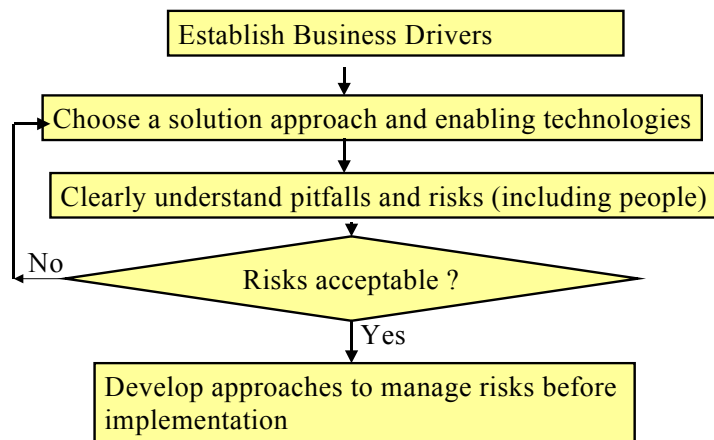


Figure 1-5: Recipe for Success

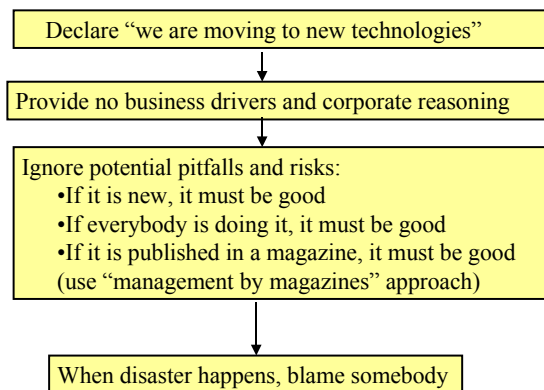


Figure 1-6: Recipe for Failure

What Went Wrong – Two Examples

1) Furniture.com Goes Out of Business

Furniture.com was reviewed by CIO Magazine in the article "Furniture.com," Jan. 15, 2000. The company was selling furniture over the Web and promised Web shoppers 24-hour browsing and six- to eight-week delivery times on everything from table lamps to 10-piece bedroom ensembles. The company reported \$22 million in net revenues for nine months ending September 2000 and attracted one million users a month. But the increase in usage also increased customer dissatisfaction. Customer complaints filed with the Better Business Bureau (BBB) in Worcester, Mass., jumped from one in 1999 to 149 in 2000 (most brick-and-mortar companies get three to four complaints a year). The most common complaints had to do with delivery problems, product quality and bill disputes.

The main problem was that the company management built the Furniture.com brand very well but they did not create the infrastructure needed to support it. The company under-estimated the logistics and costs involved in shipping such a bulky commodity cross-country and did not build a good way to track orders -- the company ended up tracking orders manually. Furniture.com also created a cancellation policy that was too expensive. The customers could, for example, cancel orders right until delivery day. Thus when six-week delivery turned into six-month delays, many orders were cancelled. Furniture.com closed down and filed for bankruptcy in November, 2000.

Source: Stephanie Overby "The Changing Landscape of e-Business -- The Survivors", May. 1, 2001, CIO Magazine.

2) Boo.com Gets Booted Out

Boo.com promised its investors and on-line shoppers a Web site for online purchasing of high-quality, stylish, designer sportswear. Despite the widespread publicity, Boo.com declared bankruptcy only six months after its Web site had been launched, causing investors to lose an estimated \$185 million. What went wrong? Here is the brief story.

The idea for Boo.com came from two 28-year-old Swedish friends who had already established and later sold Bokus.com, which is the world's third-largest on-line bookstore after Amazon.com and Barnes&Noble.com. The idea was to sell trendy fashion products over the Web at full retail price rather than at a discount. The Web site enabled shoppers to view every product in full-color, three-dimensional images with zooming and rotation capabilities to view them from any angle. The site's search engine allowed customers to search for items by color, brand, price, style, and even type of sport. In addition, the visitors could get fashion advice from "Miss Boo", an animated figure, and customer service advice from telephone operators. To further entice buyers, the Boo.com customers earned "loyalty points," which they could use to obtain discounts on future purchases. Boo.com Web site was fluent in seven languages, accepted local currencies from 18 countries, and also offered free delivery within one week and also free returns for dissatisfied customers. In essence, this was to be the dream Web site for "time poor, cash rich" people.

Boo.com was financially backed by J. P. Morgan & Co. With start-up funds in hand, the company started an advertising campaign and set a target date of May 1999 for launching the Web site. The management committed \$25 million to an advertising budget and chose to advertise in expensive but trendy fashion magazines, cable television and the Internet. Boo decided to develop both its Internet platform and customer-fulfillment systems from scratch. The overall plan was to launch the Websites in 18 countries and handle 100 million Web visitors at once. The management also decided to open satellite offices in Munich, Paris, New York, and Amsterdam and hired several hundred people to take orders from these offices once the site went live. However, the launch date had to be postponed a few times because of incomplete Web site development, and so many of the staff sat idle for months. By September the company had spent \$70 million, and Boo undertook more fund-raising.

The Web site was finally launched in early November, 1999. The promised mass marketing blitz never happened. Basically, raising people's interest through pre-launch advertising while delaying the opening resulted in many disappointed and alienated potential customers. In addition, the site reviews were not good. Many (40 percent) of the site's visitors could not even gain access, the site was full of errors, and even caused

visitors' computers to freeze. The site was slow and very difficult to use, far from revolutionary. Only 25% of the customers were able to purchase anything and users of Macintosh computers could not even log on because Boo.com was incompatible with them. The flashy graphics and interactive features took too long for users with slow Internet access. Angry customers jammed Boo.com's customer support lines and sales fell short of expenses. Things started going down hill quickly. Boo lost support from J.P. Morgan and Boo started selling its clothing at a 40 percent discount and laying off staff. Finally, in May 2000, the firm was liquidated with many outstanding bills it could not pay.

So what went wrong? Naturally, one problem was lack of planning and control. No matter what, all businesses need the fundamental activities of budgeting, planning, execution, and control. The company promised too much (e.g., 18 countries simultaneously), spent too much money on advertising and marketing hype (e.g., advertising in expensive magazines and renting offices in high-priced areas in London, Paris, and New York), and just wasted money without return on investment (employees reportedly flew first class and stayed in five-star hotels). Another problem was the lack of oversight by the board. The board seats were mostly controlled by the Boo management, with only four being allocated to investors. However, those four investor representatives rarely attended board meetings. The board members had no significant retail or Internet experience and were not able to offer the supervision it needed.

In addition, there were serious technical problems. Developing everything from scratch proved slow and expensive. The developers had to develop a complex virtual inventory system, because Boo maintained very little inventory of its own. Boo's multimedia presentation was complex and even the shopping cart was intricate because one customer might have a shopping cart with items from four or five different sources. The support for seven languages and 18 different currencies with calculations for taxes from 18 different countries is also an extremely complex task. Finally, many homes in the US and Europe lack the high-capacity Internet connections required to easily access the graphics and animation on the Boo.com site. To make matters worse, some supposedly attractive features became flaws. For example, the constant presence of Miss Boo was annoying because she was constantly injected regardless of whether the visitor desired her. In summary, a multitude of management and technical problems killed Boo.com.

Sources:

- Laudon, K., and Laudon, J., "Management Information Systems", 7th edition, Prentice Hall, 2002
- Michelle Slatalla, "Boo.com Tries Again, Humbled and Retooled," *New York Times*, January 11, 2001;
- Andrew Ross Sorkin, "Boo.com, Online Fashion Retailer, Goes Out of Business" *New York Times*, May 19, 2000;
- Stephanie Gruner, "Trendy Online Retailer Is Reduced to a Cautionary Tale for Investors," *Wall Street Journal*, May 19, 2000;

1.1.4 How to Go From Strategies to Working Solutions

Simply stated, strategy is a game plan to win. For example, lawyers develop strategies to win cases. In the same vein, army commanders develop strategies to win battles. In the turbulent and highly competitive marketplaces of today, IS managers have to develop strategies to win or to help their companies to win. The book "Art of Strategic Planning for Information Technology" by Bernard Boar [Boar 2001] discusses IS strategic planning as a metaphor for battlefield. We will discuss IS strategy in more detail in Chapter 1 of the "Applications" Module and also in Chapter 1 of the "Management" Module.

Developing an effective strategy is essential but not enough. As evidenced by the above case studies, the strategic vision must be doable within the technical and business constraints. As noted by a Chief Executive Officer [Charan 1991]:

"There is a fine line between vision and hallucination".

To avoid "hallucination", the strategy must be translated into a working solution that executes the strategy. A working solution is a system (software + hardware) that satisfies the technical as well as organizational requirements (functional, security, performance, budgetary) and can be deployed, installed, operated, and managed. Without a good working solution, the strategies stay as visions or dreams that do not go anywhere. But how can a business strategy be translated into a working solution that can be actually deployed and used? A wide range of approaches, generally under the umbrella of "IS planning", have been developed over the years. Examples are IBM's Business Systems Planning (BSP), Rockart's Critical Success Factors (CSF), Nolan's Stage Model, and Porter's Competitive Force Models. We will review these and other methodologies in later chapters (Chapter 1 of the Overview Module and the Management Module).

For the purpose of a quick overview, let us discuss two views shown in Figure 1-7. The strategy triangle view emphasizes that IT strategy must be established in accordance with the business and organizational strategies [Pearlson 2004]. The Henderson and Venkataram [Henderson 1994] model goes into more detail and views business and IT in terms of strategy and infrastructure. The four closely interacting components of this model are: business strategy, IT strategy, business infrastructure, and IT infrastructure. The business strategy is concerned with the business game plan to win and survive (e.g., double sales of existing products, increase customer retention, introduce new products, etc.). The IT strategy concentrates on the information systems needed to support the business strategy. It may consist of a mixture of engineering of new applications (e.g., a new customer relationship management system) and re-engineering of existing applications (e.g., integration of existing order processing systems with Oracle Financial Systems). The IT infrastructure consists of the computer systems, the networks, and the middleware services needed to support the IT strategy. This alignment of IT infrastructure may also involve a mixture of engineering of new IT infrastructure (e.g., a new broadband network) and re-engineering of existing IT infrastructure (e.g., replacement of mainframes with desktops and integration of wireless and wired networks). The business infrastructure consists of the policies, procedures, roles, responsibilities, and the physical sites of a business.

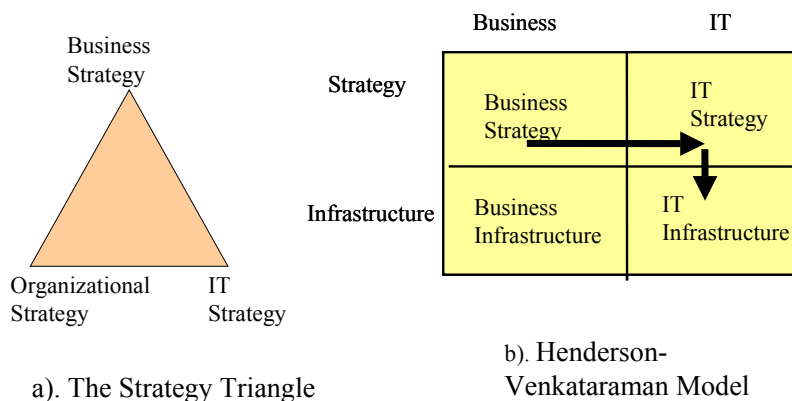


Figure 1-7: Aligning IT with Business Strategies

The most common scenario for aligning IT with business processes is shown in Figure 1-7. In this scenario, the business strategy drives the IT strategy which in turn influences the IT infrastructure. This is a common way of translating strategies to working solutions. As we will see in Chapter 1 of the Applications Module, other scenarios and interactions can be envisioned. An extensive discussion of these scenarios with different applications can be found in [Luftman 1996].

Consider, for example, a company that wants to double its sales. To accomplish this business strategy, it may need new applications such as online-purchasing. In addition, it may have to integrate its back-end order processing and inventory systems to support online purchasing. But online purchasing requires faster access from customers, thus the networks may need to be improved and faster servers may be needed to provide quick access to product catalogs. Thus a given business strategy can result in a multitude of application and infrastructure activities to provide a working solution (see the sidebar "CASE EXAMPLE: How GUESS

Jeans Translated Strategies to Working Solutions"). These activities need to be architected and managed properly for success. As we will see, this book attempts to cover all of these activities (strategies, applications, architectures, integration, infrastructure, and management) to show how to go from strategies to working solutions.

In today's increasingly digital economy, information systems and IT infrastructure are becoming a major, if not the primary, contributor to the working solutions. Figure 1-8 attempts to put the information systems in context and shows how the current trend in e-business is increasing the reliance of organizations on IT. As stated previously, the business strategies decide what type of products and/or services are needed (1). The financial, marketing, and other services are outlined to support the business strategy (2). Basically ISs are developed to support products and services and the support systems as shown by arrows 3, 4 and 5. The IT infrastructure in the past was only developed to support the information systems (6). But now, the same IT infrastructure is also used to deliver the products and services as well as the information systems. For example, airline companies do not use the IT infrastructure for their payroll only -- they use it to advertise, sell, schedule, and inform the customers -- virtually *all* business activities are supported by the IT infrastructure. This is the main shift due to e-business.

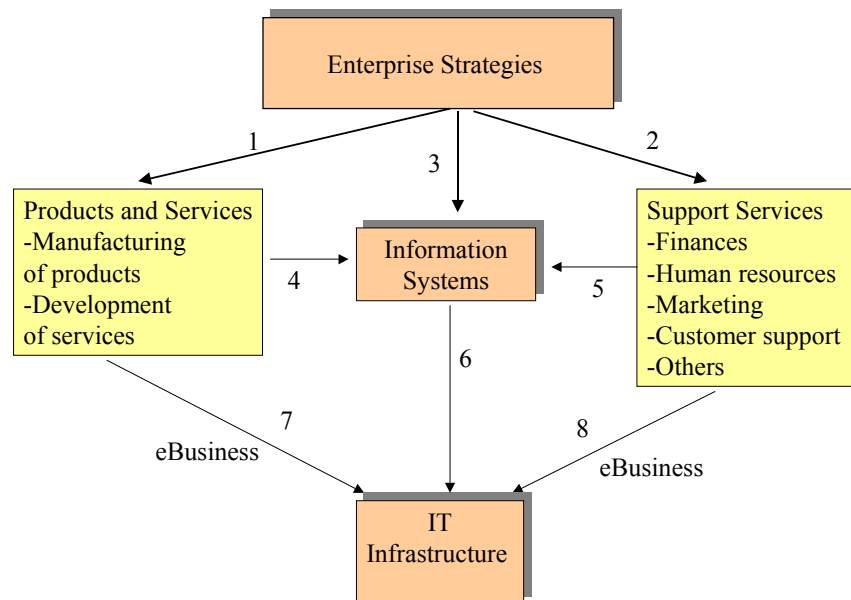


Figure 1-8: Putting IS in Context

But how to proceed? Figure 1-9 shows a non-sequential "methodology pattern" that can be customized for specific cases. The key points of this methodology pattern are:

- Translation of strategies to working solutions is an intensely iterative process.
- All iterations are based on the refinement and expansion of the following core activities:
 - Analysis,
 - Solution architectures,
 - Implementations, and
 - Deployment/support.
- Planning, architectures, first release and subsequent releases are in fact iterations (not separate phases) in which each one of these activities is performed at a different level of detail.
- Some activities are more extensive than others in each iteration (represented by the width of activity traversed in each iteration in Figure 1-9). For example, the first iteration requires extensive analysis and some high level architectures – the implementation and deployment/support activities are minimal. This

is because the first iteration emphasizes business opportunity analysis and assessment of technical feasibility through architectural evaluations. However, later iterations successively reduce the time spent in analysis but increase the architecture, implementation and deployment/support activities. Naturally, later releases of a system are heavily implementation and deployment/support centric.

- For a major release or enhancement of an application, you may re-start the entire process with first iteration.

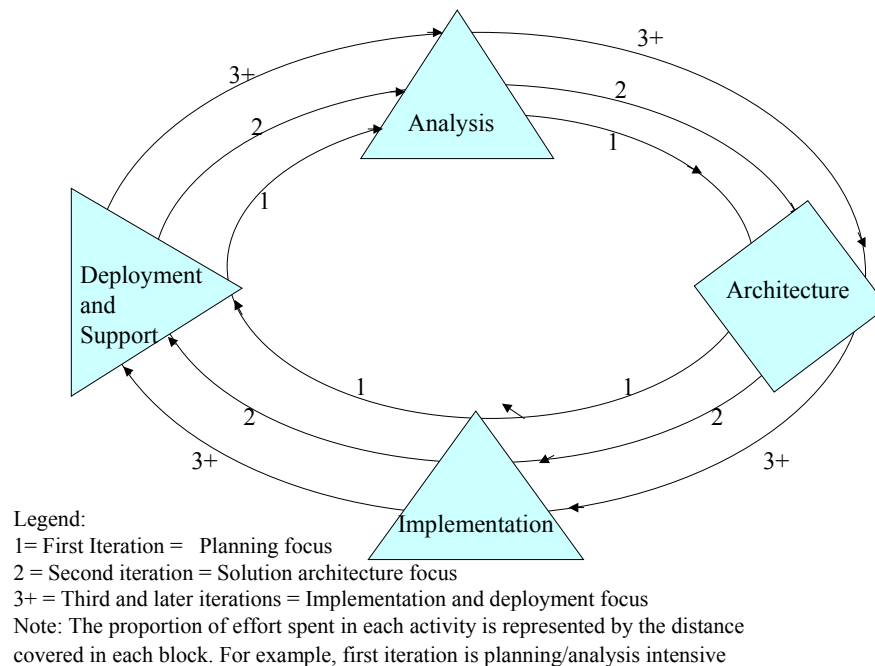


Figure 1-9: An Iterative Methodology Pattern

Let us briefly review these iterations:

First Iteration (Planning Focus). This iteration, discussed in Chapter 3 of the Applications module, essentially concentrates on the overall strategic and planning issues with quick analysis of architectural and implementation issues. It identifies the business drivers, key stakeholders/funding sources, strategic requirements, and costs/benefits based on a high level review of proposed solution architectures, implementation considerations, and deployment/support issues raised. The main purpose of this iteration, in our case, is to translate strategies to a *sketch* of a working solution that will be refined and deployed in later iterations. Specifically, this iteration concentrates on the following question: Given a business strategy and business drivers (e.g., doubling sales), should new system(s) be built (i.e., engineered) from scratch, should existing system(s) be reengineered, should a mixture of engineering/reengineering approaches (e.g., build a small portion and interface it with the existing system) be used, or should the whole activity be outsourced?

Second Iteration (Solution Architecture Focus). In the second iteration, discussed in modules "Architectures" and "Integration", you typically establish the blueprint that can be deployed, supported, and managed. The architectures, implementations, and deployment/support aspects of enterprise-wide systems are studied and prototyped to gain insights into feasibility and effort sizing. In particular, the solution sketch developed in the first iteration is revised, expanded, and prototyped.

Production (Third and Later) Iterations. In the next iterations, the first and future releases of the IS are built and deployed. The specific steps and tools in these iterations depend on the type of systems and

on the type of technologies employed. Other modules of this book (e.g., "Management", "Networks", "Middleware") will explore these iterations in more detail.

This general methodology pattern is based on my own experience and will be expanded in other modules of this book.

CASE EXAMPLE: How GUESS Jeans Translated Strategies to Working Solutions

GUESS Jeans dominated the designer jeans and casual clothing market during the 1980s and early 1990s. But by 1997 the company had evolved into a large corporation that was difficult to manage and was having to compete with Levi's and the Gap for market share. Paul Marciano, the company's co-chair and co-chief executive officer, set an ambitious sales target to triple sales to \$2 billion by 2003. He also turned to the Internet to help him keep costs low while increasing sales.

To accomplish this goal, GUESS launched several major projects. It first replaced its outdated network with up-to-date network technology, working with Cisco Systems. In addition, GUESS used the help of software vendors PeopleSoft and CommerceOne to create a B2B Buying Network for its suppliers and independent retailers in the United States and many other countries. The suppliers/retailers could order merchandise directly from a B2B Web site called ApparelBuy.com. This online purchasing system is integrated with GUESS's core order processing systems, thus the customers can track their orders through fulfillment or delivery any time of the day or night. The ApparelBuy.com system maintains an on-line catalog and integrates information from sales, inventory, and other business functions. ApparelBuy.com can detect order errors by checking catalog product numbers, correct the orders, and avoid shipping the wrong products, thus cutting down the number of returns. With new systems in place, GUESS reduced its ordering process to one or two days, as compared to one to two weeks to place and receive orders using manual processes.

GUESS also maintains a C2B Website for retail customers, called GUESS.com, which offers product catalogs and the ability to order merchandise on-line. GUESS also established BabyGuess.com and GuessKids.com as e-commerce sites for retailing infants' and children's clothing and accessories. These sites generate as many sales as one of the GUESS walk-in stores. GUESS is also streamlining its internal business operations by using Internet and Web technology. The company has established GUESSExpress as an internal private network (Intranet) that is used for exchanging messages between managers and employees, reviewing industry trends, purchasing supplies, reviewing plans for new stores, making travel arrangements, and access to employee benefits records.

GUESS management is relying on the Internet to change how the company conducts business in the twenty-first century. The new systems are expected to replace most of GUESS's telephone and fax-based processes. Management believes these systems will increase revenue and decrease costs by providing more sales channels, improving supply chain management, and reducing administrative expenses.

Sources:

- Laudon, K., and Laudon, J., "Management Information Systems", 7th edition, Prentice Hall, 2002
- Thomas York, "Perfect Fit," Cisco IQ Magazine, January/February 2001
- www.Guess.com

1.1.5 Why This Book?

The main goal of this book is to translate IS strategies to working solutions. To accomplish this goal, enough details are provided so that the translation can happen successfully. This guides the breadth as well as the

depth of various topics. For example, the book attempts to synthesize the strategic, architectural, integration, IT infrastructure, and management issues in a single volume with help from case studies, examples and tutorials. The Applications, Architectures, Integration, and Management modules discuss the topics that link strategies to working solutions. Almost 100 case studies and examples are used to highlight the key points. Special attention is paid to the modern distributed computing technologies (physical networks, the Internet, Web technologies and other middleware services) in the Networks, Middleware, and Platforms modules. These technologies provide the infrastructure needed to enable e-business strategies and are advancing rapidly. That is the good news. The bad news is that many of the issues and tradeoffs are not well understood, thus increasing the risk of failures. In particular, a plethora of jargon, interrelationships, models, frameworks, products, and techniques have been introduced (see Figure 1-10). Information technology practitioners and managers are facing questions such as:

- How can e-business strategies be translated into working solutions by leveraging the distributed computing technologies?
- What are the issues and trade-offs associated with these translations?
- What are the key building blocks and how can they be used to architect and integrate systems and solutions?
- What are all the new terms, what do they mean, and how do they interrelate with each other?
- Where can I find more information?

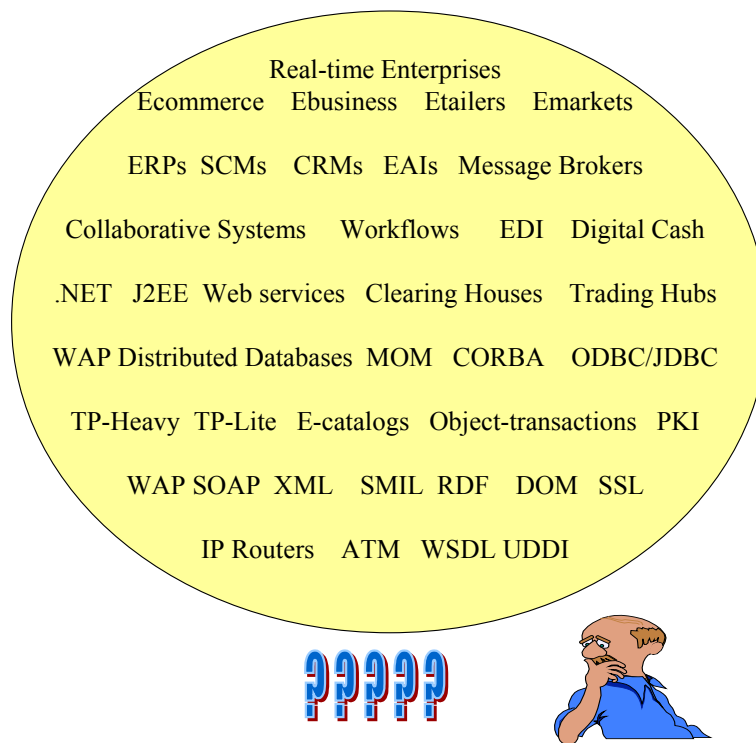


Figure 1-10: The Jargon Jungle

The primary objective of this book is to answer these questions and to bridge the gap between business and technical issues. It attempts to cover all the players shown in the framework for discussion (Figure 1-3) and is intended to serve as a tutorial on technical as well as management aspects of e-business. The book does its best to interrelate business issues with enabling technologies. Many books discuss strategic issues with no reference to the role of enabling technologies while others concentrate mainly on technologies without any reference to business. This book views e-business as an application of 3G distributed computing and covers

the key building blocks of distributed computing with emphasis on EB. Due to the widespread industrial applications and continuing research efforts in this area, our discussion will include:

- *State of the Art* approaches, which are prototypes and/or research and development reports and papers
- *State of the Market* information to show commercial availability of the approaches as products
- *State of the Practice* information to show that the approaches/products are being actually used by organizations.

Each module of the book concludes with a chapter devoted to discussion of these topics. Coverage of all three aspects will give the reader a more realistic view of the subject matter. This is especially important because, due to the delays and filters built into the industry, only a few of the state of the art ideas become state of the market and even fewer become state of the practice. Focus on one area only (e.g., state of the art) may give the reader the wrong impression about the potential impact of the topics discussed. In addition, it is not possible to develop transition strategies from the current to the future environments without an understanding of the current environments ("How can you get there from here if you do not know where you are?").

As stated in the preface, the emphasis of this book is on synthesis and interrelationships and not on detailed technical coverage of one topic. The book will intentionally cover a great deal of ground so that the interrelationships between different views, perspectives, approaches, and technologies can be understood. There are usually three different ways of covering a broad subject area like this:

- A coverage of the terms and concepts only with no detailed discussion. This option is depicted in Figure 1-11a where the X axis shows the breadth and the Y axis shows the depth of the coverage.
- A very detailed discussion of one topic such as networks with little or no reference to related areas (see Figure 1-11b)
- A coverage of the terms, concepts, building blocks and interrelationships of several related areas (see Figure 1-11c). This is the approach used in this book.

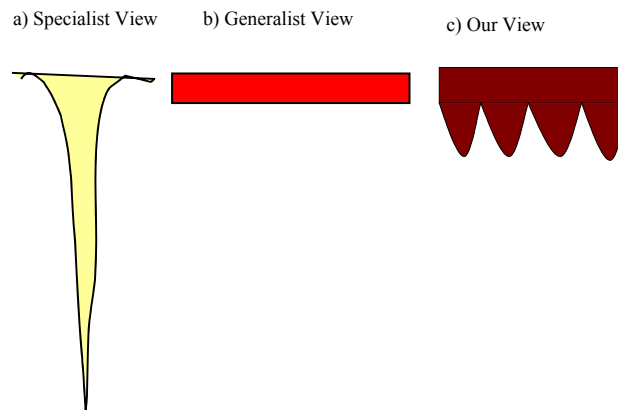


Figure 1-11: Different Views

Each chapter is written as a self-contained tutorial on the subject matter. Different levels of discussion are included in each chapter (conceptual overviews, management summaries, trends and technical details) to support different audiences. Numerous references for additional study are provided. To illustrate the key points, a single case study about a company that is moving through the e-business maze is used throughout the book.

This chapter is a sneak preview of the coming attractions in this book. We introduce a framework to establish the interrelationships between the various components such as communication networks, middleware, and distributed application systems. The framework also includes management/support issues.

This framework, introduced in Section 1.3 is at the foundation of this book. The chapter concludes with an outline of a case study which will be used throughout this book to expose the reader to the complex decisions of building solutions in the modern digital corporations.



Time to Take a Break

- ✓ • Overview
- Evolution of e-Business & Distributed Computing
- Book Roadmap



Suggested Review Questions Before Proceeding

- How is distributed computing related to e-business and e-commerce?
- What are the top five promises as well as pitfalls of e-business (rank them by importance)?
- What is the best way of translating strategies to working solutions?

1.2 e-Business and Distributed Computing Evolutions – The Next Generation Real-Time Enterprises

1.2.1 e-Business Evolution

As discussed previously, the Internet is gradually restructuring business-to-business (B2B) relationships and enabling new commerce activities, processes, and business models that were previously unimaginable. However, the Internet is also heightening customer expectations, increasing competition, and intensifying pressures to reduce costs, improve productivity, and speed time-to-market. It seems obvious that the most successful companies in this hyper-competitive economy will be those that can effectively leverage the Internet to automate, streamline, and integrate all business processes - from sales and purchasing to product and supply management to delivery and customer service. The sidebar "Use of the Internet in Business -- A Quick Summary" highlights the key points.

e-Business has gone through several stages of evolution. Figure 1-12 shows one view that casts e-business evolution into the following four broad stages.

Stage 1: Simple Web sites (C2B for Information Services). This stage became popular in the mid 1990s and is still the foundation of many corporate Web sites. The basic idea is to use the Web sites to display/advertise company products. All other company operations are largely unaffected. For example, the customers have to separately order the products that they select by browsing through company Web sites.

Stage 2: Basic e-Commerce (C2B for Online Purchasing). In this stage, the consumers could select the products through the Internet and then also buy them from a single organization. In this case the service is not only advertised but also delivered over the Internet. In addition, the Web is used as an

interface to corporate applications (i.e., new applications are developed by using the Web and existing applications are given “face lifts” by using the Web). This stage became popular in the late 1990s.

Stage 3: Extended Enterprises (B2B Direct). EEs (Extended Enterprises) go beyond basic e-commerce sites by tying services from multiple businesses through a single Web interface. In this stage, Web technologies take a central role in gluing services across multiple organizational units spanning different organizations. It adds B2B interactions to C2B as encountered in the previous two stages. The B2B interactions, although hidden from the users, take place directly between business partners. This stage, popular at the turn of the 21st century, is at the core of contemporary e-business activities like online shopping, trading between business partners, and integration of business processes across organizational boundaries (e.g., workflows across organizations through IT). An example of extended enterprises, also known as virtual enterprises, is Amazon.com (when you order a book from Amazon.com, many other suppliers may be involved in this transaction).

Stage 4: Next Generation Enterprises (NGEs). This stage goes beyond stage 3 to add intermediaries (trading hubs, emarkets), real-time business monitoring and control, mobility, self-serve customers, and other features. In this stage, gaining popularity at the time of this writing as *“real-time enterprises”*, the interactions between business activities within an enterprise are conducted, monitored, and controlled electronically. In addition, external communications with business partners are conducted through trading networks that support B2N (business to network) interactions. The Internet-based IT infrastructure becomes the primary source of company business in this model. In fact, NGEs rely almost exclusively on the Internet-based IT infrastructure to conduct business and often result in restructuring and transformation of the industry.

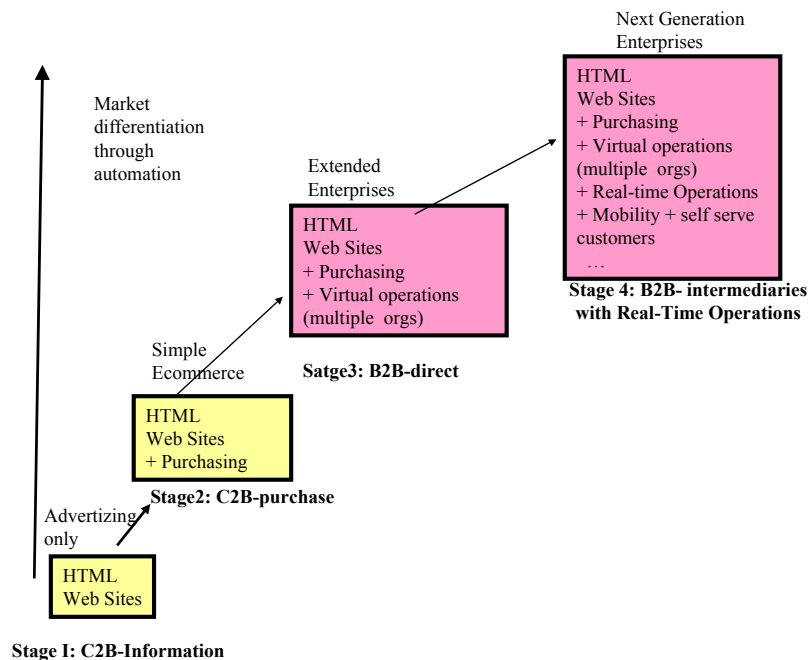


Figure 1-12: e-Business Stages of Evolution

Our interest is primarily in NGEs -- we will take a closer look at NGEs in Section 1.2.2. An interesting example of NGE is General Electric with its evolution into a real-time digital corporation (see the GE case study in Section 1.2.5). Other examples of NGEs, with varying degrees of compliance, are Intel, Dell computing, next generation “virtual telephone companies”, virtual software companies, and numerous electronic businesses like online clearing houses and trading hubs. NGEs employ innovative business models and rely on the emerging “next generation” technologies” (e.g., Next Generation Networks, Next

Generation Web, Next Generation Databases, Next Generation Software Infrastructure). NGEs raise several issues that span business and technical domains. For example, the four stages mentioned previously introduce costs and delays displayed in Table 1-1. Additional examples of the issues raised are:

- Strategic and applications issues such as the business risks and pitfalls that need to be avoided
- Architecture and integration issues that address how NGEs can be architected, developed, and integrated
- IT infrastructure issues that are concerned with enabling technologies such as networks and middleware for NGEs
- Management and support issues that address the planning, organizing, staffing, and security issues concerned with NGEs

We will develop a more extensive list of these issues in the next section and will attempt to answer them in the balance of this book.

Table 1-1: Costs and Efforts Associated with Stages of Evolution (source: Gartner)

Stage of Evolution	Cost To Implement	Effort To Implement
Stage 1: Simple Web sites	\$500K to \$1M	6 to 8 staff months
Stage 2: Simple e-commerce sites	\$1M	1 to 2 staff years
Stage 3: Intermediaries and Virtual Enterprises	\$2 to \$4 M	2 to 3 staff years
Stage 4: Next Generation Enterprises	\$5 to \$50M	5+ staff years (can be significantly higher for large scale NGEs)

Use of the Internet in Business – A Quick Summary

Use of the Internet for entertainment, online-purchases, and conducting business grew dramatically in 1999 but slowed down considerably in 2001. Despite the slowdown in 2001, e-business continues to grow and the volume as well as the value of Internet transactions is increasing. This growth has brought about fundamental shifts in how business is carried out by enterprises: how enterprises do business with each other, how they interact with their customers, and the mix and distribution channels of new products and services. Adoption of the Internet within the enterprise is being driven by an intense demand for economic, seamless interoperability of business processes within and among enterprises. Business models and processes can be expected to undergo large shifts as the implications of these changes take hold. In today's marketplace, across all industry segments, businesses are realizing that transformation to e-business is required to remain competitive. As enterprises around the world undergo transformations, they are increasingly leveraging Internet technologies to:

- Broaden their markets by extending their reach globally at minimal additional expense and enticing new prospects to become customers
- Enter new business areas through collaborations or expanded services made possible with Web-based interactions
- Increase employee productivity by providing easier access to corporate information and services
- Reduce costs through improved operations that integrate Web access and traditional IT systems
- Achieve operating efficiencies by reducing the number of people making routine decisions, by decreasing turnaround time, by managing reduced inventories, etc.
- Combine faster response times, continuous availability, and an ability to deal with complexity through the use of e-business applications to enable business opportunities that couldn't be made profitable in a manual implementation

Not only has the e-business transformation changed the competitive landscape, it has also changed the way

companies must identify and deal with new threats and vulnerabilities to their business assets. Business procedures and IT policies need to be updated to account for these new business risks.

Obviously, Internet has had positive as well as negative impacts. A landmark paper by Mike Porter [Porter 2001] discusses in detail the negative as well as positive impacts of the Internet on a) the industry structure, which determines the profitability of the average competitor and b) sustainable competitive advantage, which allows a company to outperform the average competitor. For example, the Internet has opened new markets for potential profits but it is difficult to maintain a competitive edge because everyone can enter the new marketplace.

1.2.2 Next Generation Enterprises (NGEs) – The Digital Real-time Corporations

NGEs, as mentioned previously, are distinguished from the current generation of enterprises because NGEs rely almost exclusively on the Internet-based infrastructure to conduct business. In recent years, new and innovative business models and business services (e.g., real-time business management, virtual operations, application service providers, business mediation through emarkets, self-serve customers, and dynamic business partnerships) have become a business reality. In the meantime, several “next generation” technologies (e.g., Next Generation Networks, Next Generation Web, Next Generation Databases, Next Generation Software Infrastructure) have emerged to support the new business models. A Next Generation Enterprise (NGE) utilizes the innovative new business models by fully exploiting and integrating the next generation technologies to conduct business. In essence, NGEs rely on the underlying IT infrastructure (networks, computing platforms, middleware) to conduct 80 to 90% of their business. Several companies such as GE have adopted this model (see the Case Study in Section 1.2.5).

As stated previously, an NGE is not just a Web site for advertising (stage 1) – it is stage 4 of evolution with emphasis on using up-to-date information, getting rid of delays, and using speed for competitive advantage. What are the differentiating features of an NGE? Let us suggest that an NGE is an enterprise that fully exploits:

- Electronic services, as much as possible, for all internal as well as external business activities.
- Real-time business activity monitoring (BAM) and control to make zero latency decisions (i.e., react to changes instantly instead of after monthly or quarterly reports).
- Additional features such as mobility, virtual operations, and self serve customers to compete and succeed in the marketplace.

1.2.2.1 Exploitation of Electronic Services for Increased Automation

Figure 1-13 shows a conceptual view of Next Generation Enterprises (NGEs) that are in stage 4 of e-business evolution and rely heavily on automation, as much as possible, of internal as well as external business processes. Because using non-real-time data to make business decisions can be costly, NGEs support a mixture of the following interactions to conduct business electronically:

- *Consumer to Business (C2B)*: In this case, the consumers buy, sell, and receive other business services electronically from the businesses. Examples include several “.com” companies such as Staples.com for buying office supplies online, E-Bay.com for purchasing numerous products, shop.com for grocery shopping, and Flowers.com for buying flowers.
- *Business to Employee (B2E)*: This represents internal business applications such as enterprise resource planning (ERP) that support back-office operations. ERPs support inventory management, order processing, and financial reporting applications. Traditionally, enterprise resources have been managed by a multitude of independent applications in human resources, payroll, order processing, inventory control, billing, and accounts payable/receivable systems. The basic idea of modern ERP systems is that

they provide an integrated approach to manage and operate enterprise resources such as employees, materials, and services. Many companies such as SAP, Oracle, and PeopleSoft support ERPs.

- *Business to Business (B2B)*: In this case, businesses interact with each other electronically for activities such as supply chain management, order processing, purchasing systems, inventory management, billing/payment, and shipping/receiving. Examples of B2B activities can be found in companies that use traditional EDI (Electronic Data Interchange) systems for order processing and invoices, as well as Amazon.com and Dell Computers that rely heavily on information technologies to conduct business between partners. B2B interactions are of two types:
 - B2B-Direct that involves interactions between businesses directly (i.e., trade between known partners)
 - B2B Indirect that involves indirect trade through eMarkets -- sometimes referred to as B2N (business to network) interactions
- *Consumer to Consumer (C2C)*: In this case, the consumers conduct business with each other directly or through intermediaries. Examples are auction sites such as E-Bay and trading hubs such as COW.com. Compared to B2B and C2B activities, C2C activities in e-business are relatively new but expected to grow in the marketplace.

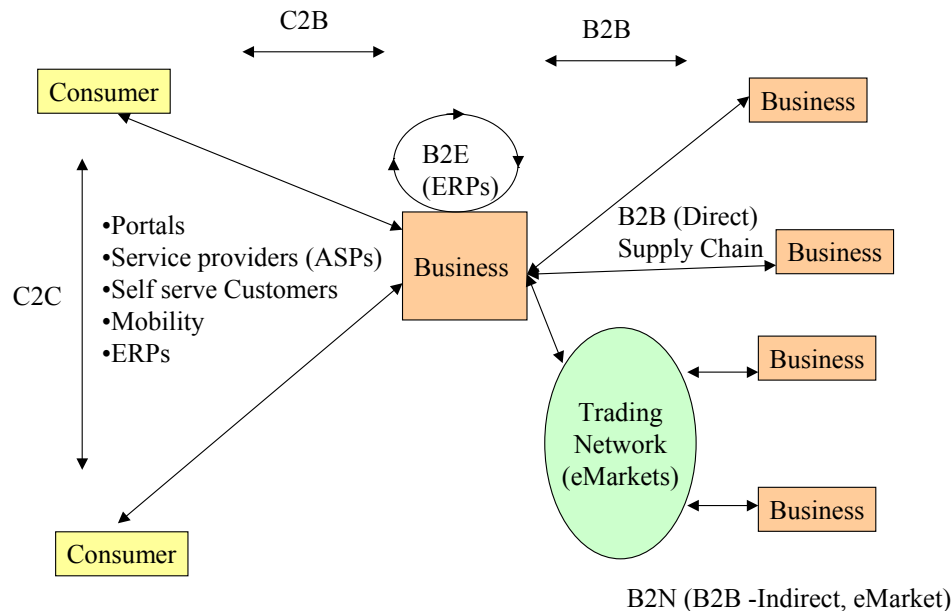


Figure 1-13: Conceptual Model of Next Generation Enterprises

The electronic exchanges between the players (consumers and businesses) can involve two-tiers (C2B, B2B, or C2C) or three-tiers (C2B2B, for example). In some cases, such as supply chains, there can be n-tiered exchanges where $n > 3$. These exchanges typically support:

- E-procurement and online purchasing systems to allow users to purchase goods and services over the Internet
- Customer relationship management (CRM) systems to attract and retain customers
- Enterprise resource planning (ERP) systems to manage enterprise resources such as people, costs, and assets in an integrated manner
- Portals to provide a uniform interface for the corporate resources
- Service providers such as application service providers (ASPs) for outsourcing
- Mobility for customers, suppliers and business partners who are increasingly mobile
- Supply chain management (SCM) for efficient transfer of goods between various stages of supply chains

- Intermediaries such as eMarkets to support electronic trade between a multitude of suppliers and customers

We will discuss these topics extensively in the "Applications" Module.

1.2.2.2 Real-Time Monitoring and Control of Business -- The Real-Time Enterprises

In addition to C2B, B2B, and B2E digital services, NGEs support the real-time enterprise model in which the real-time status of business activities critical to the company's day-to-day operations is displayed and acted upon immediately. Real-time companies are building digital nervous systems that connect everything involved in the company's business -- IT systems, factories, employees, suppliers, customers and products. To support the monitoring and split-second reaction times across widely distributed business units, the companies have to rely on sophisticated IT infrastructure (e.g., wired and wireless networks, global positioning satellites, sensors, handheld devices, interconnectivity middleware, and large databases). In essence, the real-time enterprises take the concept of device monitoring as used in network management platforms such as HP's OpenView and extend it to enterprise level.

An example of a real-time enterprise, also known as Zero-Latency (ZLT) Enterprises, is General Electric (see the GE Case Study in Section 1.2.5). GE top management uses a large keyboard and a huge screen display panel that shows the real-time status of applications critical to GE's day-to-day operations. The screen displays an array of green, yellow, and red icons that represent the status of GE's business operations around the globe ranging from plastics to online purchases. The objective is to respond to changes and manage risks continuously instead of waiting for end-of-the-month or end-of-the-quarter reports. Real-time enterprises are event-driven, i.e., they capture the important business events (e.g., a purchase order received, customer payment made, stock running out of an item, delay in a supply chain) and display them on a continuous basis. As we will see later, enterprises that want to operate in real time use event-oriented design based on message-oriented middleware and publish-and-subscribe communication. The digitization strategy of real-time enterprises can be discussed in terms of the following three broad activities that are monitored and controlled by a management console -- a corporate information nerve center that allows constant monitoring and reaction to problems (see Figure 1-14):

- B2E (Business to Employees) activities should interact faster within an enterprise and all critical internal systems should be linked to the management console. ERPs, computer integrated manufacturing (CIM) and other integration efforts within organizations support real-time monitoring and feed the management console. In particular, ERP II systems (the new breed of ERPs) are critical players in the real-time enterprises.
- C2B activities should hasten interaction with customers and support real-time monitoring of online purchasing, CRM (customer relationship management), and portals. Real-time techniques can be employed to deliver stronger intimacy and greater relevance in customer interactions. For example, a CRM company, E.piphany, has unveiled a real-time product based on "self-learning". The system makes sure that personalized offers pushed to customers are affected immediately by reactions others have had to similar offers. Enterprise portals also form a key part of a "real-time enterprise" initiative by feeding necessary events to the management console.
- B2B should allow interacting better and faster with suppliers. This B2B activity saved GE more than \$680 million through Web-based auctions. Similar results have been reported from the auto emarket established by GE, Ford, and Chrysler. Enabling business activity monitoring of B2B through a management console is important for a real-time enterprise. For example, zero latency supply chains can be developed by making sure that any delays (latencies) in the supply chains are detected and corrected in real-time.

1.2.2.3 Additional Services (Mobility, Self Service, and B2N Trade)

In addition to digital real-time operations, NGEs also support other features such as mobility, B2N (Business to Network) trade, and self-serve customers.

Mobile devices and wireless networks are vital to the real-time operations of NGEs. Specifically, getting the best information to and from the mobile users is crucial to take advantage of the effect this group has on sales and revenues. For example, access to e-business applications can be enabled through mobile devices and monitoring of business activities can be achieved through handheld devices. However, a sound, mobile-enabled middleware infrastructure and wireless network is necessary to achieve strategic business benefits. We discuss these topics extensively in the Platforms and Networks modules, respectively.

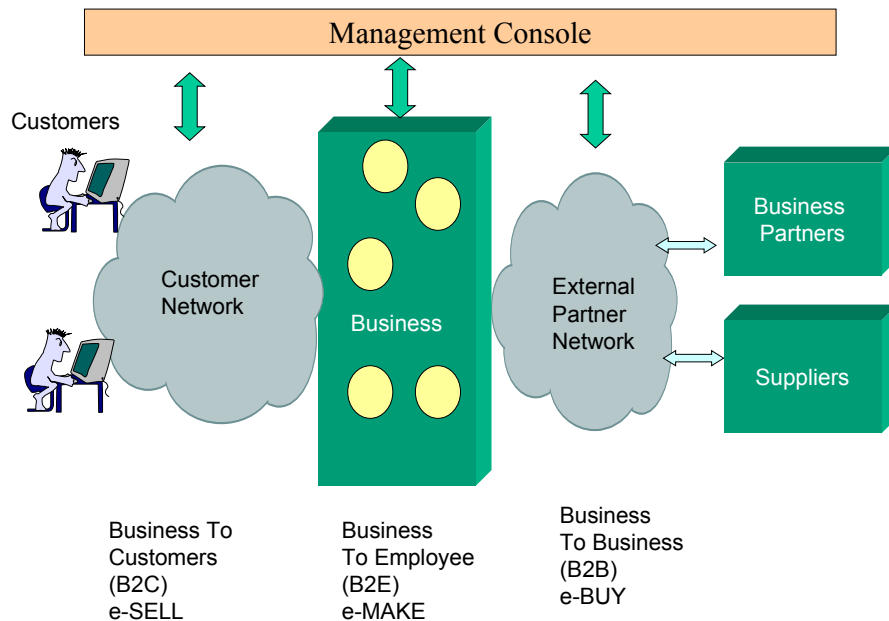


Figure 1-14: Conceptual View of a Real-time Enterprise

Self-serve customer systems allow customers to receive services without interacting with the human representatives. Examples range from automated teller machines to e-tickets that the customers can use to get boarding passes on airlines without interacting with the representatives. Self-serve customer systems do not eliminate the need for customer care but expand customer services without having to add new staff.

B2B trade through Emarkets -- sometimes referred to as B2N (Business to Network) interactions -- are also an important aspect of NGEs. B-to-B trade has been vastly accelerated by the introduction of electronic marketplaces and exchanges. Emarkets, discussed in the Applications Module, bring together multiple vendors "under one roof" and provide a single point of access for brokering financial transactions and information exchange across a large community of buyers and sellers. NGEs benefit from emarkets because they offer a powerful means for purchasing based on vendors, price, terms, order, payment plans, etc.

NGEs may also need additional functionalities to support a real-time digital corporation. For example, real-time business activity monitoring requires "extreme knowledge management" where business activities are knowledge-enabled to minimize response times and optimize response quality. Thus the creation and sharing of unstructured information is a fundamental underpinning of the NGE. Security also should be embedded in all real-time processes and NGEs must plan for and mitigate the risk of any type of business process interruption.

1.2.2.4 Issues in NGEs

NGEs with their real-time digital attributes offer tremendous benefits when properly used. However, there are naturally several issues and open questions in this area.

1. Strategic and application issues:

- What are the business risks and pitfalls that need to be avoided?
- What type of applications should be instrumented first for real-time monitoring, given that not all applications can be monitored at once?
- What are the social issues involved in real-time enterprises -- will the employees like the idea of being watched constantly by all levels of management?

2. Application architecture and integration issues:

- How can NGE sites with mobility, real-time business activity monitoring, and virtual operations be developed (i.e., what type of methodologies, tools, and techniques can help)?
- How can the various applications and technologies be packaged into solution architectures?
- How can NGE services be integrated with traditional enterprise services (e.g., back-office ERPs)?
- How can an existing enterprise smoothly migrate to NGE with minimal costs and risks (i.e., what type of methodologies, tools, and techniques can help)?

3. IT infrastructure issues:

- What type of network services are needed to support the real-time and mobility services of NGEs ?
- What type of middleware is needed, i.e., how can the message-oriented middleware and publish-subscribe services support the event-driven enterprises?
- What type of application servers and middleware platforms can be used to build the mobile and B2B applications for NGEs?

4. What type of management and support issues will need to be addressed?

- How can security solutions be architected to maintain the privacy, authorization, authentication, and integrity of the real-time business activity monitoring?
- Can the lessons learned in real-time monitoring of manufacturing plants and chemical engineering plants be helpful? Implementing real-time enterprise business processes will need applications that come with instruments to measure and manage them pre-installed.
- Can the current breed of management platforms as discussed in the Management Module be extended to serve as "enterprise management platforms"?
- How can enterprises not drown their executives in irrelevant data by making sure that the information is carefully and properly directed?
- How to do business continuity planning because, for many real-time enterprises, a four- to 24-hour site outage would cause irreparable damage to the enterprise?

These questions and issues will be addressed in various modules and will drive the discussions about future trends in this book.

1.2.3 Evolution of Distributed Computing Technologies

Let us now look at the evolution of distributed computing technologies and their role in e-business. Distributed computing has evolved since the 1970s and will continue to evolve for many years to come. During this evolution, we have accumulated many terms such as distributed processing, distributed cooperative processing, distributed data processing, client-server computing, network computing, Internet computing, Web computing, distributed object computing, real-time computing, and B2B computing. Let us briefly review the evolution in terms of stages of evolution shown in Figure 1-15² and try to put some of these terms in perspective.

² This figure has been reproduced here for convenience.

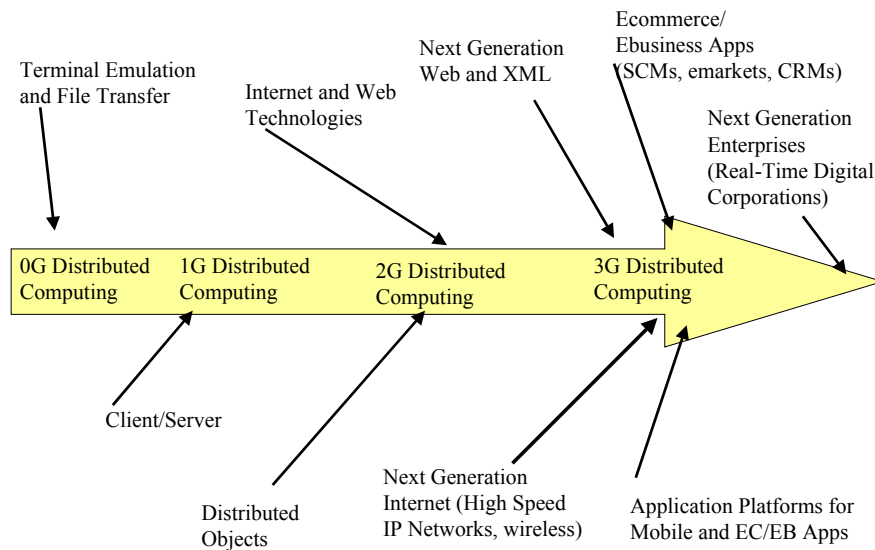


Figure 1-15: Evolution of Distributed Computing

Zero Generation Distributed Computing – Terminal Emulation and File Transfer. This model of distributed computing, introduced during the 1970s and 1980s, is largely based on terminal emulation and file transfer. During the 1970s, distributed computing was characterized by mainframes and minicomputers interconnected through wide area networks (WANs). These networks were slow, typically in the range of 2400 to 9600 bits per second (bps), and the computers exchanged information through terminal emulation and file transfer. Typically, minicomputers were used as terminals so that data at mainframes could be accessed through terminal emulation. In some cases, files were transferred between mainframes and minicomputers through file transfer packages.

Many file transfer and terminal emulation packages were developed in this time period. Although a great deal of research in distributed databases was conducted (see for example [Rothnie 1977]), this technology did not become state of the market and state of the practice in this time period. Two terms became popular in this stage:

- Distributed processing which refers to application processes at multiple computers, and
- Distributed data processing which refers to data as well as processes at different computers.

Independent of the terms used, the underlying information exchange technologies were primarily file transfer and terminal emulation.

During the 1980s, three fundamental changes took place: proliferation of desktop computers, availability of local area networks (LANs), and common usage of higher data communication rates (4 to 16 million bps for LANs, and 56,000 bps to 1.54 million bps for WANs). Typical DCSs in this time period consisted of mainframes, minicomputers, and desktop computers, interconnected through LANs and WANs. In addition to distributed processing and distributed data processing, the term network computing became popular to underline the role of networks as a value added feature of computers. Although some distributed database and client-server packages became state of the market (see for example [Rauch-Hinden 1987]), the main state of the practice technologies for information exchange in this stage were still terminal emulation and file transfer. Thus the data at a remote computer was still accessed either by remotely logging on to the remote computer or by transferring the files through file transfer packages (many of these systems are operational at present).

First Generation Distributed Computing -- The Client-Server Model. This generation of DCS, introduced in the early 1990s, brought about fundamental changes under the umbrella of "client-server computing". The foundation of this form of distributed computing is availability of client-server (C-S) packages for transparent information exchange between remote processes. C-S computing has also benefited from proliferation of powerful and inexpensive desktop and laptop computers, surge of multi-vendor products, emphasis on open standards, and commercial availability of high speed networks (100 million bps and higher for LANs, WANs and MANs). Typical DCS in this time period consisted of many computers of different capabilities from different vendors, which were connected across vast geographical areas over high speed networks from different suppliers. The term distributed cooperative processing became in-vogue because it underscores C-S systems, the main feature -- C-S systems allow processes at different computers to exchange information interactively with each other. Client-server (C-S) computing allows client applications (e.g., spreadsheets, query processors, and user interfaces) to access servers (e.g., database servers, file servers, application servers, print servers) transparently across a network. C-S computing is a major step forward from the older terminal emulation and file transfer based distributed computing. C-S computing became state of the market and state of the practice due to the wide range of COTS (commercial off the shelf) products from major vendors such as Oracle, Microsoft, and IBM. Many books have been written on this topic; [Umar 1993, Orfali 1994] are early examples.

Second Generation Distributed Computing -- The Web-Internet Model. This form of distributed computing, known as the Web-Internet model, was introduced in the mid 1990s due to the almost sudden and dramatic popularity of Internet and Web technologies. For all practical purposes, Web technologies (i.e., Web browsers, Web servers, HTTP) are a special form of C-S computing in which Web browsers are the clients, Web servers are the servers, and HTTP is the exchange protocol. Enough has been written about the reasons for the popularity of this model. The main reason, of course, is the Internet (a large collection of TCP/IP networks) that allowed users from anywhere to access and manipulate information through URLs and GUI (Graphical User Interface) browsers. Another important aspect of this stage is the popularity of distributed object computing (DOC) that allowed remotely located objects to communicate with each other. In particular, standards-based DOC technologies such as CORBA (Common Object Request Broker Architecture) and vendor-based DOC technologies such as Microsoft DCOM became widely available in the mid to late 1990s to fuel popularity of DOC. In fact, DOC meshes very well with Web-Internet technologies (CORBA as well as DCOM work on top of the Internet) and inter-works easily with Web browsers and servers -- details to be provided later). In this stage, the basic e-commerce (C2B advertising online purchasing) took hold, thus providing a direct link between EB and DCS. This stage developed the foundation of "Object-oriented, Client-Server, Internet (OCSI)" environments because these three powerful technologies were successfully packaged together in the late 1990s (see the books on this topic [Umar 1997 February, Umar 1997 May]).

Third Generation (3G) Distributed Computing -- The XML Web Component Model. This form of distributed computing, popular at the time of this writing, is the main area of our interest. This stage has further extended the "Object-oriented, Client-Server, Internet (OCSI)" model and is the focus of this book. In particular, the following technologies are leveraged to support e-business and NGEs:

- Next Generation Internet. This includes the growth of IP (IPv6) over very high speed converged networks that combine data networks with telephony networks and wired networks with wireless ones. This convergence allows global data transfers between a wide range of Internet users (data applications, telephony, video conferencing). We will discuss these technologies in the "Networks" Module of this book.
- Next Generation Web and Web Services Components. This includes growth of XML, object-oriented technologies and XML-based data and transaction processing services to support a wide range of Web users. An important development is "business components" based on XML Web Services that can be developed, deployed, and accessed through platforms such as Sun J2EE and Microsoft .NET. In addition, real time enterprises use message-oriented middleware and publish-and-subscribe communication to record important events. We will discuss these technologies in the "Middleware" Module of this book.

- Application Platforms to Support e-Business and Mobile Applications. This includes application specific middleware services for e-business, e-commerce, and mobility that are being packaged into complete platforms, known as application servers or middleware platforms. The services include support for payment, catalogs, application integration, wireless applications, and B2B transactions. We will discuss these technologies in the "Platforms" Module of this book.

These technologies provide the key infrastructure needed to support the wide range of EB/EC applications that are being developed at present for B2B as well as B2N situations (stage 3 and 4 of e-business evolution). These applications, as stated previously, involve supply chains, mobile applications, CRMs, portals, and real-time business activity monitoring to support the real-time digital enterprises of today and tomorrow.

1.2.4 Synthesis of e-Business and Distributed Computing Evolutions

Figure 1-16 shows a synthesis of the evolution of e-business and distributed computing. This figure is a variant of the framework shown earlier in Figure 1-3. It shows that stages 1 and 2 of e-business rely on the technologies developed in the first and second generations of distributed computing (C-S, Web, and Internet), and stages 3 and 4 of e-business rely on 3G distributed computing technologies. Basically, the Next Generation Enterprises (NGEs) rely heavily on the 3G distributed computing technologies.

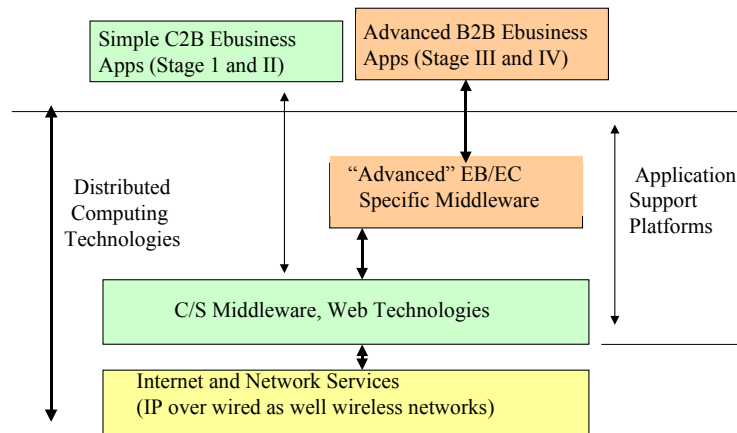


Figure 1-16: Combining e-business with Distributed Computing

Figure 1-17 shows another view, for architectural considerations, of next generation enterprises with additional details of enabling technologies. This view shows the enabling IT infrastructure components (e.g., XML, enterprise application integrators, mobile agents, and wireless middleware). We can use this view to study the interplays between the infrastructure components and to build architectures of e-business systems. We can also use this architecture to study migration issues, and to address operational issues such as performance, fault tolerance, security, and manageability. We will study this model in detail in "Applications", "Architectures", and "Integration" modules of this book.

At the core of this architecture is a Web site that provides a wide range of middleware services. The mid tier is surrounded by two integration tiers that leverage the business logic in the middle tier. The front-end integration tier takes into account the wide range of devices (laptops, Web browsers, PDAs, cellular phones) and applications (desktop or mainframe-based) that you need to communicate with. The back-end integration is used to connect to various local as well as remote (external trader) applications and databases. Notice that both integration tiers are triangular, i.e., the integration glue is thin in some cases but quite thick in others. For example, integration with Web-based applications requires less effort than a mainframe-based application. The integration effort also depends on whether you are interacting with local (i.e., within the

same enterprise) or external applications. As stated previously, this architecture will be used as a generic framework in this book to study the interplays between the infrastructure components, to examine integration/migration issues, and to address operational issues such as performance, fault tolerance, security, and manageability.

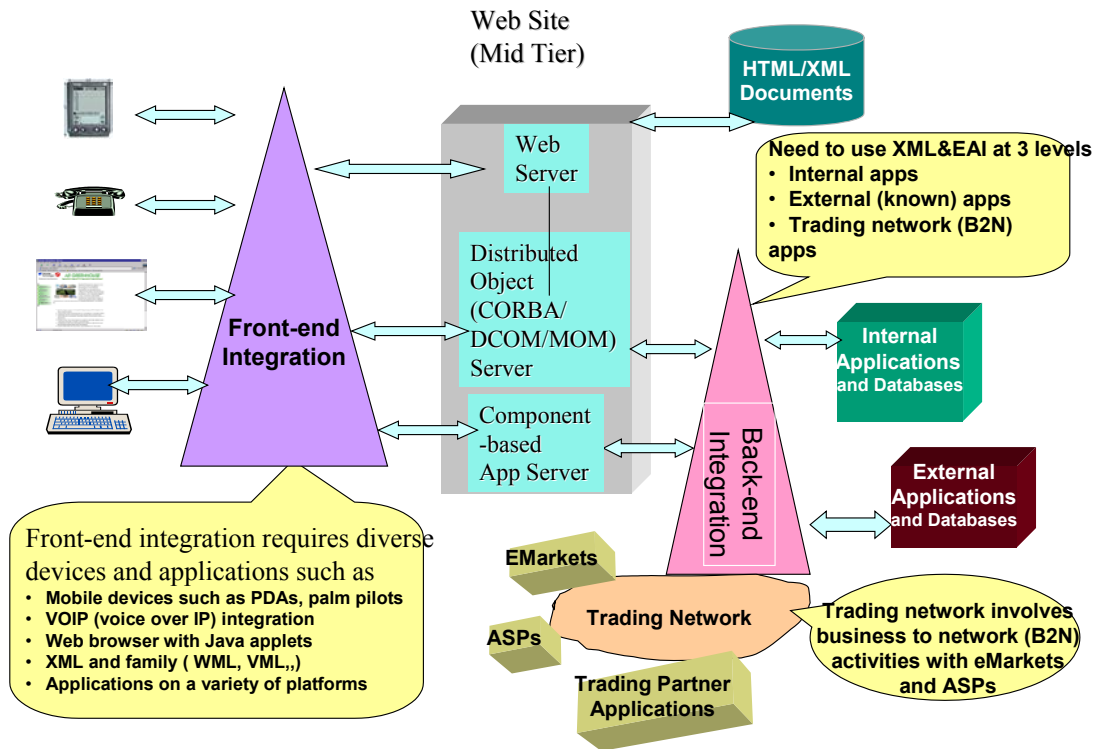


Figure 1-17: An Architectural Framework for Next Generation Enterprises

1.2.5 Case Study: GE Evolves into a Real-Time Digital Enterprise

1.2.5.1 Overview

General Electric (GE) is the world's largest diversified manufacturer with \$155 billion in revenue and 460,000 employees in 100 countries. Despite its size and old-economy businesses, *Internet Week* named GE its e-business company of 2000. GE started conducting purchasing and selling on the Internet in the mid 1990s with some early successes. For example, GE Plastic's distribution arm (Polymerland), began distributing technical documentation over the Web in 1994 and put its product catalog on the Web in 1995. In 1996, GE Lighting reduced its purchasing cycle from 14 to 7 days and also reduced its supply prices by 10 to 15 percent because of open bidding on the Internet. In 1997, seven other GE units began purchasing via the Internet.

Fast forward to November, 2002. Gary Reiner, current CIO of General Electric Co., uses a large keyboard and a huge screen display panel that shows the real-time status of software applications critical to GE's day-to-day operations. The screen displays an array of green (indicates good), yellow (not as good as it could be) and red (trouble) icons that represent the status of GE's operations around the globe. For example, Reiner uses the main screen for GE's plastics operation, which flashes a series of green lines and a few yellow lines. If red bars appear on the screen, Reiner sends an e-mail to the appropriate division manager asking for an immediate explanation. His goal is to monitor, once every 15 minutes, GE's mission-critical operations such as sales, daily order rates, inventory levels, and other important activities across the company's 13 different

businesses around the globe. The icons of up-to-the-minute *business* performance across the company are checked regularly by *agents* that send test transactions to exercise various business operations such as an online purchase. These transactions typically take a few seconds to complete and trigger an automatic e-mail or inquiry when the status is yellow or red. The main idea is to respond to changes and manage risks continuously instead of waiting for end-of-the-month or end-of-the-quarter reports.

GE estimates that its digitization efforts saved the company \$1.6 billion in 2001. "We said we'd cut \$10 billion in costs in five years, and we're already a third of the way there," Reiner says.

1.2.5.2 How Did it Happen -- The Evolution

The serious transformation of GE into a digital company started in January 1999 when Jack Welch, then President of GE, announced a new initiative to turn GE into an Internet company and pledged that the Internet will change the way business is done at GE. The goal was to Internet-enable its business processes and reduce overhead costs by half, saving as much as \$5 billion per year. Specifically, all buy side transactions (B2B trade between GE and its suppliers) were to be done electronically and most sell side transactions (C2B trade such as customer service and order taking) were also to be automated. To motivate individual units, Welch ordered all of its 20 GE units to determine how dot.com companies could destroy their businesses and explained that if these GE units did not identify their weaknesses, others would. Unit managers were told to change their units to prevent it from happening and uncover new Net-related business opportunities with alternative approaches that enhance value to the customer and reduce total costs.

The most interesting part of the Internet initiative is that it started by changing the GE culture at the very top. GE's internal newsletters and many of Welch's memos became available only on-line and all top managers and executives, including Welch (who also had to take typing lessons), were assigned skilled mentors. The mentors worked with the managers to make them comfortable with the Web and to enable them to evaluate their competitors' Web sites. Every GE employee was given training and blue collar workers could use kiosks at the factory floor to access the Internet.

Many successful projects came out of the initiative. For example, GE Power Systems developed its Turbine Optimizer, which uses the Web to monitor any GE turbine, comparing its performance (such as fuel burn rate) with other turbines of the same model and suggesting how to improve turbine performance. GE Transportation built an Internet auction system for purchasing supplies. Other units adopted this system -- handling \$5 billion of GE purchasing in 2000. GE Medical Systems identified its threat as aggregators, such as WebMD, which offered information on competing products as well as selling those products. The GE unit's response was iCenter, a Web connection to customers' GE equipment to monitor the equipment operation at the customer site. iCenter collects data and feeds it back to each customer who can then ask questions about the operation of the equipment through the same site. GE Aircraft adapted iCenter and now monitors its customers' engines while they are in flight. GE Appliances developed a point-of-sale system, which they placed in retail stores such as Home Depot, where customers enter their own orders. In 2000 Appliances reported 45 percent of its sales, totaling \$2.5 billion, took place on the Internet.

Although GE has been praised universally for its Internet initiative, some people are skeptical. Mark Roberti of *The Industry Standard*, in a January 2001 article, commended GE for embracing the Internet so quickly. But he noted that "these endeavors are unlikely to make GE vastly more profitable . . . because the "company is not using the Internet to reach new markets or create major new sources of revenue." Although Roberti and others have questioned the great savings through Internet-based cost cutting of GE, the overall effort at such a large scale is quite admirable.

1.2.5.3 Moving Into Real-Time Enterprise Arena

With its entry into the real-time enterprise arena, GE's goal is to monitor, once every 15 minutes, the company's mission-critical operations such as sales, daily order rates, inventory levels, and other important activities across the company's 13 different businesses around the globe. The icons of up-to-the-minute business performance across the company are checked regularly by agents that send test transactions to

exercise various business operations such as an online purchase. The digitization strategy of real-time enterprises may consist of the three activities: "e-buy, e-make and e-sell."

- E-make is concerned with interacting faster within an enterprise. Also known as B2E (Business to Employees), this activity is concerned with tightly coupling all internal systems to a corporate information nerve center that allows constant monitoring and reaction to problems. ERPs, computer integrated manufacturing (CIM) and other integration efforts within organizations can be of help in this area.
- E-sell aims to hasten interaction with customers: Also known as C2B, this involves online purchasing systems such as GE's Polymerland Web site, which helps customers research GE's products and prices. This site has reduced phone calls to service reps by 300,000 calls per year. By digitizing sales, GE has also speeded up service -- and has cut 60 percent from the costs of selling GE's vast array of products, from dishwashers to polymers. Dell Computers and Amazon.com are also good examples of e-selling.
- E-buy is also about interacting better and faster—but with suppliers. This B2B activity saved GE more than \$680 million through Web-based auctions. Similar results have been reported from the auto emarket established by GE, Ford, and Chrysler. Speed gains also show up in billing. For example, simply by collecting more data on customers who were late in paying their bills, GE was able to be more effective in getting them to pay on time, for a savings of \$6 million in interest.

Despite the slow economy in 2001-2002, GE has continued its investment in e-business and now in the real-time enterprises. The main idea is to manage the business as a real-time operation where the management can adjust to changes continuously to increase profit margins.

Sources:

- Dave Lindorff, "GE's Drive to Real-Time Measurement", CIO Magazine, November 11, 2002
- Ken Laudon and Jane Laudon, "Management Information Systems", Prentice Hall, 7th edition, 2002
- Mark Roberti, "General Electric's Spin Machine," The Industry Standard, January 15, 2001
- Marianne Kolbasuk McGee, "E-Business Makes General Electric a Different Company," InformationWeek, January 31, 2000



- Time to Take a Break**
- ✓ • Overview
 - ✓ • Evolution of e-Business & Distributed Computing
 - Book Roadmap



Suggested Review Questions Before Proceeding

- What are the key attributes of Next Generation Enterprises and how do they rely on 3G distributed systems?
- What are the interrelationships between evolutions of e-business and distributed computing?
- What has GE done to become a Next Generation Real-Time Enterprise? What did the company do right?

1.3 From Strategies to Working Solutions – The Book Roadmap

1.3.1 An Overall Approach

As stated previously, strategy is a game plan to win. For example, lawyers develop strategies to win cases and army commanders develop strategies to win battles. In the same vein, IS managers have to develop strategies to help their companies to win in the marketplace. The basic premise of this book is that strategies have to be translated into working solutions. A working solution is a system (business application software plus the needed IT infrastructure such as middleware services, computing platform, and network services) that satisfies the technical as well as organizational requirements and can be deployed, installed, supported, and managed.

Going from strategies to working solutions requires many activities shown in Figure 1-18. For e-business, business strategies must be cast into the e-business applications that will support the strategy. This results in a *technology independent model (TIM)* that feeds into the application architecture and integration (application engineering/re-engineering) activities. These activities translate the TIM into a *technology specific model (TSM)* through several iterations by using knowledge of the existing or future IT infrastructure.

The application engineering/re-engineering can result in engineering/re-engineering of the IT infrastructure. For example, when GUESS Jeans wanted to provide online purchasing, it had to re-engineer its network by working with Cisco. In some cases, the business strategies can directly drive the engineering/re-engineering of IT infrastructure without any new applications. For example, to promote better patient care, the Hospital for Sick Children in Toronto created an electronic Child Health Network (eCHN) linking it to three community hospitals, a homecare service, and a dozen physicians. In general, improving the network and/or middleware services can also improve customer satisfaction and customer retention without any new applications.

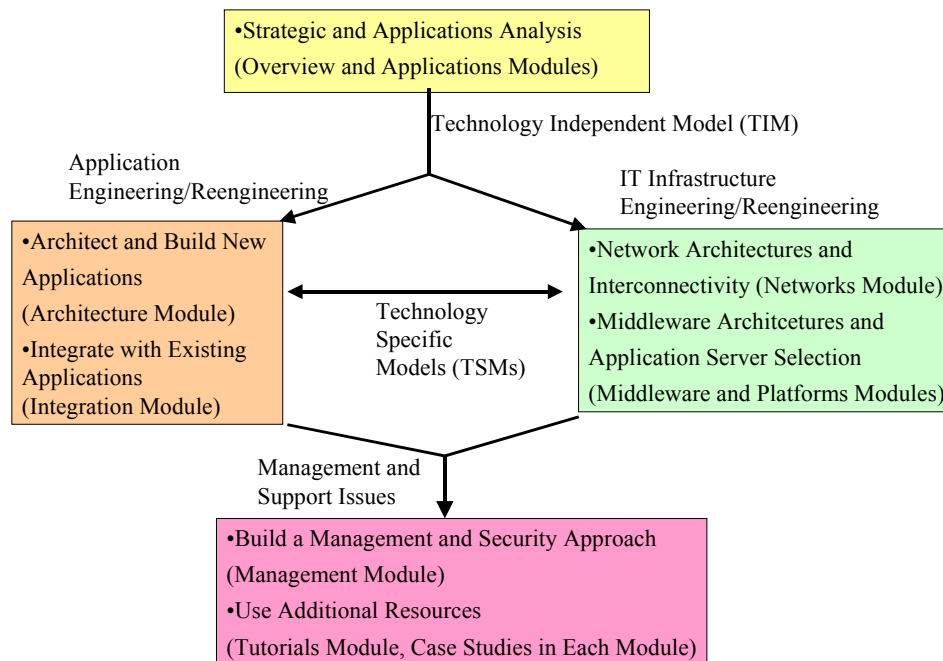


Figure 1-18: Book Modules at a Glance

Engineering of new and re-engineering of the existing IT infrastructure (especially the networks and the middleware services) is an important aspect of solutions that work. Of course, a solid management and support approach is needed to plan, organize, staff, and monitor the implementation and deployment efforts. This approach should include the important issues of security. In addition, the experience of others as reflected in case studies should be used to see what works, what does not work, and why not.

This book attempts to cover all these activities through modules that cover strategies, applications, architectures, integration, networks, middleware, platforms, and management issues (see Figure 1-18). The following discussion elaborates on this view by using a Reference Model as a roadmap.

1.3.2 A Reference Model

e-Business systems, as indicated previously, are essentially large scale, in many cases global, distributed systems that consist of several broad building blocks: applications that support the business functions and processes, the IT infrastructure that consists of networks and middleware to enable the applications, and management to facilitate and support all of the above. Figure 1-19 shows a Reference Model that establishes the interrelationships between these building blocks. This model, yet another variant of Figure 1-3, will serve as a roadmap that we will use throughout this book -- the building blocks will be covered in different modules of this book.

The highest layer of this model concentrates on the e-business applications, services, and models. We will introduce these applications and services in three modules ("Applications", "Architectures", "Integration") that describe the issues related to engineering/re-engineering of e-business applications in the modern 3G distributed systems.

A variety of IT infrastructure services are needed to support the e-business applications and services. At a conceptual level, the IT infrastructure consists of the following building blocks:

- **Networks** to provide the network transport between remote parties and are responsible for routing and flow/error control support. The networks may be the private value added networks (VANs), Public Internet, and/or Extranets that utilize the wired or wireless transmission media. We will discuss networks in Module "Networks" of this book.
- **Middleware** to interconnect remotely located, including but not restricted to, EB partners. Middleware components are business/industry unaware software modules that provide a variety of services such as Web services, directory services, Email, remote data services (e.g., bulk data transfer, browsing, and programmed access), remote application services (e.g., interactions between remote objects), distributed transaction services, and legacy system access/integration. We will discuss the general middleware in detail in Module "Middleware" and specialized (higher level) middleware services that are being packaged into "middleware platforms" in Module "Platforms".

Management and support services are needed for administering the e-business applications as well as the underlying IT infrastructure. Examples of these services include planning, fault management, performance management, and security management. We will discuss these services in Module "Management" of this book.

The sidebar "Book Outline" lists the chapter titles and provides a book roadmap. For convenience and focus, the modules are clustered into three topic areas ("tracks"): e-business applications, architectures, and integration; Enabling IT infrastructure; and Management and support.

MODULE (OVERVIEW)

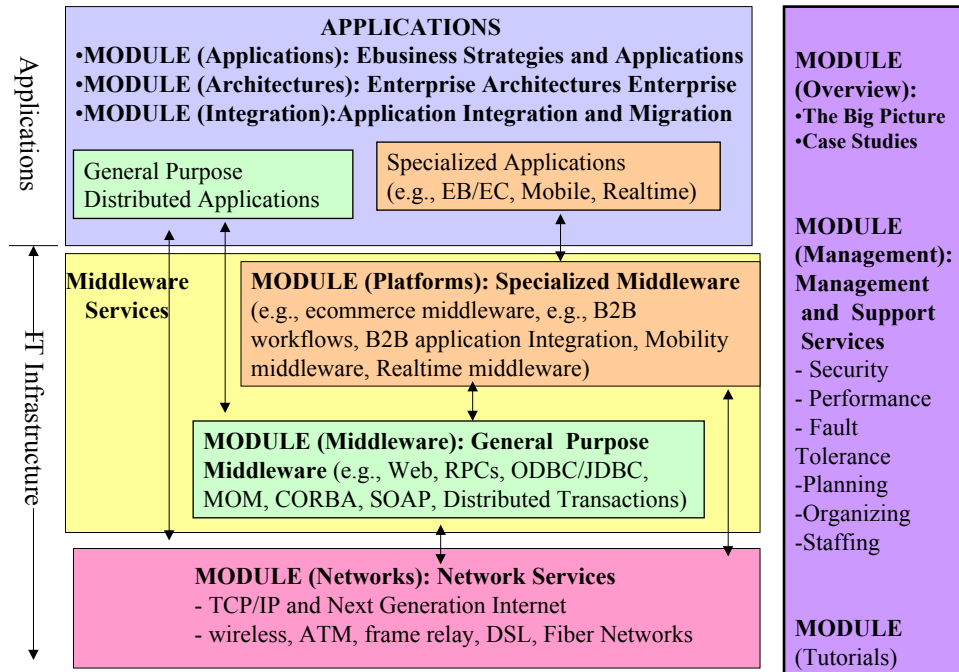


Figure 1-19: A Reference Model

BOOK OUTLINE

MODULE (OVERVIEW): The Big Picture and Case Studies

- Chapter 1: e-Business and Distributed Systems – From Strategies to Working Solutions
- Chapter 2: Case Studies and Examples

E-BUSINESS APPLICATIONS, ARCHITECTURES, AND INTEGRATION

MODULE (APPLICATIONS): e-Business Strategies and Applications

- Chapter 1: e-Business– From Strategies to Applications
- Chapter 2: e-Business Applications (CRMs, ERPs, eMarkets, SCM, ASPs, Portals)
- Chapter 3: From Strategies to Solutions – A Planning Methodology
- Chapter 4: IT Infrastructure – Overview of Enabling Technologies
- Chapter 5: Applications State of the Practice, Market, and Art

MODULE (ARCHITECTURES): Solution Architectures Through Components

- Chapter 1: Solution Architecture Overview
- Chapter 2: Enterprise Application Architectures - A Component-based Approach
- Chapter 3: Enterprise Data Architectures in Web-XML Environments
- Chapter 4: Architecture Implementation: Concepts and Examples
- Chapter 5: Architectures State of the Practice, Market, and Art

MODULE (INTEGRATION): Enterprise Application Integration and Migration

- Chapter 1: Integration with Existing (Including Legacy) Applications – An Overview
- Chapter 2: Enterprise and Inter-Enterprise Application Integration (EAI/eAI)
- Chapter 3: Data Warehouses and Data Mining for Integration
- Chapter 4: Migration Strategies and Technologies
- Chapter 5: Integration State of the Practice, Market, and Art

ENABLING IT INFRASTRUCTURE (NETWORKS AND MIDDLEWARE)

MODULE (NETWORKS): Network Services and Architectures in the Internet World

- Chapter 1: Principles of Communication Networks
- Chapter 2: Network Architectures and Interconnectivity

Chapter 3: Wireless and Broadband Networks – Next Generation Networks:
Chapter 4: IP-based Networks and the Next Generation Internet
Chapter 5: Networks State of the Practice, Market, and Art
MODULE (MIDDLEWARE) : Application Interconnectivity Through Middleware
Chapter 1: Middleware Principles and Basic Middleware Services
Chapter 2: Web, XML, Semantic Web, and Web Services
Chapter 3: Distributed Objects, CORBA, Web Services, J2EE, .NET, SOAP, and EJB
Chapter 4: Enterprise Data and Transaction Management
Chapter 5: Middleware State of the Practice, Market, and Art
MODULE (PLATFORMS): Application Servers for Mobile and EC/EB Applications
Chapter 1: Mobile Application Servers
Chapter 2: e-Commerce Platforms for C2B Trade – The Commerce Servers
Chapter 3: B2B Platforms and Standards – The B2B Servers
Chapter 4: Platforms for Multimedia and Collaboration
Chapter 5: Application Servers State of the Practice, Market, and Art
<u>MANAGEMENT AND SUPPORT</u>
MODULE (MANAGEMENT): Management and Security
Chapter 1: e-Business Management in Practice
Chapter 2: Management Platforms for Network and Systems Management
Chapter 3: Security Management– Approaches and Technologies
Chapter 4: Security Solutions – Using Technologies to Secure Systems
Chapter 5: Management State of the Practice, Market, and Art
MODULE (TUTORIALS): Tutorials and Detailed Discussions on Special Topics
Chapter 1: Network Technologies – A Tutorial
Chapter 2: Object-Orientation, Java, and UML – A Tutorial
Chapter 3: Database Technologies and SQL – A Tutorial
Chapter 4: Web Engineering and XML Processing – A Closer Look
Chapter 5: CORBA – A Closer Look

1.3.3 Overview of e-Business Applications, Architectures, and Integration

Flexible and powerful e-business applications can strategically equip modern organizations to respond quickly to market conditions, deal with intense local and global competition, and gracefully handle continued business process re-engineering. For example, a powerful online purchasing and customer relationship management system can directly impact the bottom line of a company. Three modules ("Applications", "Architectures", "Integration") highlight the strategic, architectural and integration aspects of these applications. The primary objective of these modules is to show how IS strategies can be translated to business applications and how these applications can be engineered/re-engineered by using the IT infrastructure discussed in other modules of this book.

Module (Applications) concentrates on e-business strategies and shows how these strategies can be translated to applications by using a systematic methodology discussed in the following chapters:

- Chapter 1: e-Business-- From Strategies to Applications
- Chapter 2: e-Business Applications (CRMs, ERPs, eMarkets, SCM, ASPs, Portals)
- Chapter 3: From Strategies to Solutions – A Planning Methodology
- Chapter 4: IT Infrastructure – Overview of Enabling Technologies
- Chapter 5: Applications State of the Practice, Market, and Art

These chapters discuss the strategic issues and discuss EB applications (CRMs, ERP, SCMs, eMarkets) in some detail. An overall application engineering/re-engineering methodology is presented and the enabling infrastructure is briefly reviewed. The concluding chapter (chapter 5) discusses various case studies, industrial products, and trends to illustrate state of the practice, market, and art.

Module (Architectures) shows how to architect new applications in an enterprise to cooperatively serve the e-business needs. The chapters in this module, listed below, present a business component view of enterprise application architectures, discuss how enterprise data architectures can be established in the modern Web/XML environments, and show implementation examples.

- Chapter 1: Solution Architecture Overview
- Chapter 2: Enterprise Application Architectures - A Component-based Approach
- Chapter 3: Enterprise Data Architectures in Web-XML Environments
- Chapter 4: Architecture Implementation: Concepts and Examples
- Chapter 5: Architectures State of the Practice, Market, and Art

The applications to be architected are combining three key technologies to deliver business value: Internet, object-orientation, and client/server. These applications, termed object-oriented, client/server, Internet-based (OCSI) applications, are a special class of distributed applications for the enterprises of the 21st century. In fact, most of the new applications being developed for e-business and NGEs at present and in the near future will be based on the OCSI paradigm due to the interest in Web technologies, distributed objects and widely distributed servers. Web Services, an example of OCSI, views these three powerful technologies as complementing each other and not as replacements for each other. According to this paradigm, the knowledge workers have access to Web browsers residing on desktop computers and mobile devices that are interconnected over fast digital networks. The resources (databases, programs, HTML/XML pages) dispersed among different sites around the globe appear as Web-enabled objects that can be created, viewed, invoked, modified, and deleted on an as-needed basis.

Module (Integration) addresses the crucial aspect of how new EB applications can be integrated with existing back-end (including legacy) applications. In addition, a diverse array of applications need to be integrated within an enterprise and across enterprises for B2B trade. The following chapters of this module start with integration strategies and discuss how the various options in enterprise application integration, data warehousing, and migration can be used in integration.

- Chapter 1: Integration with Existing (Including Legacy) Applications -- An Overview
- Chapter 2: Enterprise and Inter-Enterprise Application Integration (EAI/eAI)
- Chapter 3: Data Warehouses and Data Mining for Integration
- Chapter 4: Migration Strategies and Technologies
- Chapter 5: Integration State of the Practice, Market, and Art

The focus of this module is on Enterprise Application Integration (EAI) that has technical as well as business implications [Acharya 2003, Lee 2003, Severance 2002]. The module concludes with a chapter that discusses various case studies, industrial products, and trends to illustrate state of the practice, market, and art in integration.

1.3.4 Enabling IT Infrastructure Overview

In most cases, business strategies, as mentioned previously, result in architectures and integration of applications. This is where the IT infrastructure comes into the picture -- it is used to translate these application architectures and integrations into technology specific models (solutions). In some cases, the business strategies can be directly supported by the IT infrastructure without any new applications. For example, improving the network and/or middleware services can improve customer satisfaction and customer retention without any new applications. A wide range of IT infrastructure components enable the aforementioned applications. Our focus is on two: networks and middleware.

1.3.4.1 Overview of Network Services -- The Network Module

Communication networks are naturally a key player in the "networked" business environments of today. A communication network is a collection of equipment and physical media, viewed as one autonomous whole, that interconnects two or more stations. A station is an end-point (source/sink) in a communication network and can be a terminal, computer, telephone, sensor or a TV. Communication networks, also referred to as networks, provide the information exchange services in distributed computing. A network can be configured as a wide area network (WAN), which utilizes common carrier facilities for communications; a local area network (LAN), which utilizes vendor supplied cables for connecting computers within a building; a metropolitan area network (MAN) within a region, which may use the communication facilities of Cable TV, or a combination of LANs, MANs, and WANs. In addition, the communication between computing

devices on a network can use analog or digital data transmission facilities over copper, wireless or fiber optic communication media. The basic communication network concepts are introduced in Chapter 1 with a discussion of LANs, MANs and WANs.

The major growth in networking is interconnection and integration of LANs, MANs and WANs into large, high speed, and intelligent supernetworks. Network interconnections are based on network architectures that describe the physical components, the functions performed by the components and the interfaces between the components of a network. Network architecture standards are needed to interconnect different networks from different vendors with different capabilities. The Open System Interconnection (OSI) Reference Model, shown in Figure 1-20 (also see the sidebar on the OSI model) specifies standards for networks from different vendors to exchange information freely. Chapter 2 presents the OSI Model, compares different network architectures and describes network interconnectivity devices such as bridges, routers and gateways.

The advancements in network transmission technologies have resulted in high speed local and wide area transmissions, typically in the range of 100 million bits per second (Mbps) or higher (Gigabit networks). Examples of the evolving network communication technologies are Asynchronous Transfer Mode (ATM), Frame Relay, Fiber Distributed Data Interface (FDDI), and wireless networks. In general, networks are becoming faster, ubiquitous and more reliable. Another area of advancement is the integration of voice, data and video images for multimedia applications such as teleconferencing and group problem solving, among others. In particular, Next Generation Networks (NGNs) combine the voice and data networks into an integrated high speed network. Chapter 3 introduces the evolving wired and wireless networks (e.g., ATMs, frame relays, xDSL, BISDN, cellular networks, integration of voice) and discusses performance issues in networks.

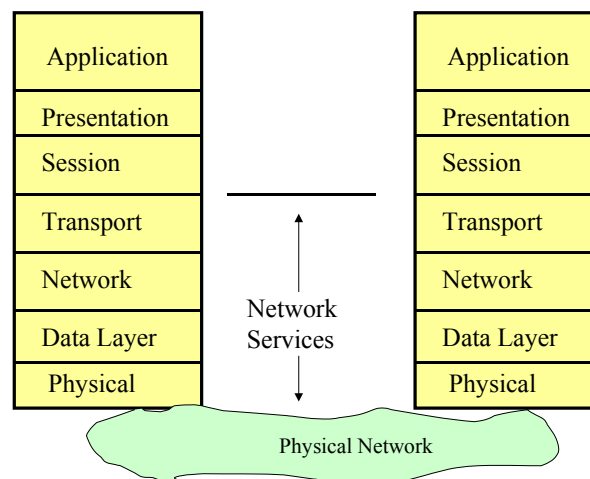


Figure 1-20: The Open System Interconnection Model

The Internet is of particular interest to e-business, since more than 80% of the e-business activities are expected to be conducted over the Internet. The origin of the Internet is the ARPANET (Advanced Research Projects Agency Network) that was initiated in 1969 to support researchers on DOD (Department of Defense) projects. For many years, Internet was used mainly by scientists and programmers to transfer files and send/receive electronic mail. Users of the Internet relied on text-based user interfaces and tedious commands to access remote computing resources. In 1989, this changed with the introduction of World Wide Web (WWW), commonly referred to as the Web. Technically speaking, Internet is a large collection of IP (Internet Protocol)-based networks that are interconnected through a wide range of interconnection devices. IP networks reside on a variety of physical network elements (e.g., ATMs, frame relays, xDSL, wireless networks) to support Web technologies. The Web has been a major contributor in turning the Internet, once an obscure tool, into a household word. The Web allows users to access, navigate and share information around the globe through GUI clients ("Web browsers") that are available on almost all

computing platforms. The Web browsers allow users to access information that is linked through hypermedia links. Thus a user transparently browses around, or "surfs" around, different pieces of information that is located on different computers in different cities and even in different countries. In addition to Web, the IP-based networks are being used for a wide range of applications such as Internet Telephony, video conferencing, and corporate computing. Chapter 4 (IP-based networks and Internet) concentrates on the technical foundations of the Internet and describes the IP-based networks in some detail.

Chapter 5 presents state of the practice (case studies), state of the market (commercial products), and state of the art (research and development trends) in networking.

1.3.4.2 Overview of Middleware – The Software Infrastructure

Middleware is basically the connectivity software that allows applications and users to interact with each other across a network. Middleware is a key enabling technology for e-business. We will use the following definition in this book:

Definition: Middleware is a set of common business-unaware services that enable applications and end users to interact with each other across a network. In essence, middleware is the software that resides above the network and below the business-aware application software.

The ISO/OSI Reference Model At A Glance

The International Standards Organization (ISO) specified the Open System Interconnection (OSI) Reference Model as a standard for networks from different vendors to exchange information freely. The OSI Model casts the functions needed to exchange information between interconnected computers in terms of seven layers. Basically, the lowest layer (i.e., the physical layer) is concerned with the electrical issue of carrying the signals across the wires. The highest layer (the application layer) handles issues of user applications (e.g., email, file transfer, database queries). What happens in between involves many activities such as translation of data formats, encryption/decryption, finding a route, sending the message over the route, and error correction (we will go through the details in Chapter 2).

According to the OSI Model, a network provides the layer 1 to layer 4 services (layers 5 to 7 belong to middleware and applications). The network provides the addressing, routing, and transport mechanisms across a network. Network services are the main goal of commonly known network software such as TCP/IP, SNA, and Novell NetWare.

According to this definition, the key ingredients of middleware are:

- It provides common business-unaware services
- It enables applications and end users to interact with each other across a network
- It resides above the network and below the business-aware application software

Middleware is business-unaware (i.e., it does not have any business logic) and is available as a common set of routines. The services provided by these routines are available to the applications through application programming interfaces (APIs) and to the human users through commands and/or graphical user interfaces (GUIs). The commonality implies that these routines are available to multiple applications and users. Ideally, middleware should be transparent to end-users but necessary -- the end-users should be unaware when it is there and aware only when it is not.

Middleware is the enabling software for applications and end users to exchange information across networks. Ideally, middleware should make the networks irrelevant to the applications and end users. In other words, the users and applications should be able to perform the same operations across a network that they can perform locally. This implies that middleware should also hide the details of computing hardware, operating systems and other software components (e.g., databases) across networks. Thus SQL middleware can allow users and applications residing on PCs under Windows to access an Oracle database residing on a Sun UNIX computer and a DB2 database on a mainframe MVS computer. We should also point out the significance of end users and applications as the users of middleware (many definitions restrict middleware usage to applications). According to our definition, middleware can support users-to-users (e.g., email) interactions, users-to-applications (e.g., Web browsers) interactions, and application-to-application (e.g., electronic fund transfer) interactions.

Middleware resides above the network and below the business-aware application software to provide the needed transparency (see Figure 1-21). It resides on both the client side and the server side. For example, if you want a customer database on a UNIX machine to be remotely accessed from 100 PCs, then one copy of middleware will need to be purchased/installed for the UNIX machine (e.g., SQL database server) and a copy of the client side middleware will need to be purchased/installed on each one of the 100 PCs. In general, middleware can be decomposed into client middleware that resides on every client machine and server middleware that resides on the server machines. There are cost as well as management issues associated with middleware.

Module "Middleware" of this book discusses middleware as the key software infrastructure needed to enable e-business and other applications. It builds on top of the network services discussed in the Network Module and exposes the reader to the various aspects of modern middleware in five chapters. Chapter 1 (Middleware Principles and Basic C-S Middleware) of this module defines middleware, gives numerous examples of middleware stack and discusses basic C/S protocols such as RPCs, MOM, publish/subscribe and remote SQL. Chapter 2 (Web, XML, Web Services) discusses the principles and evolution of Web technologies such as HTTP, XML, Web browsers, Web servers, Semantic Web, and Web Services. Chapter 3 (Distributed Object Technologies) covers advancements in distributed objects with special attention to CORBA, SOAP, and J2EE/Dot Net. The issues of enterprise data and transaction processing and object transaction services are discussed in Chapter 4 of this module. Chapter 5 presents state of the practice (case studies), state of the market (commercial products), and state of the art (research and development trends) in middleware services.

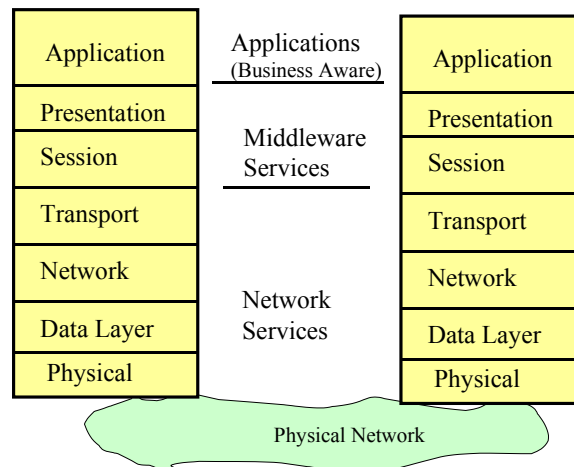


Figure 1-21: Middleware

Module "Platforms" concentrates on the special purpose middleware services that are specifically needed for e-commerce/e-business. In many cases, these middleware services are being packaged with general

purpose middleware services and being delivered as "*Application Servers*", also known as "*Middleware Platforms*". Chapter 1 of this module discusses how mobile computing and wireless middleware such as WAP (Wireless Application Protocols), I-Mode, and Wireless Java can be used to build mobile applications. Chapter 2 explains e-commerce servers that package middleware such as electronic catalog systems, payment systems, and digital cash into a single platform. Chapter 3 concentrates on B2B servers that combine middleware services and standards such as XML, ebXML, Rosettanet, and extended workflows into a single platform. Emerging middleware services in real-time computing and distributed operating systems are discussed in Chapter 4 of this module. Chapter 5 presents state of the practice (case studies), state of the market (commercial products), and state of the art (research and development trends) in application servers..

1.3.5 Overview of Management and Security

It is important for upper management to provide a vision for the administrative aspects of e-business. The well known management cycle of planning, organizing/staffing, development/deployment, and monitoring/control can be used as a basis for discussion. The objective of information system planning is to exploit the role of technology to shape a company's future. Given a business architecture of an enterprise, planning produces a technology architecture by taking into account the business growth and strategic business trends plus the technology trends. The organizational problems are concerned with establishing the organizational structure to meet the strategic objectives of an organization. The training and staffing issues are concerned with the policies, procedures, and preparedness of existing personnel. The support of distributed systems involves a wide range of issues in management and support of networks and distributed applications. The main management challenge is to understand the tradeoffs between various options and select the most effective courses of action.

It is also crucial to properly manage and support the IT infrastructure (i.e., networks, middleware), and the applications in e-business. Basically, any solution must be operable (i.e., must not introduce significant costs, delays, choke points and security leaks when operated) and easily manageable (i.e., authorized administrators must be able to monitor and control its activities if needed). Numerous "management platforms" have appeared in the marketplace to address different aspects of operability and management. In theory, these platforms are intended to address the five factors known as FCAPS (Fault management, Capacity management, Accounting management, Performance management, Security management). In particular, management platforms for networks are quite mature due to a growth in the size, complexity, diversity and organizational reliance on networks. Examples of these platforms are IBM's NetView and HP's OpenView. In addition to networks, management platforms for applications (e.g., Tivoli) are also available.

Naturally, security is a major concern because increased reliance of enterprises on applications and the IT infrastructure (networks, computing platforms, middleware services) is creating new security and intrusion threats. Comprehensive security architectures are needed that protect the corporate IT and physical assets by employing the latest security technologies to respond to external factors and organizational requirements. Instead of detailed discussion of cryptography and individual security technologies, it is important to develop an architectural view that shows how the various corporate assets can be protected by using a combination of technical and organizational approaches. Building a security solution for a modern enterprise is somewhat similar to securing a ship for survival before it sails off. You have to know what the holes and vulnerabilities are, architect a solution approach that addresses the vulnerabilities and also works well with other parts of the ship, and then implement the solution approach. A good security solution approach for IS must follow a similar approach - it must include various security threats and vulnerabilities at different levels and devise a solution approach based on an overall architecture.

Module "Management" of this book concentrates on the management and security aspects of e-business and addresses the platform as well as the administrative issues. Chapter 1 of this module gives an overview of management and support issues such as planning, organizing, and staffing. Chapter 2 reviews network and systems management standards and platforms that have emerged to support management of distributed

systems. The next two chapters of this module concentrate on the all important issues of security. Chapter 3 concentrates on the management approach, the requirements, and the enabling technologies (i.e. cryptographic techniques) aspects of security. Chapter 4 shows how to build solutions that can protect the enterprise IT systems by using the available technologies. This chapter concentrates on building security solutions that involves use of the cryptographic and other techniques to build solutions at different layers (networks, middleware, applications) and then put the pieces together. Chapter 5 concludes this module by reviewing state of the practice (case studies), state of the market (commercial products), and state of the art (research and development trends) in management and security.

The book is very case-studies oriented. A single case study, based on a real life company, is developed throughout the book to illustrate the wide range of topics discussed. In addition, a chapter "Case_Studies" is included in the Overview Module to describe short as well as long case studies and examples. Moreover, each module has several pertinent case studies. In particular, each module concludes with a chapter that discusses numerous case studies to illustrate state of the practice in the subject area.

The Tutorials Module includes tutorials on basic technologies so that the book can be of value to novices as well as experienced practitioners. The chapters of the Tutorials Module contain technical discussions about Network Technologies, Object-Oriented Technologies and Java, Database Technologies and SQL, Web and XML, and CORBA.

1.4 A Case Study: Introducing XYZCorp

We will use the following case study to illustrate the concepts introduced in this book. This case study is based on a realistic company.

XYZCorp was formed in 1985 by a small group of engineers in Chicago to build, repair, and sell electronic devices. The initial business of the company was televisions, radios and calculators. With time, the company included VCRs and PCs into its product lines. In the 1990s, the company entered into business partnerships with numerous suppliers around the globe and acquired a startup company that builds desktops, laptops, "network computers", and personal digital assistants. XYZCorp also formed partnerships with numerous other computer hardware/software vendors and acquired several retail electronic stores that sell and service computers, televisions, VCRs, radios and calculators. These stores also sell, market and service the XYZCorp products. In the 2000s, the company has started thinking about providing technology solutions, consulting, and training services to a diverse array of industries. The company management believes in controlled growth, i.e., systematically explore new markets and diversify by using new products and services after careful strategic analysis and evaluation of core competencies.

The company headquarters are in Chicago with branch offices in the US, Europe and Asia. The company has currently about 3000 employees with a great deal of growth expected in the next 5 years. The company operates many regional offices: Southern (HQ: Atlanta), Western (HQ: San Francisco), Eastern (HQ: New York), Midwestern (HQ: Detroit), North Western (HQ: Seattle), European (HQ: Paris), and Asian (HQ: Tokyo). Each region supports between 5 to 10 local offices (some of these offices are stores, the others are marketing, training, consulting and support centers), with an average of 200 staff members per region.

To stay competitive and adapt to new products and services, the company has gone through several re-organizations and its IT infrastructure has changed several times. Most of the operations in the 1980s were manual -- a DEC computer in Chicago was enough to maintain the inventory, handle orders, and process accounts payables and receivables. In the early 1990s, an IBM mainframe with MVS operating system was installed and an IBM SNA (System Network Architecture) network was used to connect the various workers in the corporate office. The manufacturing plant adopted a Unix Sun platform. In the late 1990s, the company started using Web technologies and did some downsizing, but admittedly to stay fashionable (everyone around us is doing it, so we must too). In addition, thanks to the acquisitions and mergers, the

company has accumulated layers of technologies and applications of different vintages that run on different computing platforms. Examples of some of the systems are:

- IBM MVS-IMS-based administrative systems (payroll, accounts receivable, accounts payable)
- IBM MVS-DB2-relational databased financial system
- An old Unix-indexed file system for customer support
- Many Unix-Oracle based regional systems
- Internet-based Human resource system at PC LANs
- Unix-based manufacturing and engineering systems
- Corporate network that consists of an Intranet that is connected to an SNA network and a public Internet

Most of these systems do not work well together and this is a major deterrent to growth. Introduction of new systems to support new products takes months and responding to simple customer requests takes several weeks. The internal systems need to be overhauled and aligned to the corporate strategy but nobody knows what the corporate strategy is .

XYZCorp has hired a new CEO -- the good Ms Jones (BSCS, MBA). Ms Jones has promised to establish a clear business strategy that will position the company for success in e-business. In particular, Ms Jones has promised that an e-business strategy will be established that will be implementable (i.e., it will be realistic enough so that it can actually work in the current business and technical environment). After a great deal of thinking, looking outside her window (jumping has been a possibility), making numerous phone calls ("Honey, I am going to be late again tonight"), and looking into literature (Want ads), she has decided to live up to her promise (a dangerous move!). She wants to explore the Next Generation Enterprise model with increased reliance on Web advertising, Web purchasing, virtual shops, customer relationship management, mobility and electronic intermediaries for success (she does not know what she is getting into!). But seriously, she did form an enterprise-wide planning team. The team has identified the main tasks that translate business strategies to working solutions. These tasks, shown in Figure 1-22, are discussed as case studies in the modules of the book.

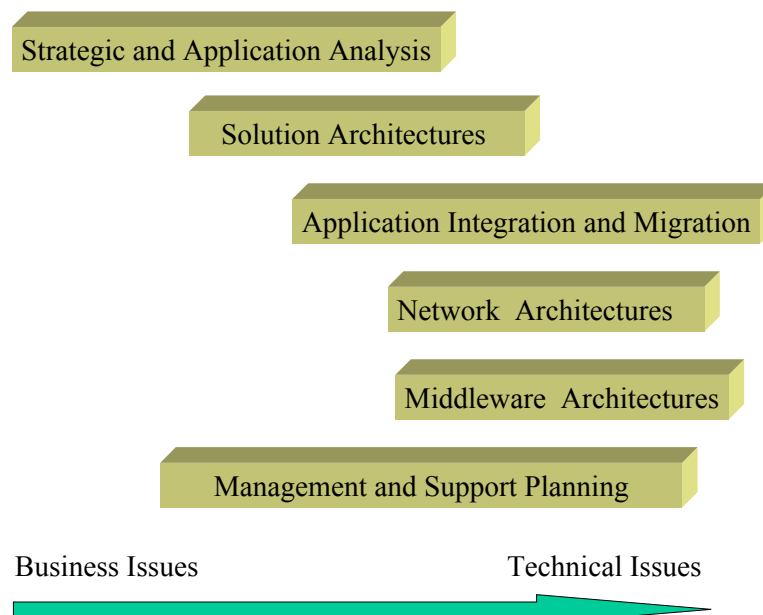


Figure 1-22: XYZCorp Planning Tasks

- **Strategic and Application Analysis.** The purpose of this task is to establish a strategy and then produce a list of applications that will support the business strategies. For XYZCorp, the applications should enable business processes (payroll, accounts receivable/accounts payable, order processing,

marketing information systems, and computerized checkout system), engineering processes (CAD, CAE, computer-aided process planning) and manufacturing processes (material requirement planning, production scheduling and flexible manufacturing systems). In addition, outsourcing decisions need to be made. This task will be discussed through the case studies in the "Applications" Module.

- **Solution Architecture** which shows how the manufacturing, engineering and business applications will be interconnected and deployed. This task will mainly concentrate on new applications needed for e-business and establish an overall architecture that includes application and data architectures at enterprise level and review some of the architecture implementation issues. We will accomplish this in the "Architectures" Module through a few case study projects.
- **Application Integration and Migration.** A major problem facing XYZCorp and many other corporations is how to integrate new applications with existing, including legacy, applications. XYZCorp needs to develop a plan to integrate its business, engineering and manufacturing applications and needs to evaluate whether these applications should be integrated "as-is" or restructured and migrated. We will accomplish this in the "Integration" Module through a few case study projects.
- **Network Architecture.** A network layout is needed which shows how the application architectures will be supported in XYZCorp. In particular, this architecture will show how the users, applications, databases, and computing devices at various sites will be physically interconnected through a network. We will make this decision as a series of case study projects in the "Networks" Module which will involve WAN design, LAN selection and design, wireless networks, Internet protocols, and network interconnectivity device selection.
- **Middleware Architectures.** Evaluation of middleware services will be needed for applications at different sites to interact with each other. The decisions of middleware selection include evaluation of Web technologies, distributed object technologies and platforms to support mobility and B2B as well as C2B trade. It is important that these services work with each other across the XYZCorp network ("middleware architecture"). These decisions will be made in the "Middleware" and "Platform" modules of this book through a series of case study projects.
- **Management and Support Planning.** The issue of managing and supporting the XYZCorp applications and IT infrastructure must also be addressed. In particular, an enterprise-wide security approach is needed and procedures for supporting the IT assets must be established. This task will concentrate on developing security approaches and choosing management platforms and administrative strategies for XYZCorp. We will make these decisions in the "Management" Module.

As we will see, each task will be further broken down into short projects in each module. This case study will help us to apply the techniques which we will learn in this book to a realistic enterprise.

1.5 Concluding Comments

This chapter has presented e-business as a special case of 3G distributed systems. We have suggested e-business and distributed systems definitions and outlined frameworks to establish the interrelationships between e-business applications, networks, middleware, and management/support issues. We have also introduced the notion of Next Generation Enterprises (NGEs) that utilize the innovative new business models by fully exploiting and integrating the next generation technologies to conduct business. e-Business is an active area of academic and industrial progress that spans strategies, applications, architectures, integration, networks, and middleware. Different modules of this book introduce the reader to these aspects of this field.

1.6 Review Questions and Exercises

1. List five different definitions of e-business and e-commerce from the existing literature.
2. Give five examples of e-business systems.

3. Give a few examples of distributed computing that do not appear to be part of e-business.
4. Describe an e-business example that you consider to be a Next Generation Enterprise (NGE). Describe the business model, application services, middleware, and network of this example.
5. How does the availability of software infrastructure help in the development of e-business applications? Explain through an example.
6. Produce a checklist of issues to consider if your company wants to be an e-business service provider (the services may be at network, middleware, or application levels).
7. Suppose that you are an information systems manager of a company that is migrating to an advanced e-business strategy (say an NGE). Use the following table to show who will need to be trained on what aspects of e-business:

Personnel	Training Needed (list topics)
. Database designers	
. Application developers	
. Systems programmers	
. Database administrators	
. Technical support	
. Systems analysts	
. Network designers	

1.7 Additional Information

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