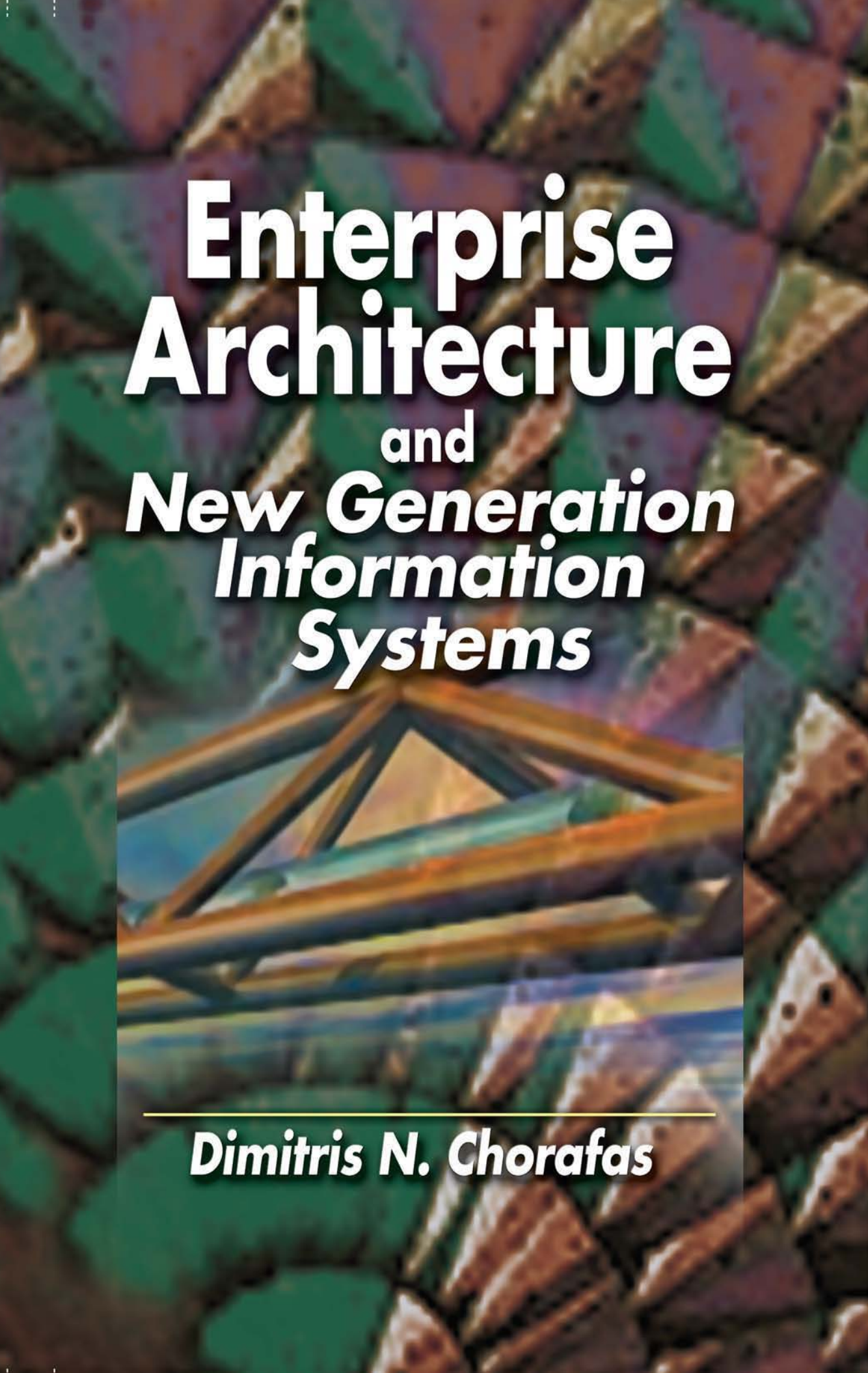
Enterprise Architecture
and
New Generation Information Systems
Dimitris N. Chorafas

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PREFACE

Written for trained professionals in business, industry, government, and education, as well as for graduate students and researchers, this book approaches the subject of *enterprise architecture* and the best applications of current technology from many viewpoints. Producers, consumers, designers, and end users are considered, as is practical everyday implementation of advanced technology from both entrepreneurial and academic perspectives.

Designing the proper network and using it to integrate the computers and communications resources of our enterprise is a demanding task. It means, first and foremost, having an architectural concept. It also calls for becoming familiar with hundreds of suppliers of hardware and software, including network switching, transmission, management, and maintenance gear, as well as of methods and techniques for system integration.

The primary role of an *enterprise architecture* is to tie together all components into one aggregate; define the functions to be supported, including their tolerances, their resource requirements and their timing; answer enduser needs with precision, but also in the most cost effective manner. The enterprise architecture incorporates the protocols under which the different components must operate, as well as the interfaces — including user interfaces. On the whole, this must follow open architectural principles, providing compatibility between systems and devices procured from different vendors but working together seamlessly.

This text helps to understand the issues and interpret the significance of changes underway so that interpretation can become a liaison agent. Both policy and technical issues are considered. The 16 chapters present what needs to be known about effective use of technological resources currently at our disposal or available in the next couple of years.

A practical, hands-on approach has been chosen because, as leaders of industry know, the market is always forcing us to look at the best way

to stay close to state of the art, if not somewhat ahead of it. This permits us to serve our customers and respond to their needs in the best possible way. We should also appreciate, however, that to provide the best products and services at competitive prices, we have to organize our company in a way that is customer-oriented rather than simply product-based.

Customer-oriented developments must be technologically supported through open standards and must be architectured. This is the message of Section I, which concentrates on "next generation" information systems technology. Years ago, when systems architectures were designed, they were made to serve hierarchical computer networks supported by a vendor's own software. This is a concept which now belongs to the Paleolithic age. A modern enterprise architecture is primarily designed by the user organization to serve its particular environment cost-effectively.

Chapters 1 to 6 present new developments in enterprise architecture. They outline the methodology, systems, and materials that will dominate the future. They also make the point that technology helps the company to reposition and reinvent itself in the market, but only when it is properly used. Therefore, the enterprise architecture we design should have the broad perspective of our business operations. It should cover the needs of senior managers and professionals; it should not be limited to transactions, as many current projects tend to be.

The theme of Section II is that of future breakthroughs, which start their systems impact today. Chapters 7 to 11 review some of the most promising projects, the methods and tools which they use, and their projected deliverables. Also, what can be achieved through new systems designs and an improved methodology, such as intelligent location-independent computing and concurrent engineering, are addressed.

There are reasons why Section III asks, "Is the Internet the 21st century's answer to an enterprise architecture?" In recent years, the need to follow a customer-based strategy has been amplified by the Internet economy and its rapid growth. What this means to the user, plus the need for security, is the message conveyed by Chapters 12 to 16.

The World Wide Web entered the business-to-consumer (B2C) relationship in 1993, and became the most diffused any-to-any network in history. Five years down the line, a study by the University of Texas found that, in 1998, the Internet economy in the U.S. generated over $300 billion in revenue and was responsible for more than 1.2 million jobs. Since then there has been another major leap forward. In less than a decade, the Internet economy already rivals the size of century-old sectors such as autos, energy, and communications. Milestones that took ages to achieve in the aftermath of the Industrial Revolution are now reached at a staggering pace, which most companies find difficult to follow.

One of the peculiarities of the Internet is that it emphasizes the need for cooperation while working in a business-to-business (B2B) environment even between companies that compete with each other. No company really knows the virtual market space deeply and inclusively enough; therefore, synergy is necessary to set the new economy's perspectives. This has dire consequences in engineering, manufacturing, merchandising, and finance.

A premise of the new economy is that we have not yet seen the biggest changes at all. On this basis, Chapter 1 presents benefits and challenges expected from a modern enterprise architecture. It explains why the market rewards companies that have a cogent enterprise strategy, reviews developing business opportunities, explains why rapid innovation requires frequent reviews of strategic decisions, and suggests that, while technology costs are dropping, technology risks are increasing.

The mission of Chapter 2 is to define the right enterprise architecture and to assure that its technical features answer the company's business needs. It also makes a case for open architectural standards. Chapter 3 offers reasons why technology repositions the organization in a competitive market. It does so at three levels of reference: policy formation, command and control, and infrastructural base.

What should the information technology strategy of the organization be? Chapter 4 answers this query by examining information technology (IT) policies which have paid dividends. It also provides a case study on how a company can reinvent itself through innovative solutions. Chapter 5 follows up on this by suggesting ways and means for revamping the technological infrastructure of a modern industrial enterprise. It also explains why this is necessary and how to go about such a demanding mission.

Chapter 6 completes Section I by discussing some of the leading-edge projects in IT; for instance, the drive for better client focus, the not-yet-successful effort to cut down the paper jungle misjudgments about third-generation mobile telephony licenses (to the tune of more than a quarter of a trillion dollars), and research on nanoscale engineering which might take more than a decade to be realized. Whether they succeed or fail, all these projects have an impact on enterprise architecture.

Chapter 7 presents MIT's Intelligent Environment Project (Project Oxygen). This example includes the tools and the background needed to promote imaginative new departures in man–machine communication. Even the most advanced solutions, however, must fit within a business architecture permitting integration of new technology with existing applications, and making it possible to get the most out of competitive and legacy software. To this subject, Chapter 8 adds the flavor of practical

implementation by addressing applications using an intelligent environment advantageously.

Issues relating to the use of knowledge artifacts within the realm of nomadic computing, filtering, and patterning are addressed by Chapter 9, which also explains the need for using agents to support Internet commerce. This chapter also includes a methodology for observing time-critical constraints through knowledge engineering tools, as well as making a case for fuzzy engineering.

As a practical example on enterprise data storage, Chapter 10 treats the twin subjects of rapidly growing storage requirements for information systems and state-of-the-art solutions addressing a corporate memory facility. Imaginative approaches go beyond traditional datamining and into patterning, as shown by case studies.

Another prerequisite for growth and survival is flexible organization and structure as shown in Chapter 11 through examples from engineering and manufacturing. This discussion broadens the implementation horizon of technology through the contributions of modeling and experimentation, practical cases in concurrent engineering, and possible benefits from fast time-to-market.

The last five chapters of this book underline the need for getting ready to face shifts in market power. These go well beyond the more classical supply–chain relationships because they involve agency costs and call for integrated solutions. The broader perspective is given by Chapter 12, which focuses on the information economy at large and, more specifically, the role played by the Internet as merchandising agent.

Another contribution to this subject is made by Chapter 13, which explains the notion of Internet time and its impact on our daily business. This chapter deals with the extended policies required by Internet time for effective implementation, the necessary cultural change, and the requirements of personal accountability which go beyond what is seen as a "must" so far.

Because innovative applications and the new culture correlate, the theme of Chapter 14 is on working end-to-end with the Internet. The text addresses the motivations of companies, the ways and means they are using, issues associated to open networks, and wing-to-wing coverage as defined by General Electric. Chapter 15 extends this discussion to intranets and extranets, explaining why they are more efficient solutions than the expensive private networks designed and implemented in the early- to mid-1990s.

On-line solutions can be instrumental in restructuring the supply chain, but they will fail if we do not pay a great amount of attention to security. Chapter 16 presents the reasons why this is true, by emphasizing my personal experience in security assurance, as well as absence of appropriate

security measures. It also shows how some companies capitalize on new technology such as biometrics to improve security. These new applications horizons, however, are not free from challenges and pitfalls, as this text will demonstrate.

The text generally takes practical examples from pacesetting entities of today, although tomorrow they could either become part of mainstream business or disappear from the market. The survival of companies using advanced technology is by no means assured; new challengers will show up to take the place of current leaders. What is more or less sure is that failure to capitalize on an advanced enterprise architecture can be lethal.

Experts envision the 21st century as empowering people through imaginative solutions — any time, at any place, for any product. New technology is a means permitting knowledge and information to flow seamlessly through businesses, offices, and homes. But are we taking advantage of it? The means are available to implement flawless Internet-commerce operations for a wide range of products and services; however, only the best managed organizations capitalize on what is currently available.

I am indebted to a long list of knowledgeable people and organizations for their contributions to the research which made this book feasible. I am also grateful to several senior executives and experts for constructive criticism during the preparation of the manuscript, particularly Dr. Heinrich Steinmann and Dr. Derek Duerden. The complete list of the 136 senior executives and 78 organizations who participated in this research is shown in the Acknowledgements.

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Dr. Chorafas is the author of 120 books, some of which have been translated into 16 languages. His seminars in the U.S., England, Germany, other European countries, Asia, and Latin America have been attended by more than 6000 banking, industrial, and government executives.

CONTENTS

I

NEXT GENERATION INFORMATION SYSTEMS TECHNOLOGY

1

BENEFITS AND CHALLENGES EXPECTED FROM AN ENTERPRISE ARCHITECTURE

INTRODUCTION

A successful company identifies needed technologies, introduces them quickly, and then commercializes them. The company that cannot do so will be absorbed by a competitor who is ahead of the curve, or simply slide downhill to oblivion. Thus, senior management demands that its technologists develop and implement a first class enterprise architecture to give the firm an upper hand over its competitors.

One of the principal roles of an enterprise architecture is to align the implementation of technology to the company's business strategy. This can be effectively done when technology investments target state-of-the-art solutions. Another key objective is to make technology serve innovation economics. Astute architectural approaches and dynamic planning help to transform the enterprise. Companies with experience suggest this means two things: 1. ability to define and keep on redefining the enterprise architecture in a business environment in full evolution, while 2. providing life cycle management of technology and all other investments which target the ability to stay competitive.

The implementation of an enterprise architecture is usually done at one of two levels. The more common but less exciting is that of a tactical instrument able to handle transactions. This addresses the lower half of the information environment shown in Figure 1.1. Its objective is to operate within a structured information environment, as well as assist middle-to-lower management and other personnel in improving their productivity.

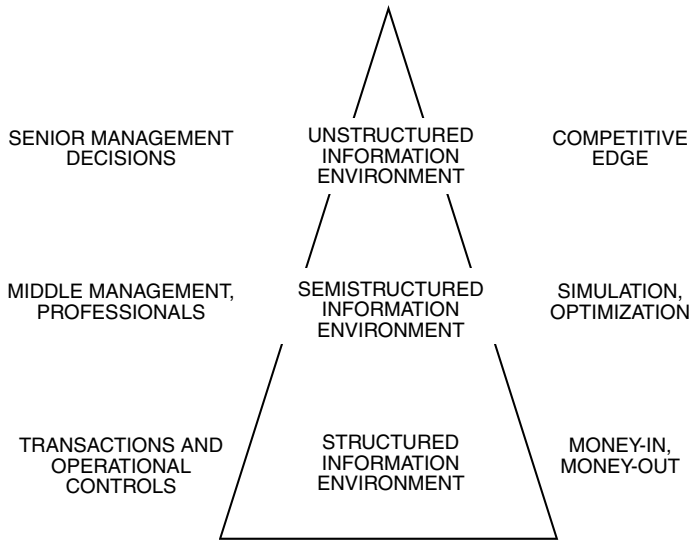

Figure 1.1 A core function of the enterprise architecture is to assure a competitive edge.

The reason for this limited view is largely historical. Years ago when systems architectures were developed, the focal point was transactions. Even at this lower level of complexity, however, the study, implementation, and maintenance of an enterprise architecture requires clearly stating the company's current and projected business objectives:

- Is the company a product manufacturer or on the sales front?
- What is the company's value-added advantage?
- How does the company bring its products to the market?
- How does the company personalize its products for its customers?

These are core issues to design of the enterprise architecture, even if it addresses only the structured part of the information pyramid in Figure 1.1. The technological side of answers to these queries will be derived from a factual and documented response to where the company is in the value chain. Is it at the front-end of rapid innovation? Is its strength special products? If the answers are yes, then its interests lie in more complex architectural requirements.

This value chain is shown in the diagram in Figure 1.2. Front end needs are highly market sensitive. Therefore they belong to a fairly unstructured context. Alternatively, the company may be at the backend of the supply chain, where products are sold out of stock. Here the architectural requirements are simpler; however, huge issues of scalability and reliability exist.

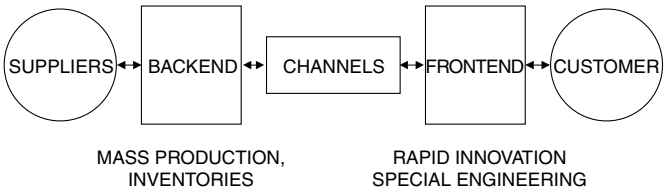

Figure 1.2 To properly project an enterprise architecture, it is important to first define location in the value chain.

Reliability, scalability, and dependability are issues present with every enterprise architecture; their importance increases with a solution which addresses the information environment depicted in the top half of Figure 1.1. Because business prerequisites dominate, some companies call such structures business architectures (see Chapter 2), though a more appropriate label would be *strategic information technology* (IT).

No two companies have exactly the same strategic IT solution, but these solutions share certain general characteristics. Real-time information is a common example because it is critical in obtaining synergy from the different channels supported and promoted by the company. Another critical factor often found in strategic level architectures is seamless integration of channels. Also, adopted solutions must be customer-oriented because customers today have more clout than ever before.

THE MARKET REWARDS COMPANIES THAT HAVE A COGENT ENTERPRISE STRATEGY

Nobody in any business should believe that, in a global business environment, the road ahead is hazard-free. The principle of uncertainty in corporate policies and business transactions evidently applies all the way from client to supplier partnerships. Some companies think supply chain management, coupled with world-class engineering and the latest production technology, can make anything possible. This still remains to be proven but, as an aim, it requires a first class enterprise architecture. Otherwise, it will not be realized.

The services provided by the architectural choices to be made must resolve several contradictions prevailing in today's environment, for instance, getting a meaningful sense of direction out of the plethora of easily available information. Data, figures, opinions, and projections are presented without sufficient time to absorb them, unless a system is in place for organizing and distilling information.

The type of company that an organization is presents advantages and challenges. For instance, pure Internet companies do not seem to have

the ability to fulfill their goals efficiently, while traditional brick-and-mortar companies lack flexibility and have difficulty defining the services an enterprise architecture should provide or in using the Internet to become a *brick-and-click* company.

The stock market crash of "pure" Internet companies in 2000 showed that there are advantages in merging the means used by traditional and virtual enterprises because, ultimately, a company's fulfillment capability is the critical element in how well its strategy will work. One of the least discussed characteristics of the enterprise architecture is that the services which it provides must go well beyond better communications to the technical aspects of an architectural solution. These are usually seen as irreducible core characteristics including not only technology, but also bulletproof security (see Chapter 16), cost, and pricing of services. In this domain lie some of the key decisions a company must make; therefore, the search to find the best technology provider is critical. This domain, however, is subservient to that of strategic choices.

Because organizations consist of people, and their structure is usually layered (see Figure 1.3), the enterprise architecture can be viewed as consisting of at least two major layers. One is concerned with management decisions, the other with technical choices regarding its design, implementation, maintenance, and future development. The lower layer addresses technology choices and their details and the upper layer, or metalayer, outlines the prerequisites posed by the business environment.

These prerequisites define the services the company requires to support its product and market efforts. Neither layer offers freedom to make all of the choices; today's decisions must be frequently reviewed and reevaluated because both technology and the business environment change. One of the choices regarding the technical layer, for example, may be that of open standards (see also Chapter 2). But which open standards?

In the late 1960s, in the manufacturing industry, the standard was the manufacturing automation protocol (MAP) by General Motors (GM).

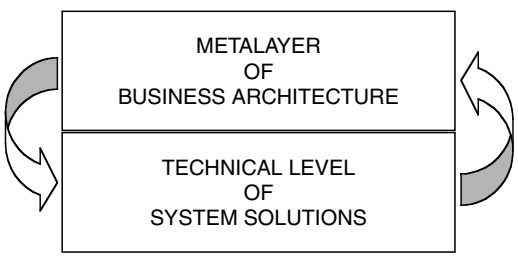

Figure 1.3 An enterprise architecture involves decisions at two levels of reference.

Eventually it faded. In 1978 the open system interconnection (OSI) by the International Standards Organizations (ISO) was considered to be *the* open standard, but its life cycle did not reach two decades. The open standard version of electronic document interchange (EDI), developed by the United Nations, has not been successful. Today some minor miracles are expected from extended hypertext markup language (XML) as the lower level protocol of end-to-end interconnection. XML is a modernized version of the Web's original protocol and its adoption sounds reasonable. It remains to be seen how successful this may be.

Important design issues such as technical standards, technical criteria, and the choice of "bread and butter" components correlate. Technical standards depend to a significant extent on business choices; and some of them have far reaching effects. For instance, to decide whether the company's basic infrastructure should be wired or wireless, it is necessary to determine which option would allow local independence in the most cost-effective and secure way.

Choices are not necessarily clear-cut. A great deal depends on the specific industry and its requirements. In banking, for example, the general notion is of permanent connection; because steady handholding with the clients is very important. No major player in the finance industry can afford not to be accessible to its business partners at any time, wherever the institution operates.

Neither can solutions concerning security be taken for granted. More confidential information and real-time execution of transactions have increased the security threshold even for unsophisticated types of business. Because higher security cannot be taken for granted and, if available, costs more money, a properly studied enterprise architecture should provide the option of security level on demand.

This brings this discussion to return on investment (ROI), which should characterize the study of any technological solution. ROI is a prerequisite to the authorization of spending money. Everything must be priced out and every benefit proven. Expected returns from successful implementation should be quantified and a price should be put on delays, design changes downstream, and outright failure.

An enterprise architecture should also be examined from a competitive perspective. What would happen if a competitor had a first class architectural solution linking on-line its business clients and suppliers and one could not compete in terms of cost-effectiveness? This question brings back the issue of strategic IT. Board members and senior executives should be aware — and indeed they are becoming increasingly convinced — that their decisions about technology have much to do with opportunities, challenges, and pitfalls encountered along the company's way.

THE INTRODUCTION OF OPPORTUNITY COSTS CHANGES THE RULES OF THE GAME

A cogent enterprise architecture requires that guidelines be established and choices made at top management levels which means that decision-making about technical issues, particularly the more pace-setting, has moved from IT shops to executive committees and people in charge of lines of business. Such decisions become more pragmatic and bring with them the notion of opportunity costs, thus changing the rules of the game.

The criteria used by senior management in strategic IT decisions tend to enlarge their horizon. They introduce issues which, in all likelihood, would have been left in the background or at least disconnected from the operational viewpoint. Even if modern technology both impacts and is affected by deregulation, globalization, and innovation, some people fail to see that these issues are interrelated with the company's product evolution line and daily business activities.

As Figure 1.4 suggests, at the intersection of four major forces affecting the modern enterprise can be found better business opportunities and a greater amount of risk. Therefore, senior management needs a governance model provided by the enterprise architecture, and also must continuously evaluate whether present solutions respond effectively to anticipated requirements. Factors determining a company's present and future clout are:

- A continuing ability to innovate
- Content and design features that appeal to clients
- Fast timetables for deliverables
- Lean production and distribution capabilities
- High quality compared to that of competitors

When the nuclear scientists of the Manhattan Project presented General George Marshall with some statistics on the destructive power of the weapon in the making, the U.S. Chief of Staff asked them how many atomic bombs per month the $2 billion project would deliver. The scientists had not thought of their project in these terms. The power of the military rests in its continuing ability to deliver, Marshall advised them. Quite similarly, the power of the modern corporation rests in its continuing ability to innovate.

Business success is also dependent on the company's capability to compress time and cost. Observing strict timetables for deliverables is a relatively new concept, particularly in IT. The enterprise architecture to be designed and implemented must act as a facilitator in keeping to strict timetables. It must also contribute to high quality and lean production —

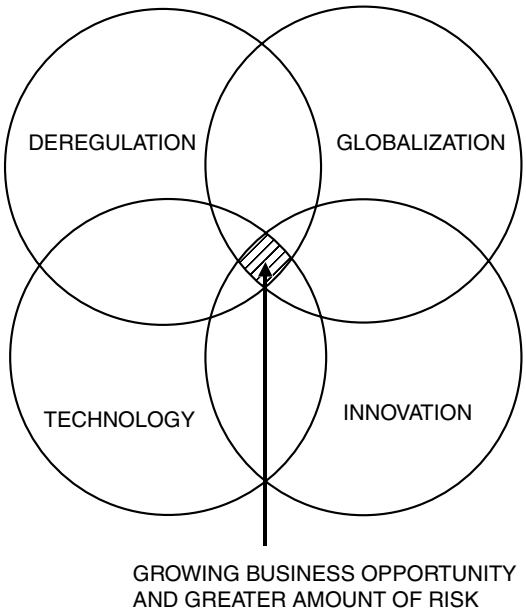

Figure 1.4 The main forces propelling rapid growth of business opportunity in the financial and other industrial sectors.

two issues that correlate with and assist one another. That is why technology audits must be steady and performed by qualified, independent auditors.

Technology audits are a relatively new concept in IT and nowhere are they more explicitly needed than in connection to enterprise architecture and the services it supports. They should serve as the means of assessing the nature and level of sophistication of technology used to run the business, the costs involved, and the returns obtained. Technology audits consist of:

- Evaluating the cost-effectiveness of current solutions
- Looking into deliverables and their timetables
- Assuring software and hardware are ahead of the curve
- Controlling the quality of technology personnel
- Proposing intensive training and other remedies

Technology audits require a supporting methodology like General Electric's Six Sigma (see Chapter 5). Their execution should be shielded from the political pressures that invariably exist in every organization. They should take place within a basic notion of modern business: that of

creating value. No innovation, technology, new product or new market is worthwhile if it does not create value. Critical concerns are:

- How to develop new technology in a way that creates value for customers
- How to link technology to markets and business partners
- How to use technology to keep people working for the organization up-to-date and productive

One way of looking at an enterprise architecture is as a fundamental framework for portraying and supporting the phases of entrepreneurial activity, and for help in locating the *next* technology. Most interesting are the results of a recent study by the Geneva Association, the insurance industry's think tank, which drew upon the current experience of insurance intermediaries worldwide. This study confirmed that knowledge and advice, more than the ability to effect a transaction, are key to the changing role of the intermediary within the insurance business or, for that matter, in any business. Insurance practitioners' responses took account of the fact that the Internet in all its emerging forms of communication, including digital wireless technology, is transforming the way a wide range of services are produced, intermediated, and consumed.

Some of the participants in the study suggested knowledge-based services as the critical concept of the 21st century,* emphasizing that the production and consumption of many services increasingly requires an advanced base of knowledge, skills, and on-line access to business partners. Real-time access is a vital part of the theme of intermediation, including the associated process of disintermediation, in which new intermediaries are spawned by new technology.

An enterprise architecture can be the pivotal point in reintermediation. On-line services over the Internet, particularly for business-to-business applications (see Chapters 12 and 13), are restructuring industries from within as well as breaking down long-standing boundaries between industrial sectors. Companies are reinventing themselves internally, taking advantage of intelligent network architectures and software for advanced business applications.

Banks must go through similar chores to those of insurance companies because of emerging financial intermediaries and developing forms of money. Service industries are not the only ones profiting from this major transition. In the mechanical and electrical industries, too, the old manufacturing and services dichotomy has broken down and traditional

* See also the discussion on agents in Chapters 7 and 9, and on mobile agents in Chapter 14.

manufacturers, from GM to IBM, are reinventing themselves as service companies.

How is managing in the new economy different from managing in the old economy? Globalization, innovation, and technology aside, management in the new and old economies has many of the same characteristics: financial discipline, the bottomline, handholding with customers, answering market needs, and building a first class management team. Also, it is necessary to be ready to exploit business opportunities as they develop and even to create them using a first class enterprise architecture.

REENGINEERING MEANS BEING READY TO EXPLOIT BUSINESS OPPORTUNITIES

Alfred P. Sloan gives an excellent example of the need to be ready and react quickly when he describes how GM avoided the aftermath of the Great Depression suffered by other companies: "No more than anyone else did we see the depression coming… We had simply learned how to react quickly. This was perhaps the greatest payoff of our system of financial and operating controls."[2] (See other references to Sloan's business viewpoints in Chapter 12.)

Sloan's dictum on quick response is an excellent example of the mission the enterprise architecture should accomplish at the metalevel (outlined in Figure 1.3). Senior management decisions are never made in the abstract; they are based on financial and marketing information and their execution is controlled through internal feedback. This, too, must be properly supported by the architectural solution chosen by the company, whose functional alignment at three different management levels is shown in Figure 1.5.

At the senior management level the goal of IT support is factual decisions and competitive edge (as shown in Figure 1.1). Remember that this is an unstructured information environment to be covered by the enterprise architecture in the most flexible manner, supported through sophisticated software, and designed in a way always open to innovation. Senior management's responsibility is to provide future vision, which should be adequately supported through IT. To do so, one must organize the firm for coming market challenges, which means that data flows and models must be in place not only for projecting the market's evolution but also for positioning the company against the forces of the future — a top management job.

At the middle management level, including the professional level, simulation, experimentation, and optimization are the common ground of design objectives. Experimental approaches came into industrial practice in the 1950s with operations research,[3] in the 1960s with simulation

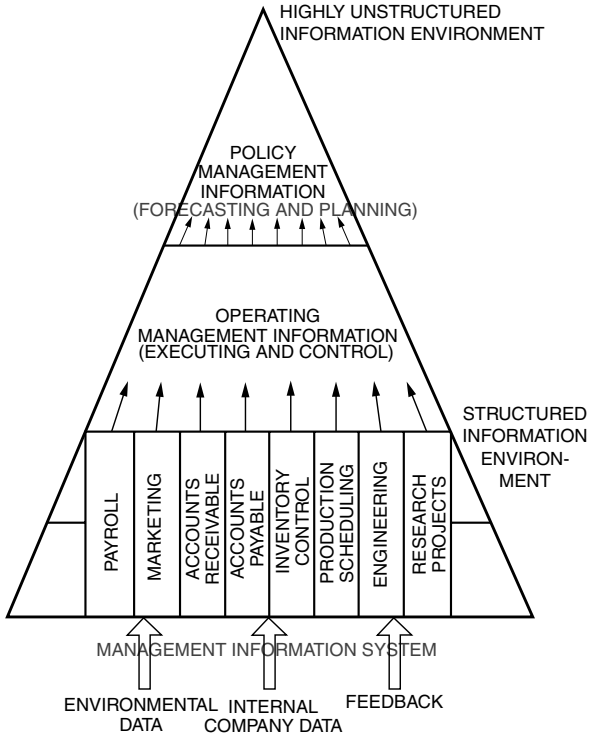

Figure 1.5 An information environment ranges from unstructured to structured, depending on functions performed.

studies,[4] in the 1970s with decision support systems (DSSs) and management information systems (MISs), in the 1980s with expert systems,[5] and in the 1990s with agents.[6] During the past five years, the two most productive tools for middle management and professionals have been enterprise resource planning (ERP) and customer relationship management (CRM). Support along this line of reference, too, is a domain which should be covered by the enterprise architecture.

At the lowest layer (Figure 1.5) are transactions and operating controls and the structured environment. These are the most common areas to which an enterprise architecture addresses itself. Although necessary, this is not enough. Technology's architectural information environment should be extended toward the upper two layers.

Because it takes an integrative view of the three layers, the functional graph in Figure 1.5 offers a global perspective to modern enterprise. Not long ago, business processes in the marketing area were viewed as a natural extension of those on the factory floor. Optimizing for worker

efficiency created an industrial paradigm of sales work based on task specialization and repetition in which workers were often viewed as interchangeable parts. But in the 1990s, the introduction of enterprise networking and concurrent engineering software (see Chapter 11) obliged the command-and-control hierarchy to change prevailing industrial organization structures. Business process reengineering is the challenge of readiness. It calls upon boards and chief executives to view their business processes as strategic assets and renovate outmoded practices. It also brings senior management attention to the critical importance of processes involving collaborative teams, where productivity cannot be measured solely in piecework terms.

It is this cultural change which makes an enterprise architecture mandatory at the senior management level. Unlike factory floor operational processes, typically seen as costs to be reduced, senior management decisions involve complex and changing collaborative processes that are largely market-oriented. They are also closely connected to revenue growth and so their relative importance increases.

Through the advantage of an enterprise architecture, these changes can assist the company in formulating its business policy and technological strategy. Only top-tier organizations appreciate that business and technology are intimately connected . Implementation of this strategy has enabled the leaders of industry and finance to break ranks with the majority of their competitors and put themselves in the forefront of new developments.

Exceptional individuals move fast and see their policies through. After salvaging Turkey from disintegration, Mustafa Kemal Atatürk favored replacing Arabic with Latin script. He applied steady pressure at all levels of society, visiting towns and villages and talking to the common man. Once engaged, reform was carried through within 6 months.[7]

This, however, is not the way the average executive operates. Organizations are made up of people and people are often slow in making decisions — even more so in putting them into effect. Therefore, the metalayer of an enterprise architecture should act as a catalyst for rapid motion, providing management with the ability to spot opportunities instantly, but always keeping in mind that business opportunities are often a by-product of mismatched, short-lived conditions.

The company must have a fast reaction time because mismatched conditions, which create opportunities, tend to reach equilibrium quickly and then disappear. The enterprise architecture must enable testing new products on a trial basis, modifying them as the market requires, and readiness to transform them into a volume operation to keep up with expanding demand when they succeed.

At the same time, as Sloan aptly suggested, accurate and timely financial information should be available. This is vital because the company must

always be prepared to withdraw if its product does not meet with market acceptance, or risk and return are not as projected. The company must also be able to cope with a multiplicity of financial risks. The market's rapid pace and global nature require constant attention to position risks, credit risks, and liquidity risks.

Figure 1.6 is a chart for interactive reporting of exposure based on a real-life implementation with a major financial institution.[8] A thoroughly studied and well implemented enterprise architecture is very important because the construction of a technological environment which multiplies the effectiveness of the company's resources cannot be achieved using past traditional data processing approaches. The beaten path in IT usually involves large development teams, which can lead to inertia and bureaucracy; long development times, which can result in slow reaction and response; and large up-front investments, which can affect profit figures without providing corresponding benefits.

Though each well-managed company will follow its own architectural design characteristics, in general terms, the goal of an enterprise architecture should be to help develop an environment which makes product creation and delivery possible in accordance with the market's pace and requirements. Examples of objectives by tier-1 companies are: new products on demand implemented quickly and economically, direct business partner access anywhere in the world, for any product, at any time, and

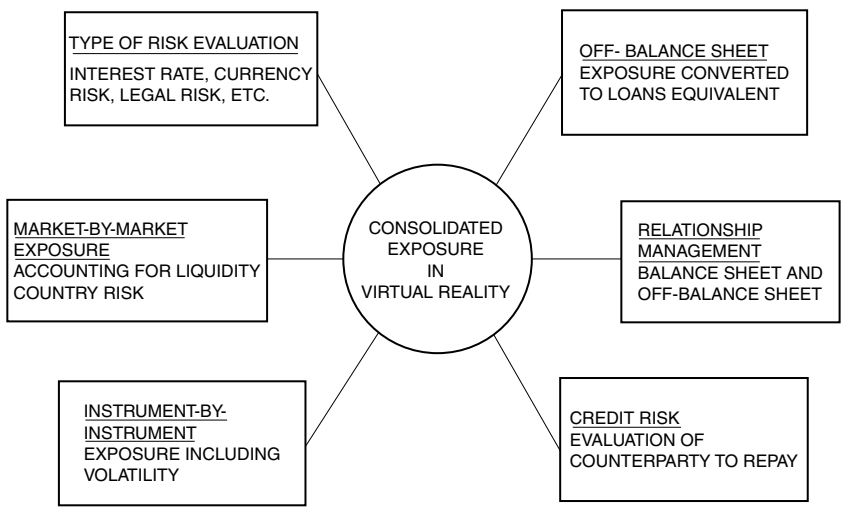

Figure 1.6 Component parts of a risk management structure designed for off-balance-sheet operations.

global reach because customers can be anywhere in a market more competitive than ever.

AN ENTERPRISE ARCHITECTURE MUST CARE PARTICULARLY FOR THE CUSTOMER

Alert businessmen appreciate that market pressures come not only from competitors but also from customers, whether companies or individuals. This sort of market pressure worries many enterprises because deregulation, globalization, and technology have made it possible for diverse businesses to take a share of their turf, as well as lowering the barriers to customer exit. The old concept of customer loyalty exists no more.

Companies must act fast to safeguard their customer bases, and technology serves in implementing a sound market-oriented policy. This is not possible when the technology that the company uses is wanting. Particularly hard hit is the notion that signing up a client means a long-standing deal, and all that is needed is be nice, answer the phone, and bring up the new contract for signature. Industry does not work this way anymore. To keep up our market leadership, it is necessary to continue being competitive, keep on innovating, and drive down costs on a steady basis — not just once every five years.

Another "must" in the 21st century is to keep up the speed of everything happening, as the previous section suggested. Speed of deliverables is necessary in order to face customer requests and confront current competitors, and to position the firm against challenges posed by new entrants. This presents a number of problems to be overcome. Banks, for example, have to continue promoting on-line delivery of financial products, even if Internet banking has not been successful so far.

Concomitant to the requirements of higher speed and lower cost is the adoption of new standards as they evolve, as well as the use of Web software for all functions for which it is available (see Chapter 15). The Web's potential for low-cost replacement of current, proprietary information technology solutions has not reached its limits and will not do so in the foreseeable future, even if technology's "earthquake" in late 2000 and early 2001 makes future prospects for Internet companies look rather bleak.

It seems likely that the market will rebound as soon as some of the excesses of the 1990s are out of the way. Growth in information technology spending slowed to 9% in 2001, down from 12% in 2000, but competition has increased. The $750 million corporate portal market already has over 50 competitors. Established portal companies, like Yahoo, must somehow extend their consumer brand in a way that inspires big businesses to fork over payments for Web software and services.

Today more and more competition is extending its influence in all industry sectors. The greater the competition, the better is the choice and the lower are the prices.

Another requirement for any company faced with transition to an enterprise architecture, is cultural change, which is important not only on the organization's side, but also on the client and supplier side. Much of this challenge is not a technological debate, even if technology acts as both catalyst and accelerator. Cultural change is primarily a management issue whose importance is magnified by market forces, competitive drive, and the aftermath of technology.

The notion of what is good and bad in a cultural and organizational sense changes with time. In the 1950s, 1960s, and part of the 1970s, mainframes saw to it that the aftermath of information technology was a centripetal force. In the legacy model, information was pushed from the periphery to the center, from the small to the large, from a personal preoccupation to the prerogative of the centralized "ivory tower" of IT.

In the 1980s and, most particularly, the 1990s, these ideas have changed. The influence of new technology, deregulation, and globalization during the tail-end of the 20th century has resulted in business systems driven by a centrifugal force, pushing power out from the center to the edge: the customer's end of the deal. The bottom line is the concept of market forces.

Historians will one day write that the switch in technology, though not yet in systems architecture, started with the development of the personal computer at the end of the 1970s. The client-server style of computing in the late 1980s put networked processing power on people's desks and did away with the ivory tower of IT.[9] Involving end users freed them from the centralized straightjacket and allowed them to use their own initiative.

The dispersal of control to customers of IT resources — the end users who reside on the network's edge — cut out whole layers of middle managers who had shuffled questions and answers between bosses and staff. This is the single most important factor leading to the productivity boom that America enjoyed in the 1990s, placing the customer at the center of the product development cycle.

Using technology in the best manner they could, companies struggled to please the customer. Toyota offered to produce and deliver a car made to customer specifications in $3^1/_2$ days. Other companies went into a soul-searching process of reinventing themselves, this time putting market wishes and customer demands at the center of their value systems. This had an important impact on the enterprise architectures these companies had developed and used.

The telephone industry is a good example of this. One of the most visible centrifugal forces at work today is that of remaking the telephone system in the image of the Internet. Nothing compares with the complexity of the telephone system's vast, centrally controlled, multitier hierarchy of switching centers still dominated by 19th century technology. But forces are at work to change that through wireless communications and voice-over Internet protocols.

Out of necessity, telephone carriers are adopting the packet-switching techniques that made the Internet user-friendly and innovative. The individual intelligent phone, which helps to propel this revolution, takes control for setting up the phone services that a customer may need. It moves the line of authority out of the hands of the central office and places it firmly in those of the end user.

Some industry specialists see this as a bigger technological innovation, with associated disruption of past practices, than all previous breakthroughs in technology. It is also, most likely, a greater market opportunity than the emergence of the personal computer. Because of technology made available at an acceptable price, the customer is in command of a process which has been centralized for more than a century.

It surely is a challenging time that carries with it some major risks, of which one is product liability. It is as well a time in which companies can end up owing vast sums of money. At the dawn of the 21st century, the bifurcation based on product liability will be, in all likelihood, the single most common pitfall created by lawsuits concerning antitrust, intelligent property, employee conduct, contractual failure, shareholder actions, and antitrust violations.

In 2000, Sotheby's, an international auction house, and UST, a chewing-tobacco firm, saw their credit downgraded because of publicized antitrust violations. Beverly Enterprises was hit for violating America's complex Medicare billing practices; American Home Products was downgraded following a $12.3 billion settlement stemming from its production of a diet drug that cleared federal safety hurdles but was later found to be dangerous.[10] A better known product liability case is that of asbestos. These are examples of operational risks.[11]

In conclusion, as the centrifugal force accelerates, companies may find themselves at the litigation end of events not quite of their own doing. Some industries will be more severely affected than others, but all need a first class customer-oriented enterprise architecture able to bring good and bad news in real-time to senior management, so that corrective action can be taken and damage control can be exercised in a timely manner.

REVAMPING BUSINESS STRATEGY AFTER 10 YEARS OF TECHNOLOGICAL INNOVATION

The old computer age, often referred to as electronic data processing (EDP), was linear. By contrast, the modern information technology age is about exponential innovation in man-made devices and systems, derivative financial instruments, analytical approaches, and increasing-return economics. Companies that do not take seriously the need to steadily adapt to the ongoing business evolution and reinvent themselves do not survive. Although this has always been true, it has become particularly pronounced since the last decade because of the accelerated pace of development.

There is nothing new about the mortality of industrial enterprises. Like people, products, and factories, companies fail. Look at the roster of the 100 largest U.S. firms at the beginning of the 1990s. Only 16 are still worth talking about. To a degree, the wave of change started in the 1950s, but in the mid 20th century change was gradual; it has accelerated in the last decade. Consider *Fortune* magazine's first list of America's 500 biggest companies, published in 1956. Only 29 of its top 100 firms could still be found in the top 100 by 1992 because of mergers, acquisitions, and business failures.

One might wonder how it is possible that so many supposedly wealthy, well-managed, successful firms fail. Evidently something happened to make them unfit for their business environment. At the risk of repetition, note again that globalization, deregulation, innovation, and technology changed the rules (though not everything is due to these factors). Quite potent negative factors to the individual company have included:

- Slow-moving management
- Falling behind the state of the art, therefore making the force of technology disruptive
- Misusing of technology, making it difficult to reinvent the firm and/or capitalize on changes in the market

A financial analysis by Merrill Lynch reveals what the capable use of technology can provide: "One of the real luxuries at GE is the wealth of management and systems which they can apply to a problem."[12] The analyst who wrote this document then considers General Electric's acquisition of Honeywell, and how deeply GE is examining and preparing to fix Honeywell. Corrective action includes improvements in management, focused cost controls, visibility of earnings, facilities rationalization, better utilization of shared services, optimization of sales and distribution assets, and revamping to get more cash earnings.

Another financial analysis by the same investment house indicates that an enterprise architecture and financial innovation correlate. It highlights

financial innovation within Cisco, taking as one of the better examples the virtual close and saying that the company is using its advanced enterprise systems to drive financial performance.[13] For example, Cisco management has the ability to track revenue, discounts, and product margins on an hourly basis. Other variables such as expenses, head count, and market share are tracked on a weekly, monthly, or quarterly basis. The financial analyst at Merrill Lynch underlines also that, of these metrics, revenue growth appears to be the most important to Cisco's top management, at this point.

A good question linking this discussion to the central theme of this book is: what kind of enterprise network does the leader of network gear envision? According to Merrill Lynch, Cisco believes the future is in an integrated optical network and Internet protocol (IP), with each used for its strengths. Optical will be employed to rapidly expand the bandwidth for a low cost per bit; IP will be helpful in managing, expanding, and linking the network in an integrative way.

An enterprise architecture with the optical core vision will be able to rapidly move multimedia information between points of presence (POP). From POP to the desktop, mobile device, home, etc., fiber will work alongside other electronic media, for instance, cable, direct subscriber line (DSL), Ethernet, dial up, and third generation (3G) wireless services (see Chapter 6).

At current state of the art, key industry factors such as quality of service (QoS) are worked in all-optical networks. Another design parameter is that approximately 80% of traffic should be between the user and a cached POP, with IP playing a key role in managing this traffic. For this reason top-tier vendors are continuously seeking to expand the reach of IP. Cisco believes that the wireless IP market is clearly at an inflection point, soon to show tornado-like growth. Therefore, the company is participating in 13 out of 15 IP-based wireless networks built in Europe.

According to Merrill Lynch, part of Cisco's wireless IP strategy has been based on building relationships with the leading radio and wireless device manufacturers. This looks quite normal for a high tech vendor. Less evident, but just as normal, is the fact that it should also be the policy of user organizations that are eager to:

- Link technology and business strategy so that they effectively support one another
- Capture the value of technological innovation to enhance their market presence
- Optimize product and process development time, in order to be ahead of their competitors

- Assure synergy between their technical capabilities and market needs, for more cost-effective response

Consider investment banking as an example. Some of the key terms heard in the investment banking business are *placement power* and *distribution network*. If one is in the business of originating loans, underwriting or placing securities, and performing other investment banking activities, one must have a distribution network capable of turning over assets at a competitive pace by selling them to investors wherever they might be located. This distribution network must be characterized by certain key attributes embedded into the enterprise architecture:

- Accounts for fluidity and shifting patterns of worldwide political and economic situations
- Reaches every corner of operations, and every potential investor, to deliver the desired financial service
- Addresses the risk of major losses if reaction time is too slow

The preceding three points are valid in revamping business strategy, and also in managing the professional work force in day-to-day activities as well as in large, complex, global projects. This last reference suggests the wisdom of customizing the enterprise architecture because business processes evolve over time, as do their automation requirements. Whether in manufacturing or in banking, real-world processes span a continuum of conceptual and structural elements including an amalgamation of activities whose natures change as one adapts to the market's evolution.

TECHNOLOGY COSTS ARE DROPPING, BUT TECHNOLOGY RISKS ARE INCREASING

The costs of communications and computing are falling rapidly (see Chapter 3 on Moore's law and the law of the photon). This has been technology's contribution to innovation and globalization, resulting in the fall of the natural barriers of time and space that, over centuries, separated national markets. For example, the cost of a 3-minute telephone call between New York and London has fallen from $300 (in current dollars) in 1930, to $1 today (see the trend curve in Chapter 6).

Although cost-cutting in classical channels has slowed down, the sharp drop in prices is expected to resume with increased use of optical fibers and satellite communications. Over the past couple of decades, the cost of computer power shrank by an average of 30% a year in real terms, as Moore's law predicted.