How Information Gives You Competitive Advantage

by Michael E. Porter and Victor E. Millar

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The information revolution is sweeping through our economy. No company can escape its effects. Dramatic reductions in the cost of obtaining, processing, and transmitting information are changing the way we do business.

Most general managers know that the revolution is under way, and few dispute its importance. As more and more of their time and investment capital is absorbed in information technology and its effects, executives have a growing awareness that the technology can no longer be the exclusive territory of EDP or IS departments. As they see their rivals use information for competitive advantage, these executives recognize the need to become directly involved in the management of the new technology. In the face of rapid change, however, they don't know how.

This article aims to help general managers respond to the challenges of the information revolution. How will advances in information technology affect competition and the sources of competitive advantage? What strategies should a company pursue to exploit the technology? What are the implications of actions that competitors may already have taken? Of the many opportunities for investment in information technology, which are the most urgent?

To answer these questions, managers must first understand that information technology is more than just computers. Today, information technology must be conceived of broadly to encompass the information that businesses create and use as well as a wide spectrum of increasingly convergent and linked technologies that process the information. In addition to computers, then, data recognition equipment, communications technologies, factory automation, and other hardware and services are involved.

The information revolution is affecting competition in three vital ways:

It changes industry structure and, in so doing, alters the rules of competition.

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Editor's note: All references appear at the end of the article.

It creates competitive advantage by giving companies new ways to outperform their rivals.

It spawns whole new businesses, often from within a company's existing operations.

We discuss the reasons why information technology has acquired strategic significance and how it is affecting all businesses. We then describe how the new technology changes the nature of competition and how astute companies have exploited this. Finally, we outline a procedure managers can use to assess the role of information technology in their business and to help define investment priorities to turn the technology to their competitive advantage.

STRATEGIC SIGNIFICANCE

Information technology is changing the way companies operate. It is affecting the entire process by which companies create their products. Furthermore, it is reshaping the product itself: the entire package of physical goods, services, and information companies provide to create value for their buyers.

An important concept that highlights the role of information technology in competition is the "value chain."[1] This concept divides a company's activities into the technologically and economically distinct activities it performs to do business. We call these "value activities." The value a company creates is measured by the amount that buyers are willing to pay for a product or service. A business is profitable if the value it creates exceeds the cost of performing the value activities. To gain competitive advantage over its rivals, a company must either perform these activities at a lower cost or perform them in a way that leads to differentiation and a premium price (more value).[2]

A company's value activities fall into nine generic categories (see *Exhibit I*). Primary activities are those involved in the physical creation of the product, its marketing and delivery to buyers, and its support and servicing after sale. Support activities provide the inputs and infrastructure that allow the primary activities to take place. Every activity employs purchased inputs, human resources, and a combination of technologies. Firm infrastructure, including such functions as general management, legal work, and accounting, supports the entire chain. Within each of these generic categories, a company will perform a number of discrete activities, depending on the particular business. Service, for example, frequently includes activities such as installation, repair, adjustment, upgrading, and parts inventory management.

A company's value chain is a system of interdependent activities, which are connected by linkages. Linkages exist when the way in which one activity is performed affects the cost or effectiveness of other activities. Linkages often create trade-offs in performing different activities that should be optimized. This optimization may require trade-offs. For example, a more costly product design and more expensive raw materials can reduce after-sale service costs. A company must resolve such trade-offs, in accordance with its strategy, to achieve competitive advantage.

Linkages also require activities to be coordinated. On-time delivery requires that operations, outbound logistics, and service activities (installation, for example) should function smoothly together. Good coordination allows on-time delivery without the need for costly inventory. Careful management of linkages is often a powerful source of competitive advantage because of the difficulty rivals have in perceiving them and in resolving trade-offs across organizational lines.

The value chain for a company in a particular industry is embedded in a larger stream of activities that we term the "value system" (see *Exhibit II*). The value system includes the value chains of suppliers, who provide inputs (such as raw materials, components, and purchased services) to the company's value chain. The company's product often passes through its channels' value chains on its way to the ultimate buyer. Finally, the product becomes a purchased input to the value chains of its buyers, who use it to perform one or more buyer activities.

Linkages not only connect value activities inside a company but also create interdependencies between its value chain and those of its suppliers and channels. A company can create competitive advantage by optimizing or coordinating these links to the outside. For example, a candy manufacturer may save processing steps by persuading its suppliers to deliver chocolate in liquid form rather than in molded bars. Just-in-time deliveries by the supplier may have the same effect. But the opportunities for savings through coordinating with suppliers and channels go far beyond logistics and order processing. The company, suppliers, and channels can all benefit through better recognition and exploitation of such linkages.

Competitive advantage in either cost or differentiation is a function of a company's value chain. A company's cost position reflects the collective cost of performing all its value activities relative to rivals. Each value activity has cost drivers that determine the potential sources of a cost advantage. Similarly, a company's ability to differentiate itself reflects the contribution of each value activity toward fulfillment of buyer needs. Many of a company's activities—not just its physical product or service—contribute to differentiation. Buyer needs, in turn, depend not only on the impact of the company's product on the buyer but also

EXHIBIT I
The value chain

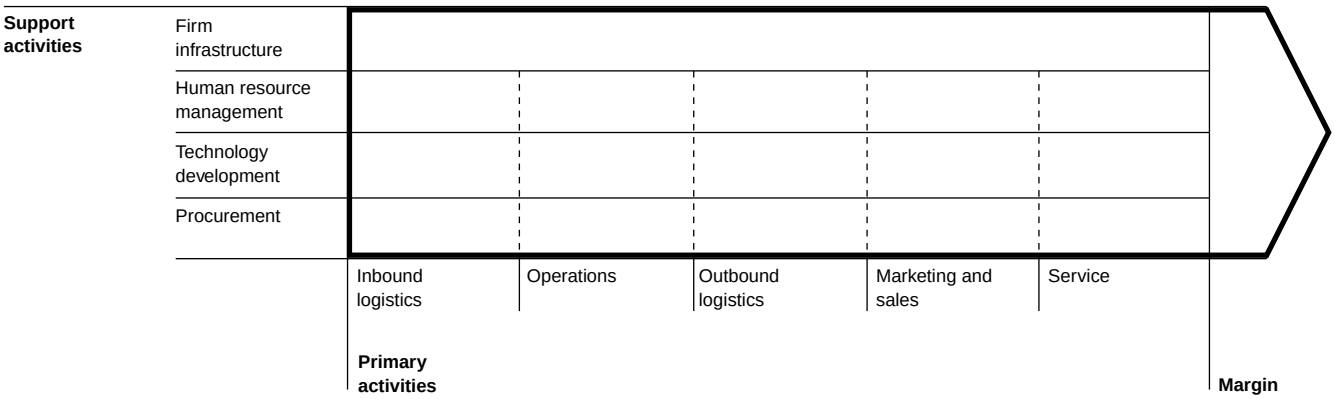
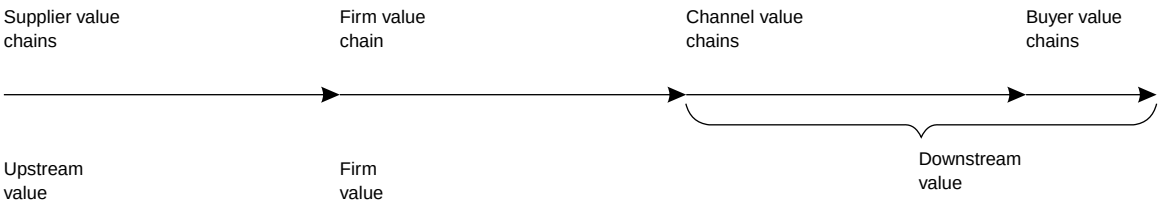


EXHIBIT II
The value system



on the company's other activities (for example, logistics or after-sale services).

In the search for competitive advantage, companies often differ in competitive scope—or the breadth of their activities. Competitive scope has four key dimensions: segment scope, vertical scope (degree of vertical integration), geographic scope, and industry scope (or the range of related industries in which the company competes).

Competitive scope is a powerful tool for creating competitive advantage. Broad scope can allow the company to exploit interrelationships between the value chains serving different industry segments, geographic areas, or related industries. For example, two business units may share one sales force to sell their products, or the units may coordinate the procurement of common components. Competing nationally or globally with a coordinated strategy can yield a competitive advantage over local or domestic rivals. By employing a broad vertical scope, a company can exploit the potential benefits of performing more activities internally rather than use outside suppliers.

By selecting a narrow scope, on the other hand, a company may be able to tailor the value chain to a particular target segment to achieve lower cost or differentiation. The competitive advantage of a narrow scope comes from customizing the value chain to best serve particular product varieties, buyers, or geographic regions. If the target segment has unusual needs, broad-scope competitors will not serve it well.

Transforming the value chain

Information technology is permeating the value chain at every point, transforming the way value activities are performed and the nature of the linkages among them. It also is affecting competitive scope and reshaping the way products meet buyer needs. These basic effects explain why information technology has acquired strategic significance and is different from the many other technologies businesses use.

Every value activity has both a physical and an information-processing component. The physical component includes all the physical tasks required to perform the activity. The information-processing component encompasses the steps required to capture, manipulate, and channel the data necessary to perform the activity.

Every value activity creates and uses information of some kind. A logistics activity, for example, uses information like scheduling promises, transportation rates, and production plans to ensure timely and cost-effective delivery. A service activity uses information about service requests to schedule calls and order parts, and generates information on product failures that a company can use to revise product designs and manufacturing methods.

An activity's physical and information-processing components may be simple or quite complex. Different activities require a different mix of the two components. For instance, metal stamping uses more physical processing than information processing; processing of insurance claims requires just the opposite balance.

For most of industrial history, technological progress principally affected the physical component of what businesses do. During the Industrial Revolution, companies achieved competitive advantage by substituting machines for human labor. Information processing at that time was mostly the result of human effort.

Now the pace of technological change is reversed. Information technology is advancing faster than technologies for physical processing. The costs of information storage, manipulation, and transmittal are falling rapidly and the boundaries of what is feasible in information processing are at the same time expanding. During the Industrial Revolution, the railroad cut the travel time from Boston, Massachusetts, to Concord, New Hampshire, from five days to four hours, a factor of 30.[3] But the advances in information technology are even greater. The cost of computer power relative to the cost of manual information processing is at least 8,000 times less expensive than the cost 30 years ago. Between 1958 and 1980 the time for one electronic operation fell by a factor of 80 million. Department of Defense studies show that the error rate in recording data through bar coding is 1 in 3,000,000, compared to 1 error in 300 manual data entries.[4]

This technological transformation is expanding the limits of what companies can do faster than managers can explore the opportunities. The information revolution affects all nine categories of value activity, from allowing computer-aided design in technology development to incorporating automation in warehouses (see *Exhibit III*). The new technology substitutes machines for human effort in information processing. Paper ledgers and rules of thumb have given way to computers.

Initially, companies used information technology mainly for accounting and record-keeping functions. In these applications, the computers automated repetitive clerical functions such as order processing. Today information technology is spreading throughout the value chain and is performing optimization and control functions as well as more judgmental executive functions. General Electric, for instance, uses a data base that includes the accumulated experience and (often intuitive) knowledge of its appliance service engineers to provide support to customers by phone.

Information technology is generating more data as a company performs its activities and is permitting it to collect or capture information that was not available before. Such technology also makes room for a more comprehensive analysis and use of the expanded data. The number of variables that a company can analyze or control has grown dramatically. Hunt-Wesson, for example, developed a computer model to aid it in studying distribution-center expansion and relocation issues. The model enabled the company to evaluate many more different variables, scenarios, and alternative strategies than had been possible before. Similarly, information technology helped Sulzer Brothers' engineers improve the design of diesel engines in ways that manual calculations could not.

Information technology is also transforming the physical processing component of activities. Computer-controlled machine tools are faster, more accurate, and more flexible in manufacturing than the older, manually operated machines. Schlumberger has developed an electronic device permitting engineers to measure the angle of a drill bit, the temperature of a rock, and other variables while drilling oil wells. The result: drilling time is reduced and some well-logging steps are eliminated. On the West Coast, some fishermen now use weather satellite data on ocean temperatures to identify promising fishing grounds. This practice greatly reduces the fishermen's steaming time and fuel costs.

Information technology not only affects how individual activities are performed but, through new information flows, it is also greatly enhancing a company's ability to exploit linkages between activities, both within and outside the company. The technology is creating new linkages between activities, and companies can now coordinate their actions more closely with those of their buyers and suppliers. For example, McKesson, the nation's largest drug distributor, provides its drugstore customers with terminals. The company makes it so easy for clients to order, receive, and prepare invoices that the customers, in return, are willing to place larger orders. At the same time, McKesson has streamlined its order processing.

Finally, the new technology has a powerful effect on competitive scope. Information systems allow companies to coordinate value activities in far-flung geographic locations. (For example, Boeing engineers

EXHIBIT III

Information Technology permeates the value chain

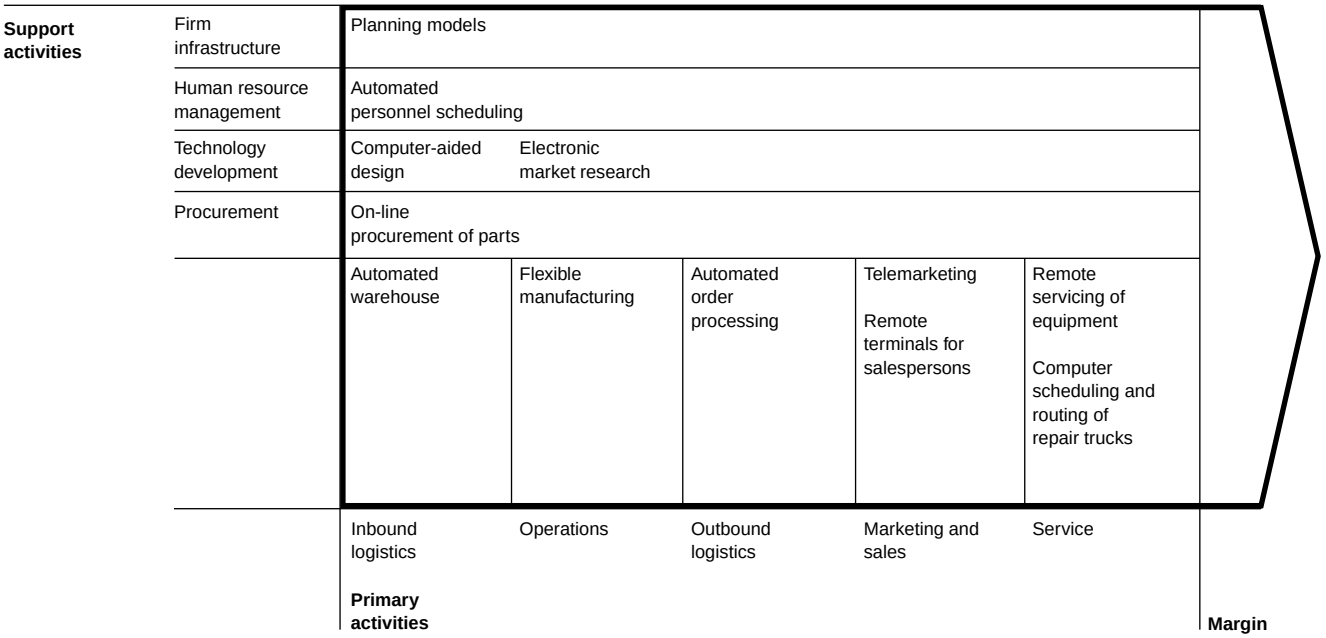


EXHIBIT IV

Information intensity matrix

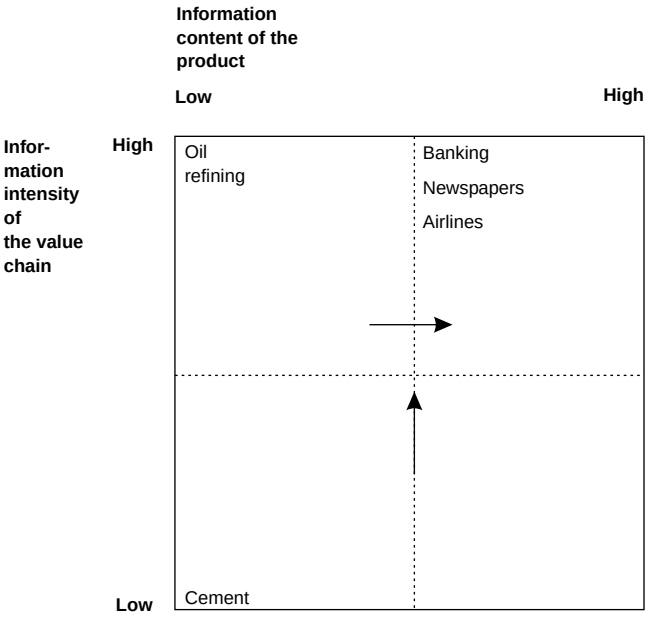
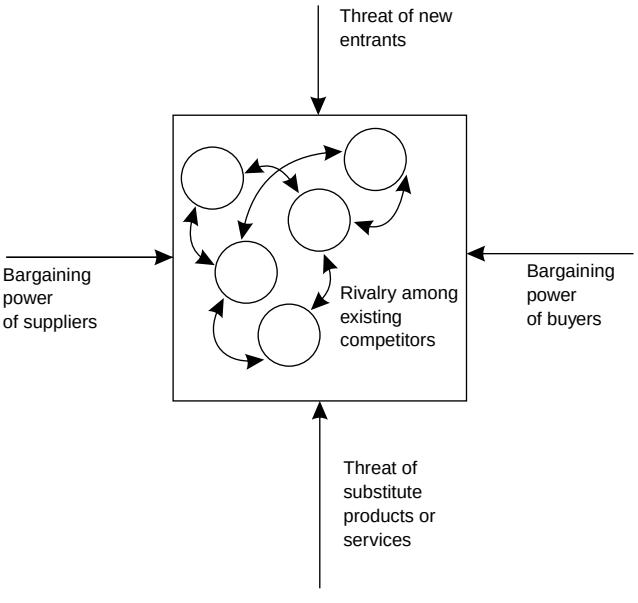


EXHIBIT V

Determinants of industry attractiveness



work on designs on-line with foreign suppliers.) Information technology is also creating many new interrelationships among businesses, expanding the scope of industries in which a company must compete to achieve competitive advantage.

So pervasive is the impact of information technology that it confronts executives with a tough problem: too much information. This problem creates new uses of information technology to store and analyze the flood of information available to executives.

Transforming the product

Most products have always had both a physical and an information component. The latter, broadly defined, is everything that the buyer needs to know to obtain the product and use it to achieve the desired result. That is, a product includes information about its characteristics and how it should be used and supported. For example, convenient, accessible information on maintenance and service procedures is an important buyer criterion in consumer appliances.

Historically, a product's physical component has been more important than its information component. The new technology, however, makes it feasible to supply far more information along with the physical product. For example, General Electric's appliance service data base supports a consumer hotline that helps differentiate GE's service support from its rivals'. Similarly, some railroad and trucking companies offer up-to-the-minute information on the whereabouts of shippers' freight, which improves coordination between shippers and the railroad. The new technology is also making it increasingly possible to offer products with no physical component at all. Compustat's customers have access to corporate financial data filed with the Securities and Exchange Commission, and many companies have sprung up to perform energy use analyses of buildings.

Many products also process information in their normal functioning. A dishwasher, for example, requires a control system that directs the various components of the unit through the washing cycle and displays the process to the user. The new information technology is enhancing product performance and is making it easier to boost a product's information content. Electronic control of the automobile, for example, is becoming more visible in dashboard displays, talking dashboards, diagnostic messages, and the like.

There is an unmistakable trend toward expanding the information content in products. This component, combined with changes in companies' value chains, underscores the increasingly strategic role of information technology. There are no longer mature industries; rather, there are mature ways of doing business.

Direction & pace of change

Although a trend toward information intensity in companies and products is evident, the role and importance of the technology differs in each industry. Banking and insurance, for example, have always been information intensive. Such industries were naturally among the first and most enthusiastic users of data processing. On the other hand, physical processing will continue to dominate in industries that produce, say, cement, despite increased information processing in such businesses.

Exhibit IV, which relates information intensity in the value chain to information content in the product, illuminates the differences in the role and intensity of information among various industries. The banking and newspaper industries have a high information-technology content in both product and process. The oil-refining industry has a high use of information in the refining process but a relatively low information content in the product dimension.

Because of the falling cost and growing capacity of the new technology, many industries seem to be moving toward a higher information content in both product and process. It should be emphasized that technology will continue to improve rapidly. The cost of hardware will continue to drop, and managers will continue to distribute the technology among even the lower levels of the company. The cost of developing software, now a key constraint, will fall as more packages become available that are easily tailored to customers' circumstances. The applications of information technology that companies are using today are only a beginning.

Information technology is not only transforming products and processes but also the nature of competition itself. Despite the growing use of information technology, industries will always differ in their position in *Exhibit IV* and their pace of change.

CHANGING THE NATURE OF COMPETITION

After surveying a wide range of industries, we find that information technology is changing the rules of competition in three ways. First, advances in information technology are changing the industry structure. Second, information technology is an increasingly important lever that companies can use to create competitive advantage. A company's search for competitive advantage through information technology often also spreads to affect industry structure as competitors imitate the leader's strategic innovations. Finally, the information revolution is spawning completely new businesses. These three effects are

critical for understanding the impact of information technology on a particular industry and for formulating effective strategic responses.

Changing industry structure

The structure of an industry is embodied in five competitive forces that collectively determine industry profitability: the power of buyers, the power of suppliers, the threat of new entrants, the threat of substitute products, and the rivalry among existing competitors (see *Exhibit V*). The collective strength of the five forces varies from industry to industry, as does average profitability. The strength of each of the five forces can also change, either improving or eroding the attractiveness of an industry.[5]

Information technology can alter each of the five competitive forces and, hence, industry attractiveness as well. The technology is unfreezing the structure of many industries, creating the need and opportunity for change. For example:

☐ Information technology increases the power of buyers in industries assembling purchased components. Automated bills for materials and vendor quotation files make it easier for buyers to evaluate sources of materials and make-or-buy decisions.

☐ Information technologies requiring large investments in complex software have raised the barriers to entry. For example, banks competing in cash management services for corporate clients now need advanced software to give customers on-line account information. These banks may also need to invest in improved computer hardware and other facilities.

☐ Flexible computer-aided design and manufacturing systems have influenced the threat of substitution in many industries by making it quicker, easier, and cheaper to incorporate enhanced features into products.

☐ The automation of order processing and customer billing has increased rivalry in many distribution industries. The new technology raises fixed costs at the same time as it displaces people. As a result, distributors must often fight harder for incremental volume.

Industries such as airlines, financial services, distribution, and information suppliers (see the upper right-hand corner of *Exhibit IV*) have felt these effects so far.[6] (See the insert, "Information Technology and Industry Structure," for more examples.)

Information technology has had a particularly strong impact on bargaining relationships between suppliers and buyers since it affects the linkages between companies and their suppliers, channels, and buyers. Information systems that cross company lines are becoming common. In some cases, the boundaries of industries themselves have changed.[7]

Information technology and industry structure

Buyer power	Videotex home shopping services, such as Comp-U-Card, increases buyers' information. Buyers use their personal computers to browse through electronic catalogs and compare prices and product specifications. Customers can make purchases at any hour at prices typically 25% to 30% below suggested retail levels. Comp-U-Card is growing quickly: revenues have quintupled in two years to $9.5 million and membership is now 15,000. According to some projections, by the mid-1990s, 75% of U.S. households will have access to such services.
Buyer power	Shelternet, an electronic information exchange offered by First Boston Corporation, allows real estate brokers to determine quickly and easily what mortgage packages are available and whether the buyer will qualify for financing. This improves the position of both brokers and homebuyers in shopping for mortgages. The parties can make preliminary commitments within 30 minutes.
Substitution	Electronic data bases, such as NEXIS, are substituting for library research and consulting firms. NEXIS subscribers can quickly search the full text of any article in 225 periodicals. Users drastically reduce the time spent in literature searches. In addition, the buyer avoids the cost of the journal subscriptions and pays only for the information required.

Systems that connect buyers and suppliers are spreading. Xerox gives manufacturing data to suppliers electronically to help them deliver materials. To speed up order entry, Westinghouse Electric Supply Company and American Hospital Supply have furnished their customers with terminals. Among other things, many systems raise the costs of switching to a new partner because of the disruption and retraining required. These systems tend to tie companies more closely to their buyers and suppliers.

Information technology is altering the relationship among scale, automation, and flexibility with potentially profound consequences. Large-scale production is no longer essential to achieve automation. As a result, entry barriers in a number of industries are falling.

At the same time, automation no longer necessarily leads to inflexibility. For example, General Electric rebuilt its Erie locomotive facility as a large-scale yet flexible factory using computers to store all design and manufacturing data. Ten types of motor

frames can be accommodated without manual adjustments to the machines. After installation of a "smart" manufacturing system, BMW can build customized cars (each with its own tailored gearbox, transmission system, interior, and other features) on the normal assembly line. Automation and flexibility are achieved simultaneously, a pairing that changes the pattern of rivalry among competitors.

The increasing flexibility in performing many value activities combined with the falling costs of designing products has triggered an avalanche of opportunities to customize and to serve small market niches. Computer-aided design capability not only reduces the cost of designing new products but also dramatically reduces the cost of modifying or adding features to existing products. The cost of tailoring products to market segments is falling, again affecting the pattern of industry rivalry.

While managers can use information technology to improve their industry structure, the technology also has the potential to destroy that structure. For example, information systems now permit the airline industry to alter fares frequently and to charge many different fares between any two points. At the same time, however, the technology makes the flight and fare schedules more readily available and allows travel agents and individuals to shop around quickly for the lowest fare. The result is a lower fare structure than might otherwise exist. Information technology has made a number of professional service industries less attractive by reducing personal interaction and making service more of a commodity. Managers must look carefully at the structural implications of the new technology to realize its advantages or to be prepared for its consequences.

Creating competitive advantage

In any company, information technology has a powerful effect on competitive advantage in either cost or differentiation. The technology affects value activities themselves or allows companies to gain competitive advantage by exploiting changes in competitive scope.

Lowering cost. As we have seen, information technology can alter a company's costs in any part of the value chain.[8] The technology's historical impact on cost was confined to activities in which repetitive information processing played a large part. These limits no longer exist, however. Even activities like assembly that mainly involve physical processing now have a large information-processing component.

Canon, for example, built a low-cost copier assembly process around an automated parts-selection and materials-handling system. Assembly workers have bins containing all the parts needed for the particular copier. Canon's success with this system derives from the software that controls parts inventory and selection. In insurance brokerage, a number of insurance companies usually participate in underwriting a contract. The costs of documenting each company's participation are high. Now a computer model can optimize (and often reduce) the number of insurers per contract, lowering the broker's total cost. In garment production, equipment such as automated pattern drawers, fabric cutters, and systems for delivering cloth to the final sewing station have reduced the labor time for manufacturing by up to 50%. (See the insert, "Aim: A Competitive Edge," for further examples.)

In addition to playing a direct role in cost, information technology often alters the cost drivers of activities in ways that can improve (or erode) a company's relative cost position. For example, Louisiana Oil & Tire has taken all ten of its salespeople off the road and made them into telemarketers. As a result, sales expenses have fallen by 10% and sales volume has doubled. However, the move has made the national scale of operations the key determinant of the cost of selling, rather than regional scale.

Enhancing differentiation. The impact of information technology on differentiation strategies is equally dramatic. As noted earlier, the role of a company and its product in the buyer's value chain is the key determinant of differentiation. The new information technology makes it possible to customize products. Using automation, for instance, Sulzer Brothers has increased from five to eight the number of cylinder

Aim: a competitive edge

Lowering cost	Casinos spend up to 20% of revenues on complimentary services for high rollers. One assignment for pit bosses has always been to keep an eye out for the big spenders. Now, however, many casinos have developed computer systems to analyze data on customers. Caesar's Palace lowered its complimentary budget more than 20% by developing a player-rating system for more accurate identification of big spenders.
Enhancing differentiation	American Express has developed differentiated travel services for corporate customers through the use of information technology. The services include arranging travel and close monitoring of individual expenses. Computers search for the lowest airplane fares, track travel expenses for each cardholder, and issue monthly statements.

bore sizes of new low-speed marine diesel engines. Shipowners now choose an engine that is more precisely suited to their needs and thereby recoup significant fuel savings. Similarly, Digital Equipment's artificial intelligence system, XCON, uses decision rules to develop custom computer configurations. This dramatically reduces the time required to fill orders and increases accuracy—which enhances Digital's image as a quality provider.

By bundling more information with the physical product package sold to the buyer, the new technology affects a company's ability to differentiate itself. For example, a magazine distributor offers retailers processing credits for unsold items more efficiently than its competitors. Similarly, the embedding of information systems in the physical product itself is an increasingly powerful way to distinguish it from competing goods.

Changing competitive scope. Information technology can alter the relationship between competitive scope and competitive advantage. The technology increases a company's ability to coordinate its activities regionally, nationally, and globally. It can unlock the power of broader geographic scope to create competitive advantage. Consider the newspaper industry. Dow Jones, publisher of the *Wall Street Journal,* pioneered the page transmission technology that links its 17 U.S. printing plants to produce a truly national newspaper. Such advances in communication plants have also made it possible to move toward a global strategy. Dow Jones has started the *Asian Wall Street Journal* and the *Wall Street Journal-European Edition* and shares much of the editorial content while printing the papers in plants all over the world.

The information revolution is creating interrelationships among industries that were previously separate. The merging of computer and telecommunications technologies is an important example. This convergence has profound effects on the structure of both industries. For example, AT&T is using its position in telecommunications as a staging point for entry into the computer industry. IBM, which recently acquired Rolm, the telecommunications equipment manufacturer, is now joining the competition from the other direction. Information technology is also at the core of growing interrelationships in financial services, where the banking, insurance, and brokerage industries are merging, and in office equipment, where once distinct functions such as typing, photocopying, and data and voice communications can now be combined.

Broad-line companies are increasingly able to segment their offerings in ways that were previously feasible only for focused companies. In the trucking industry, Intermodal Transportation Services, Inc. of Cincinnati has completely changed its system for quoting prices. In the past, each local office set prices using manual procedures. Intermodal now uses microcomputers to link its offices to a center that calculates all prices. The new system gives the company the capacity to introduce a new pricing policy to offer discounts to national accounts, which place their orders from all over the country. Intermodal is tailoring its value chain to large national customers in a way that was previously impossible.

As information technology becomes more widespread, the opportunities to take advantage of a new competitive scope will only increase. The benefits of scope (and the achievement of linkages), however, can accrue only when the information technology spread throughout the organization can communicate. Completely decentralized organizational design and application of information technology will thwart these possibilities, because the information technology introduced in various parts of a company will not be compatible.

Spawning new businesses

The information revolution is giving birth to completely new industries in three distinct ways. First, it makes new businesses technologically feasible. For example, modern imaging and telecommunications technology blend to support new facsimile services such as Federal Express's Zapmail. Similarly, advances in microelectronics made personal computing possible. Services such as Merrill Lynch's Cash Management Account required new information technology to combine several financial products into one.

Second, information technology can also spawn new businesses by creating derived demand for new products. One example is Western Union's EasyLink service, a sophisticated, high-speed, data-communications network that allows personal computers, word processors, and other electronic devices to send messages to each other and to telex machines throughout the world. This service was not needed before the spread of information technology caused a demand for it.

Third, information technology creates new businesses within old ones. A company with information processing embedded in its value chain may have excess capacity or skills that can be sold outside. Sears took advantage of its skills in processing credit card accounts and of its massive scale to provide similar services to others. It sells credit-authorization and transaction-processing services to Phillips Petroleum and retail remittance-processing services to Mellon Bank. Similarly, a manufacturer of automotive parts, A.O. Smith, developed data-communications expertise to meet the needs of its traditional businesses. When a bank consortium went looking for a contractor to run a network of automated teller

machines, A.O. Smith got the job. Eastman Kodak recently began offering long-distance telephone and data-transmission services through its internal telecommunications system. Where the information technology used in a company's value chain is sensitive to scale, a company may improve its overall competitive advantage by increasing the scale of information processing and lowering costs. By selling extra capacity outside, it is at the same time generating new revenue.

Companies also are increasingly able to create and sell to others information that is a by-product of their operations. National Benefit Life reportedly merged with American Can in part to gain access to data on the nine million customers of American Can's direct-mail retailing subsidiary. The use of bar-code scanners in supermarket retailing has turned grocery stores into market research labs. Retailers can run an ad in the morning newspaper and find out its effect by early afternoon. They can also sell this data to market research companies and to food processors.

COMPETING IN THE AGE OF INFORMATION

Senior executives can follow five steps to take advantage of opportunities that the information revolution has created.

1 Assess information intensity. A company's first task is to evaluate the existing and potential information intensity of the products and processes of its business units. To help managers accomplish this, we have developed some measures of the potential importance of information technology.

It is very likely that information technology will play a strategic role in an industry that is characterized by one or more of the following features:

☐ Potentially high information intensity in the value chain—a large number of suppliers or customers with whom the company deals directly, a product requiring a large quantity of information in selling, a product line with many distinct product varieties, a product composed of many parts, a large number of steps in a company's manufacturing process, a long cycle time from the initial order to the delivered product.

☐ Potentially high information intensity in the product—a product that mainly provides information, a product whose operation involves substantial information processing, a product whose use requires the buyer to process a lot of information, a product requiring especially high costs for buyer training, a product that has many alternative uses or is sold to a buyer with high information intensity in his or her own business.

These may help identify priority business units for investment in information technology. When selecting priority areas, remember the breadth of information technology—it involves more than simple computing.

2 Determine the role of information technology in industry structure. Managers should predict the likely impact of information technology on their industry's structure. They must examine how information technology might affect each of the five competitive forces. Not only is each force likely to change but industry boundaries may change as well. Chances are that a new definition of the industry may be necessary.

Many companies are partly in control of the nature and pace of change in the industry structure. Companies have permanently altered the bases of competition in their favor in many industries through aggressive investments in information technology and have forced other companies to follow. Citibank, with its automated teller machines and transaction processing; American Airlines, with its computerized reservations system; and *USA Today,* with its newspaper page transmission to decentralized printing plants, are pioneers that have used information technology to alter industry structure. A company should understand how structural change is forcing it to respond and look for ways to lead change in the industry.

3 Identify and rank the ways in which information technology might create competitive advantage. The starting assumption must be that the technology is likely to affect every activity in the value chain. Equally important is the possibility that new linkages among activities are being made possible. By taking a careful look, managers can identify the value activities that are likely to be most affected in terms of cost and differentiation. Obviously, activities that represent a large proportion of cost or that are critical to differentiation bear closest scrutiny, particularly if they have a significant information-processing component. Activities with important links to other activities inside and outside the company are also critical. Executives must examine such activities for ways in which information technology can create sustainable competitive advantage.

In addition to taking a hard look at its value chain, a company should consider how information technology might allow a change in competitive scope. Can information technology help the company serve new segments? Will the flexibility of information technology allow broad-line competitors to invade areas that were once the province of niche competitors? Will

information technology provide the leverage to expand the business globally? Can managers harness information technology to exploit interrelationships with other industries? Or, can the technology help a company create competitive advantage by narrowing its scope?

A fresh look at the company's product may also be in order:

Can the company bundle more information with the product?

Can the company embed information technology in it?

4 Investigate how information technology might spawn new businesses. Managers should consider opportunities to create new businesses from existing ones. Information technology is an increasingly important avenue for corporate diversification. Lockheed, for example, entered the data base business by perceiving an opportunity to use its spare computer capacity.

Identifying opportunities to spawn new businesses requires answering questions such as:

What information generated (or potentially generated) in the business could the company sell?

What information-processing capacity exists internally to start a new business?

Does information technology make it feasible to produce new items related to the company's product?

5 Develop a plan for taking advantage of information technology. The first four steps should lead to an action plan to capitalize on the information revolution. This action plan should rank the strategic investments necessary in hardware and software, and in new product development activities that reflect the increasing information content in products. Organizational changes that reflect the role that the technology plays in linking activities inside and outside the company are likely to be necessary.

The management of information technology can no longer be the sole province of the EDP department. Increasingly, companies must employ information technology with a sophisticated understanding of the requirements for competitive advantage. Organizations need to distribute the responsibility for systems development more widely in the organization. At the same time, general managers must be involved to ensure that cross-functional linkages, more possible to achieve with information technology, are exploited.

These changes do not mean that a central information-technology function should play an insignificant

Sears and the consensus

By the early 1920s, however, the "buyer for the American farmer" concept had begun to lose its relevance to economic and social realities. With the coming of the automobile and good roads, rural America rapidly became less isolated, and the kinds of merchandise of interest to the farm family came more and more to be the kinds of merchandise of interest to city dwellers as well. In this process, radio advertising also played a significant role. There was no longer a separately definable rural market with its own unique characteristics and needs; that market, and the previously distinct urban market, were homogenizing into a general American mass market.

The then managements of Sears and Ward's alike failed to grasp the significance of these new developments. They knew that their companies had problems; sales were increasingly difficult to get and profits were slipping.

Sears found the answer first—fortuitously. By bringing General Wood into the company in November of 1924, Julius Rosenwald acquired much more than the higher order of managerial skills he was seeking. He acquired a man who was capable of introducing a new entrepreneurial concept as fully responsive to the needs and opportunities of the times as Rosenwald's own had been to the needs and opportunities of a quarter-century earlier.

One of Wood's interesting personal traits was a fascination with census data. This had its origins during his years on the Canal, where good reading material—or, for that matter, any reading material—was scarce. The story is told that once, while confined to the infirmary with a minor ailment, the only thing Wood could find to read was the *Statistical Abstract of the United States,* which he began perusing simply to pass the time but soon came to study avidly. Whether or not the infirmary story is apocryphal, it is clear that in his Canal experience he acquired a taste for and an understanding of demographic and economic statistics that stayed with him for the rest of his life. During his mature years, there was a widely circulated myth (probably grounded in fact) that the *Statistical Abstract* was his favorite bedside reading. In any event, his keen grasp of major trends in American life was evident in his business planning and even ordinary conversation.

role. Rather than control information technology, however, an IS manager should coordinate the architecture and standards of the many applications throughout the organization, as well as provide assistance and coaching in systems development. Unless the numerous applications of information technology inside a company are compatible with each other, many benefits may be lost.

Information technology can help in the strategy implementation process. Reporting systems can track progress toward milestones and success factors. By using information systems, companies can measure their activities more precisely and help motivate managers to implement strategies successfully.

The importance of the information revolution is not in dispute. The question is not whether information technology will have a significant impact on a company's competitive position; rather the question is when and how this impact will strike. Companies that anticipate the power of information technology will be in control of events. Companies that do not respond will be forced to accept changes that others initiate and will find themselves at a competitive disadvantage.

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1. For more information on the value chain concept, see Michael E. Porter, *Competitive Advantage* (New York: Free Press, 1985).

2. For a discussion of the two basic types of competitive advantage, see Michael E. Porter, *Competitive Strategy* (New York: Free Press, 1980), Chapter 2.

3. Alfred D. Chandler, Jr., *The Visible Hand* (Cambridge: Belknap Press of Harvard University Press, 1977), p. 86.

4. James L. McKenney and F. Warren McFarlan, "The Information Archipelago—Maps and Bridges," HBR September–October 1982, p. 109.

5. See Michael E. Porter, "How Competitive Forces Shape Strategy," HBR March–April 1979, p. 137.

6. See F. Warren McFarlan, "Information Technology Changes the Way You Compete," HBR May–June 1984, p. 98.

7. James I. Cash, Jr. and Benn R. Konsynski, "IS Redraws Competitive Boundaries," HBR March–April 1985, p. 134.

8. See Gregory L. Parsons, "Information Technology: A New Competitive Weapon," *Sloan Management Review,* Fall 1983, p. 3.

9. Victor E. Millar, "Decision-Oriented Information," *Datamation,* January 1984, p. 159.

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