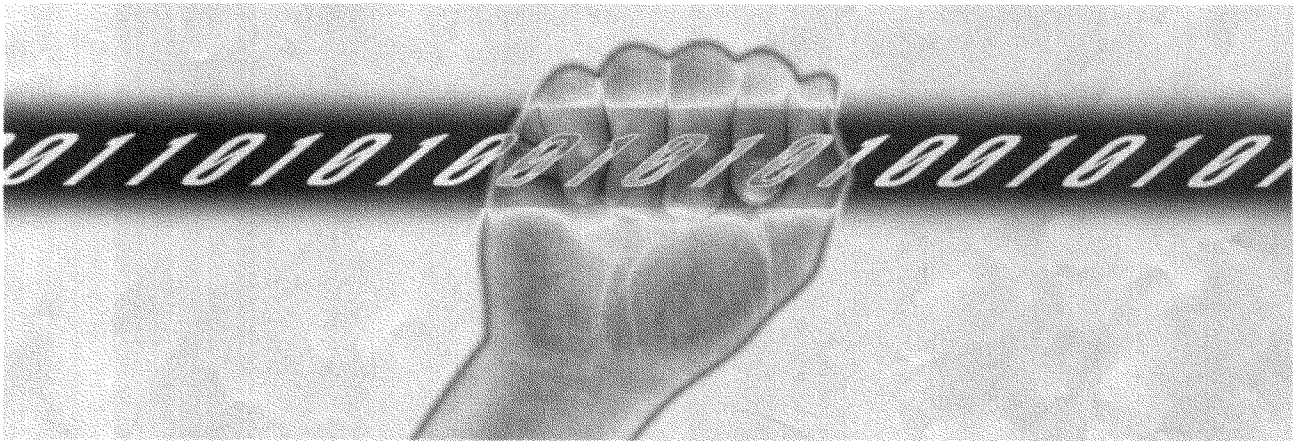


Exploiting the Virtual Value Chain



by Jeffrey F. Rayport and John J. Sviokla

Every business today competes in two worlds: a physical world of resources that managers can see and touch and a virtual world made of information. The latter has given rise to the world of electronic commerce, a new locus of value creation. We have referred to this new information world as the *marketspace* to distinguish it from the physical world of the *marketplace*. (See "Managing in the Marketspace," HBR November-December 1994.) A few examples illustrate the distinction. When consumers use answering machines to store their phone messages, they are using objects made and sold in the physical world, but when they purchase electronic answering services from their local phone companies, they are utilizing the *marketspace*—a virtual realm where products and services exist as digital information and can be delivered through information-based channels. Banks provide services to customers at branch offices in the marketplace as well as electronic online services to customers in the *marketspace*; airlines sell passenger tickets in both the "place" and the "space"; and fast-food outlets take orders over the counter at restaurants and increasingly through touch screens connected to computers.

Executives must pay attention to how their companies create value in both the physical world and the virtual world. But the processes for creating value are not the same in the two worlds. By understanding the differences and the interplay between the value-adding processes of the physical world and those of the information world, senior managers can see more clearly and comprehensively the strategic issues facing their organizations. Managing two interacting value-adding processes in the

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two mutually dependent realms poses new conceptual and tactical challenges. Those who understand how to master both can create and extract value in the most efficient and effective manner.

Academics, consultants, and managers have long described the process of creating value in the physical world, often referring to the stages involved as links in a "value chain." The value chain is a model that describes a series of value-adding activities connecting a company's supply side (raw materials, inbound logistics, and production processes) with its demand side (outbound logistics, marketing, and sales). By analyzing the stages of a value chain, managers have been able to redesign their internal and external processes to improve efficiency and effectiveness.

The value chain model treats information as a supporting element of the value-adding process, not as a source of value itself. For instance, managers often use information that they capture on inventory, production, or logistics to help monitor or control those processes, but they rarely use information itself to create new value for the customer. However, Federal Express Corporation recently did just that by allowing customers to track packages through the company's World Wide Web site on the Internet. Now customers can locate a package in transit by connecting on-line to the FedEx site and entering the airbill number. After the package has been delivered, they can even identify the name of the person who signed for it. Although FedEx pro-

through and with information. Creating value in any stage of a virtual value chain involves a sequence of five activities: gathering, organizing, selecting, synthesizing, and distributing information. Just as someone takes raw material and refines it into something useful – as in the sequence of tasks involved in assembling an automobile on a production line – so a manager today collects raw information and adds value through these steps.

Adapting to a Virtual World

An examination of Geffen Records, a unit of MCA's music division, illustrates the use of information to create value. The traditional product of a major record label such as Geffen is a package of prerecorded music captured on an audiocassette or compact disc. The product is the end point of a set of value-adding processes that occur in the physical world. Those processes include discovering new musicians, screening them for potential marketability, recording their work in a studio, editing and selecting their music, creating master tapes, producing CDs or cassettes, and finally packaging, promoting, and distributing the products.

Increasingly, new competitors for Geffen's business are emerging in the marketspace. These entrants are viable because of the new economics of doing business in the world of information. For example, groups such as the Internet Underground Music Archive (IUMA) are posting digital audio

tracks from unknown artists on the network, potentially subverting the role that record labels play. Today's technology allows musicians to record and edit material inexpensively themselves, and to distribute and promote it over networks such as the World Wide Web or commercial on-line services. They also can test consumers' reactions to their music, build an audience for their

recorded performances, and distribute their products entirely in the marketspace.

The point here is simple: Bringing music to market can sometimes be done faster, better, and less expensively in the marketspace. Hence the challenge for Geffen. The company has a site on the World Wide Web devoted to the label's bands and uses it to distribute digital audio and video samples and to provide information about the bands' tours. The Web page has become Geffen's showroom in the marketspace and a potential new retail channel. It is also an information mirror of an activity that traditionally has occurred in the physical world –

To create and extract value with information, managers must turn to the virtual world of the marketspace.

vides this service for free, it has created added value for the customer – and thus increased loyalty – in a fiercely competitive market.

To create value with information, managers must look to the marketspace. Although the value chain of the space can mirror that of the place – buyers and sellers can transfer funds over electronic networks just as they might exchange cold, hard cash – the value-adding processes that companies must employ to turn raw information into new marketspace services and products are unique to the information world. In other words, the value-adding steps are *virtual* in that they are performed

a stage in a virtual value chain that parallels a stage in a physical value chain.

In addition to using its own Web page, Geffen could search for new talent at IUMA's home site rather than audition bands in a studio, or edit and modify music on a computer rather than record take after take with a band to create one suitable version for the master tape. Each activity is a stage in a virtual value chain that occurs through and with information and mirrors a stage in the physical world.

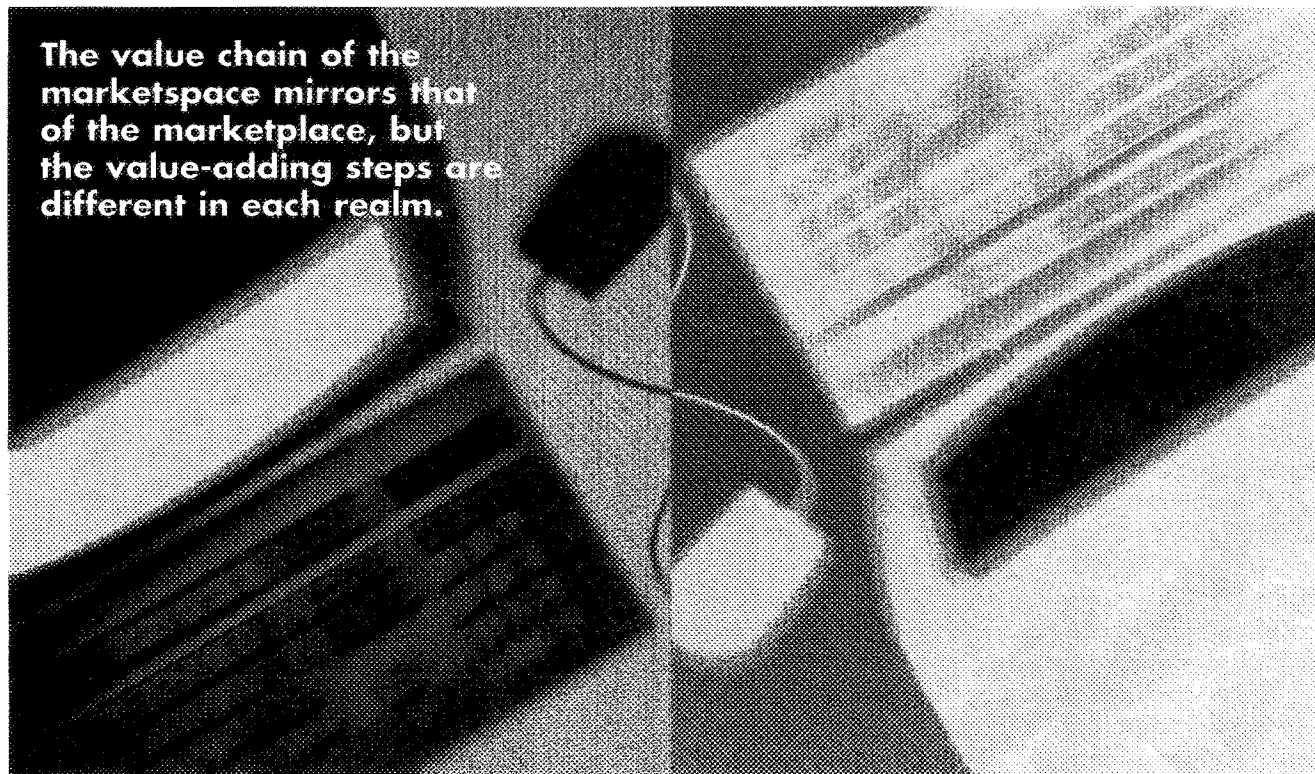
To truly exploit the virtual value chain, however, Geffen's managers might go further by applying the generic value-adding steps of the marketspace to the information the company collects at every stage of the physical chain, thereby creating new value for customers. For example, they might utilize the digital information captured during a band's practice sessions by inviting fans to sit in the studio on the Internet. They might also allow fans to listen as engineers edit the material or to electronically download interviews with a band's members before they are published or distributed more widely. In the physical value chain, information collected in the studio or during editing has value to the extent that it enables Geffen to produce and sell CDs more efficiently; in the virtual world, it is a potential source of new revenue. Moreover, that information presents opportunities to develop new relationships with customers at very low cost—for

instance, a customer not interested in a new compact disc by the Rolling Stones may nevertheless pay to sit in on a chat session with them in the Internet's Voodoo Lounge.

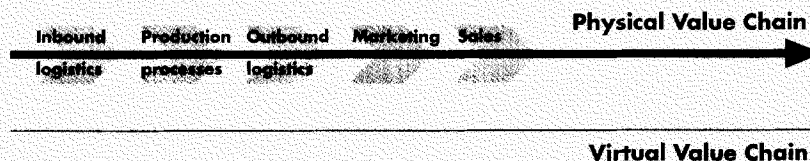
Like most companies, Geffen must play both in the place and in the space. The company's managers must continue to oversee a physical value chain—making and selling CDs—but they must also build and exploit a virtual value chain. We have studied scores of companies in a variety of industries attempting to do business in both the place and the space and have found that organizations making money in the information realm successfully exploit both of their value chains. Rather than managing one series of value-adding processes, they are actually managing two. The economic logic of the two chains is different: A conventional understanding of the economies of scale and scope does not apply to the virtual value chain (VVC) in the same way as it does to the physical value chain (PVC). Moreover, the two chains must be managed distinctly but also in concert.

We have observed that companies adopt value-adding information processes in three stages. In the first stage, *visibility*, companies acquire an ability to “see” physical operations more effectively through information. At this stage, managers use large-scale information technology systems to coordinate activities in their physical value chains and in the process lay the foundation for a virtual

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Building the Virtual Value Chain



When companies integrate the information they capture during stages of the value chain—from inbound logistics and production through sales and marketing—they construct an information underlay of the business. This integrated information provides managers with the ability to “see” their value chains from end to end.

value chain. In the second stage, *mirroring capability*, companies substitute virtual activities for physical ones; they begin to create a parallel value chain in the marketplace. Finally, businesses use information to establish *new customer relationships*. At this third stage, managers draw on the flow of information in their virtual value chain to deliver value to customers in new ways. In effect, they apply the generic value-adding activities to their virtual value chain and thereby exploit what we call the *value matrix*.

As companies move into the information world to perform value-adding steps, the potential for top-line growth increases. Each of the three stages represents considerable opportunity for managers.

Visibility

During the last 30 years, many companies have invested in technology systems to enable managers to coordinate, measure, and sometimes control business processes. The information collected by these systems about steps in the value chain has helped managers to plan, execute, and evaluate results with greater precision and speed. In other words, information technology has allowed managers to see their operations more effectively through the information world. In recent years, managers have been able to gain access to the information generated in the course of traditional operating activities, and that information helps them see their physical value chains as an integrated system rather than as a set of discrete though related activities. In this way, they can gain new insight into managing the value chain as a whole rather than as a collection of parts.

Companies such as FedEx, Wal-Mart, and Frito-Lay have transformed this kind of visibility into competitive advantage. The successful use of

world-class information systems by each of these companies is now common knowledge, but consider one example – Frito-Lay – from the perspective of the marketplace. Frito’s achievement with its widely publicized “information revolution” initiative illustrates the necessary first steps companies must take if they are to establish and then exploit their virtual value chains.

Underlying the manufacture and distribution of a variety of Frito-brand snack foods is an efficient information system that

gives managers the ability to visualize nearly every element of the company’s value chain as part of an integrated whole. It is a central nervous system within the business that integrates marketing, sales, manufacturing, logistics, and finance; it also provides managers with information on suppliers, customers, and competitors.

Frito’s employees in the field collect information on the sales of products daily, store by store across the nation, and feed it electronically to the company. The employees also collect information about the sales and promotions of competing products or about new products launched by competitors in select locations. By combining this field data with information from each stage of the value chain, Frito’s managers can better determine levels of inbound supplies of raw materials, allocate the company’s manufacturing activity across available production capacity, and plan truck routing for the most efficient coverage of market areas. The company’s ability to target local demand patterns with just the right sales promotion means that it can continuously optimize margin in the face of inventory risk. In short, Frito can use information to see and react to activities along its physical value chain. The company executes actions in the marketplace while it monitors and coordinates those actions in the marketplace.

Mirroring Capability

Once companies have established the necessary infrastructure for visibility, they can do more than just monitor value-adding steps. They can begin to manage operations or even to implement value-adding steps in the marketplace – faster, better, with more flexibility, and at lower cost. In other words, managers can begin to ask, What are we doing now in the place, and what could we do more

efficiently or more effectively in the space? What value-adding steps currently performed in the physical value chain might be shifted to the mirror world of the virtual value chain? When companies move activities from the place to the space, they begin to create a virtual value chain that parallels but improves on the physical value chain.

Executives at Ford Motor Company engaged in such work during the past decade as the company aggressively adopted videoconferencing and CAD/CAM technologies. When Ford developed its "global car" (marketed in North America as the Contour sedan), the automaker moved one key element of its physical value chain – product development – into the marketpace. Ford intended to create a car that would incorporate its best engineering, design, and marketing talent worldwide while also bringing to bear a vision of how a single car design could appeal at once to all major world markets. To gain leverage from its substantial investments in marketpace-enabling technology systems, Ford brought managerial talent from around the world together in the marketpace. Rather than creating national product teams or convening elaborate design summits, Ford established a *virtual* work team to develop the car. In this way, it extracted the best talent and the broadest vision it could muster.

By moving product development from the place to the space, Ford's managers did more than perform tasks in an information-defined world that were traditionally accomplished through physical actions. In the virtual world, the design team could transcend the limitations of time and space that characterize management in the physical world. They built and tested prototypes in a simulated computer environment and shared the designs and data with colleagues over a computer network, 24 hours a day, around the world. In the virtual world of information, they established common global specifications for manufacturing, integrated component systems centrally, and even drew suppliers into the design process. Ford thus performed critical value-adding steps not on the PVC but on the VVC – in other words, in a world that mirrored traditional managerial realities.

With such a complete information-based representation of the

product, everyone on the team could see the project holistically in the mirror world. The goal: a global car with global appeal. The virtual value chain made a much more integrated process possible. The marketing challenge of getting customers to buy the Contour remains.

Managers at the Boeing Company took their exploitation of the mirror world one step further. A few years ago, they redesigned the engine housing for a new model of the 737 airplane. Previously,

Managers can begin to ask, What could we do more efficiently or effectively in the marketpace?

Boeing and other airplane manufacturers would design airframes by developing physical prototypes, testing them in wind tunnels to gauge the flow of air over their contours, and then repeating the process through multiple iterations. When Boeing addressed the question of how to create a new engine to improve the performance of its existing 737 airframe design, it turned not to wind tunnels but to a synthetic environment—a mirror world made of information. Boeing engineers developed the prototype as a virtual product that incorporated relevant laws of physics and materials sciences and enabled the company to test an evolving computer-simulated model in a virtual wind tunnel. As a result, engineers could test many more designs at dramatically lower costs and with much greater speed. The outcome was a teardrop shape for the engine housing that stunned the aerospace world. Why? Because only a process that could endlessly test different possibilities at near-zero incremental cost per syn-

Exploiting the Virtual Value Chain



With an integrated information underlay in place, companies can begin to perform value-adding activities more efficiently and effectively through and with information. In other words, these information-based activities mirror steps in the physical value chain. When companies move a number of value-adding activities from the marketplace to the marketpace, they exploit a virtual value chain.

thetic prototype could give rise to a product concept that was outside the bounds of conventional thinking. By moving elements of the PVC – R&D, product design, prototyping, and product testing – to the mirror world of the VVC, Boeing succeeded in shattering a dominant paradigm of engine design and delivered a product that easily outperformed the competition, a feat that had proved impossible in 20 years of wind-tunnel testing.

Every manager knows that staying competitive today depends on achieving higher levels of performance for customers while incurring lower costs in R&D and production. Traditionally, companies have gotten more for less by exploiting vast economies of scale in production while focusing on raising levels of quality. Japanese automakers such as Toyota have successfully pursued that strategy, delivering highly differentiated products at the lowest possible costs. When scale economies do not apply, as in many service-sector businesses, managers seeking better performance at lower cost can tap the mirror world, in which the economics are altogether different. On the VVC, companies may find dramatic low-cost approaches to delivering extraordinarily high-value results to customers.

New Customer Relationships

Ultimately, however, companies must do more than create value in the space: They also must extract value from it. They can often do so by establishing space-based relationships with customers.

Once companies become adept at managing their value-adding activities across the parallel value chains, they are ready to develop these new relationships. In the world of high technology, examples of building customer relationships on the VVC abound. Today thousands of companies have established sites on the World Wide Web to advertise products or elicit comments from customers. Some companies have gone further and have actually automated the interface with the customer, thus identifying and fulfilling customers' desires at lower cost. Digital Equipment Corporation, making a comeback from its slump in the late 1980s, has developed a new channel for serving customers on the Internet. DEC's World Wide Web site allows prospective customers to use a personal computer to contact sales representatives, search for products and services, review the specifications of DEC equipment, and actually take a DEC machine for a "test drive." Similarly, Oracle Corporation, a data-

base software maker, now distributes a new product over the Internet as well as through physical channels. These companies are joining the burgeoning ranks of major high-tech firms in the business-to-business sector that have become Internet marketers; the group includes GE Plastics, Sun

Once companies can manage value-adding activities across both chains, they can develop new customer relationships.

Microsystems, and Silicon Graphics, all of which use the Web to establish and maintain relationships with selected accounts.

Other companies view their challenge as that of managing each individual customer relationship in both the marketspace and the marketplace. Those that succeed have an opportunity to reinvent the core value proposition of a business, even an entire industry. One extraordinary example of success in this regard is United Services Automobile Association, which has truly maximized its opportunities to deliver value to customers in both the space and the place and has thereby become a world-class competitor.

USAA began as an insurance company. Over time, it has used its information systems—installed to automate its core business, insurance sales and underwriting—to capture significant amounts of information about customers, both individually and in aggregate. USAA integrated information about customers and distributed it throughout the company so that employees are ready to provide products, services, and advice anytime a customer contacts the company. Having made this investment in visibility, USAA found that among other things it could prepare customer risk profiles and customize policies on the VVC. Looking at the flow of information harvested along its VVC, USAA's managers invented business lines targeted to specific customers' needs, such as insurance for boat owners.

But USAA also used its growing expertise with information to create new value for customers in ways that had little or nothing to do with insurance. For example, the company went one step further for the boat owners: It designed financing packages for purchasing boats. In fact, USAA now offers a wide range of financial products as well as shopping services for everything from jewelry to cars.

Further, when a customer calls in with a theft claim, the company can offer to send a check or to replace the stolen item. (Many customers opt for the latter because it involves less work and solves their problem.)

By aggregating demand statistics and likely loss ratios, USAA has become a smart buyer for its loyal customer base, getting discount prices through high-volume purchases and passing some or all of the savings along to the customer. Today USAA is one of the largest direct merchandisers in the country, shipping real goods along its PVC as directed by

that allows companies to identify customers' desires more effectively and fulfill them more efficiently. For instance, when an automobile manufacturer can shift its R&D activities from the PVC to the VVC, it becomes possible for the company to exploit the matrix by engaging customers in the new-product-development process even if they are located around the world. The company could gather, organize, select, synthesize, and distribute design information drawn from the R&D process to create a computer simulation for customers, who could then enter the virtual design space and give feedback – which in turn could be used to add value in the unfolding design of the vehicle.

Moreover, the information can be turned into new spin-off products: Digitally captured product designs can become the basis for personal-computer-based or television-based multimedia software, such as the Lamborghini driving game, a software package now on the market.

While the information used in such products also aids physical processes and feeds into a physical end point—an automobile, a compact disc, an insurance policy – it is also the raw material for new kinds of value.

The newspaper industry is another example of how such processes can be shifted from the place to the space. Executives can apply the five value-adding steps to each link of the virtual value chain to envision a matrix of opportunities for creating value. For instance, drawing from the information used to support reporting and editing, newspapers could provide information packets to readers with audio files of reporters' interviews, images from their notebooks, photos that did not make it into the paper, and even editors' comments about early drafts of stories. The value matrix guides managers as they consider how to establish the processes necessary to exploit new opportunities.

By thinking boldly about the integration of place and space, executives may be able to create valuable digital assets that, in turn, could change the competitive dynamics of industries. Consider Image Technology International (recently acquired by MCI Communications Corporation), a company that has entered the imaging market with an entirely digital approach to the capture, organization, selection, manipulation, and distribution of photographic images.

By using digital code as its raw material rather than chemicals as in traditional photography, Image can offer higher value to its customers in a

Each extract from the flow of information along the virtual value chain could constitute a new product or service.

the sensing capabilities of its VVC. USAA does not actually manufacture anything. Rather, it is a trusted intermediary between the demand it senses and the supply it sources.

Although USAA's "product line" is eclectic, it represents a logical, cost-effective, and profitable progression of new business ventures, all of which are underwritten by the information about customers captured in the company's virtual value chain. (Management of that information has become USAA's central activity.) Through clever integration of the information harvested along the VVC and through a PVC that delivers goods and services, USAA creates new value for customers by serving a broader set of their needs.

The Value Matrix

The new relationships that companies such as USAA are developing with customers spring from a matrix of value opportunities. Each stage of the virtual value chain – as a mirror of the physical value chain – allows for many new extracts from the flow of information, and each extract could constitute a new product or service. If managers want to pursue any of these opportunities, they need to put into place processes to gather the information, organize it for the customer, select what's valuable, package (or synthesize) it, and distribute it – the five value-adding steps unique to the information world. In effect, these value-adding steps, in conjunction with the virtual value chain, make up a value matrix

number of ways. First, the company offers lower-cost prepress services. The cost of a high-quality industrial photo for a catalog is \$150 to \$250 or more when captured on photographic film. The output of a chemical-based photo is limited: The incremental costs of using the image captured for the catalog in an additional product—such as a follow-on brochure—start at \$15 and go up from there. In the world of digital code, the image (captured on a digital camera) costs half as much to create because of the photographer's increased productivity, the avoidance of chemical processing, improved image quality, and efficiencies of storage and manipulation.

Second, Image Technology can manipulate and reuse a digital photo in several different ways to allow businesses to communicate with their customers in either the marketplace or the marketpace. For instance, using specially designed software, the company can incorporate an image on acetate film or a digital press; both are used in printing promotional flyers. The same image can be directed to a photocopier to create a black-and-white or color copy of the same image for distribution of handbills announcing a sale. Image can manipulate a digital photo (which the company can organize in a database with other relevant data, such as the price of the object photographed and a text description of it) so that customers can use it in CD-ROM catalogs, videos, or on-line services. In short, by exploiting a virtual value chain the company can capture an image more efficiently and transform that image so that it can be used in many different physical processes—from dye transfer to photocopier to video—and virtual processes. Image

can create an asset that has tremendous economies of scale and scope.

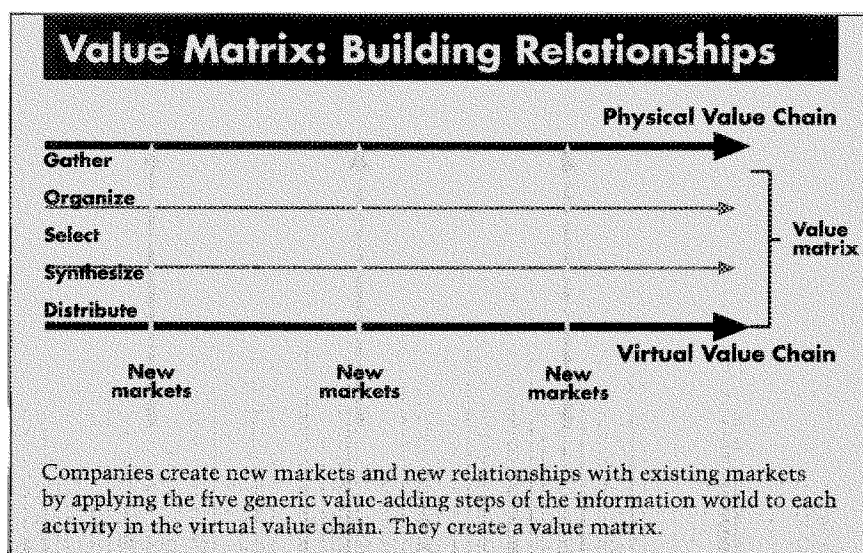
For example, consider one of the vertical markets Image competes in: the hardlines industry—the industry that makes, distributes, and sells hardware. Any business in the industry can use Image's preproduction technology to publish product images and data less expensively. A local hardware store can draw on Image's database of hammers, screwdrivers, and other products to create a newspaper flyer conventionally with pictures, halftones, and

Companies that create value with digital assets may be able to reharvest them in an infinite number of transactions.

pasteup—or digitally, using Image's picture-processing software. A large distributor that wants to create a major catalog of product lines can do so less expensively, faster, and more flexibly using information-based services and products from Image. Whereas once the process of creating a catalog required tens of thousands of photos and months of layout work, Image can create a database of images and text for a customer far more quickly. Subsequent catalogs, drawing from the same digital asset, can be prepared for publication in just days, even if the distributor drops several items from the list and changes the price of many others or adds a broad range of hammers with different handle colors. Image can manipulate the size of images, reshuffle

their order, and change text or even colors far more easily in the space than in the place.

In the process of helping hardline industry businesses to reduce the cost of communicating with their customers, Image is amassing a huge database of photos that will provide it with a dominant position in the industry. If Image's database can contain an industrial-grade picture of almost every piece of hardware in existence, why would any player in the hardlines channel—manufacturer, distributor, or retailer—go to another source or shoot a picture that was already



available in physical and virtual form? (Pursuing the same logic, Bill Gates and other pioneers of electronic commerce are quickly buying up electronic rights to works of art and many other objects.)

To anyone who views Image's operations strictly as an information-based parallel to the traditional chemical process, the company's value chain merely looks far more efficient than other companies' physical value chains. However, considering how value is added in the information world, Image has in fact reinvented the business model for the capture and display of images. To create and process a photo, Image gathers information (finds subjects and takes photographs); organizes information (creates the photo database); selects information (chooses images to produce from the database); synthesizes information (processes images for different media); and distributes information (outputs images to relevant platforms). Image does not make and process the digital equivalent of photographic film and ancillary products. It parlays its digital assets across many forms, from newsprint to catalogs to videos. That is, by thinking in terms of a virtual value chain *and* a physical value chain, the company's managers look at far more opportunities for creating and extracting value than they would have by considering the business exclusively from the point of view of a traditional physical value chain. Thinking about a business in terms of its value matrix can allow managers to go beyond changing the rules of the game: They can reinvent an industry.

Such thinking is springing up around the world as new ways of creating and extracting value in the

could easily become the basis for a whole new transaction and communications infrastructure into and out of China. After all, unlike a company entering the physical marketplace, the China Internet Company will have global reach the very instant it goes on-line.

Implications for Management

What all this means for managers is that they must consciously focus on the principles that guide value creation and extraction across the two value chains separately and in combination. These two value-adding processes are fundamentally different. The physical value chain is composed of a linear sequence of activities with defined points of input and output; in Geffen's case, it runs from locating new bands to manufacturing and distributing CDs of a band's music. By contrast, the virtual value chain is nonlinear – a matrix of potential inputs and outputs that can be accessed and distributed through a wide variety of channels. USAA can meet customers' needs wherever and however they are manifested. Image can deliver images and data on a wide variety of platforms and across a wide variety of distribution infrastructures. The China Internet Company may perform similar functions for an entire burgeoning national economy.

How can we make sense of this new realm of activity – the information space that allows for the creation of a virtual value chain and the exploitation of a value matrix? To succeed in this new economic environment, executives must understand the differences between value creation and extraction in the marketplace and in the marketspace; they must manage both effectively and in concert. More specifically, a company's executives must embrace an updated set of guiding principles because in the marketspace many of the business axioms that have

In the marketspace, many of the business axioms that have guided managers don't apply.

marketspace become clear. For example, the China Internet Company, backed by the Xinhua News Agency, will roll out a network of Internet sites for 40 industrial cities in China before the end of 1995. On this network will be multimedia documents that describe a wide range of products, from toys to towels to auto parts. The China Internet Company will also provide a complete catalog of Chinese laws pertaining to trade and export, a translation service, and news. Because the Chinese do not have an adequate physical infrastructure for information about exports, they hope to create a virtual platform *first*. This new information infrastructure

guided managers no longer apply. We offer five new principles here.

The Law of Digital Assets. Digital assets, unlike physical ones, are not used up in their consumption. Companies that create value with digital assets may be able to reharvest them through a potentially infinite number of transactions, thus changing the competitive dynamics of their industries. For example, when Image Technology gathers and organizes a million images of hardware, it will have the dominant digital asset in that industry. Companies using traditional chemical-based processes will have a difficult time competing with

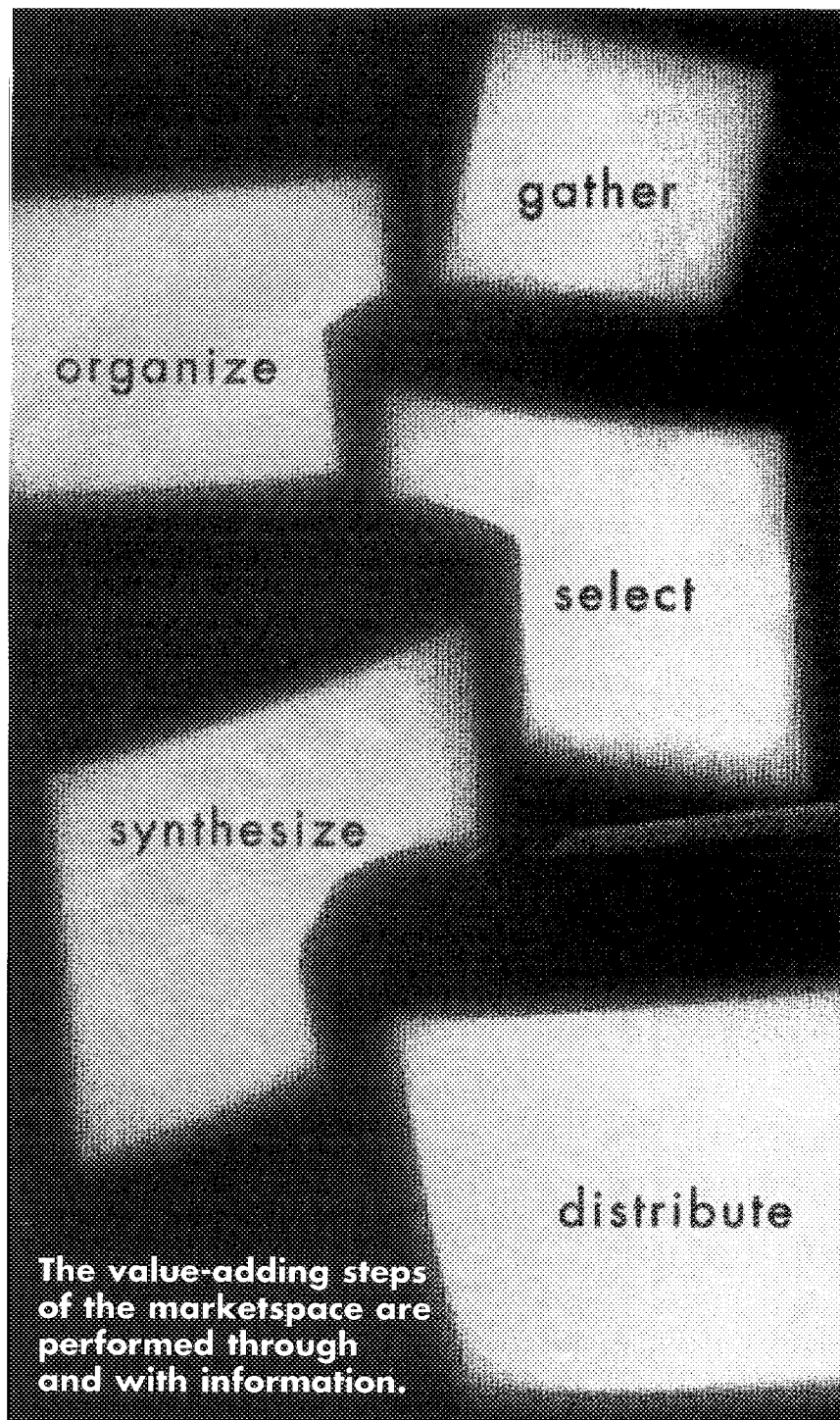


Image because the variable cost of creating value using digital-information assets is zero or close to it. Therefore providers of products or services that must price according to the traditional variable-cost model—based on the consumption of the underlying materials—will have a tough time competing against companies that, by exploiting their virtual value chains, can price aggressively and still make margin.

New Economies of Scale. The virtual value chain redefines economies of scale, allowing small companies to achieve low unit costs for products and services in markets dominated by big companies. The U.S. Postal Service, which views the world according to an industrial paradigm, could never afford to build a post office in every one of the nation's homes. But FedEx has done exactly that in the market-space by allowing individuals with access to the Internet to track packages through the company's site on the World Wide Web. (Customers can also request software from FedEx that allows them not only to track their parcels but also to view at any time the entire history of their transactions with FedEx.) The new economies of scale make it possible for FedEx to provide what are, in effect, ministorefronts to each and every customer, whether millions of users request the service at any given moment or just one.

New Economies of Scope. In the marketpace, businesses can redefine economies of scope by drawing on a single set of digital assets to provide value across many different and disparate markets. USAA dominates the insurance market for military officers with a 97% segment share, a scale of operations built on direct marketing. Now, through the new customer relationships made possible by its digital assets (the information USAA collected about its customers), the company is expanding its scope. Using

its virtual value chain, USAA can coordinate across markets and provide a broader line of high-quality products and services.

Transaction-Cost Compression. Transaction costs along the VVC are lower than their counterparts on the PVC, and they continue to decline sharply as the processing capacity per unit of cost for microprocessors doubles every 18 months. In the 1960s, it cost about \$1 to keep information

about an individual customer. Today it costs less than one cent per customer. Lower transaction costs allow companies to control and track information that would have been too costly to capture and process just a few years ago. For instance, lower transaction costs made it possible for Frito to monitor its value chain from shipments of corn to in-store inventory.

Rebalancing Supply and Demand. Taken together, these four axioms combine to create a fifth: The world of business increasingly demands a shift from supply-side to demand-side thinking. As companies gather, organize, select, synthesize, and distribute information in the marketplace while managing raw and manufactured goods in the marketplace, they have the opportunity to "sense and respond" to customers' desires rather than sim-

ply to make and sell products and services. (See "Managing by Wire," by Stephan H. Haeckel and Richard L. Nolan, HBR September-October 1993.) USAA senses a demand in its customer base and then connects that demand to a source of supply. In today's world of overcapacity, in which demand, not supply, is scarce, managers must increasingly look to demand-side strategies.

Senior managers must evaluate their business—its strengths and weaknesses, its opportunities and risks—along the value chains of both worlds, virtual and physical. Today events in either can make or break a business.

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"I used to be into Kant, Nietzsche, and Schopenhauer, but now I'm into modular storage."