

# INFORMATION TECHNOLOGY AND PHYSICAL SPACE

DESPITE THE RECENT SHARP DOWNTURN IN THE various technology markets, disappearance of so many promising dot-com startup companies, loss of investor confidence in technology manufacturers and distributors, and consolidation and layoffs throughout the computer industry, information technology remains an important force changing the nature of organizations and the way all of us are likely to work in the future. IT design variables make it possible to create new organizational structures and new modes of operation. A second-order effect of these new types of organizations and working arrangements is on physical space; virtual organizations, highly mobile work forces, and e-commerce are changing the demand and market for and nature of office, retail, and industrial space. A third-order effect is seen in the form of changes in patterns of real estate use and the relocation of people in cities, suburbs, and rural areas brought about by these trends in the need for physical space.

IT, especially in the form of communication networks, is having a profound effect on how organizations structure themselves, assign their employees, and partner and compete with one another, as well as

*Expect a substantial decrease in demand for space for offices, stores, factories, and warehouses over the next five years due to IT-related changes in how businesses are run and consumers shop, communicate, and travel.*

on the global economy. Here, I seek to identify the trends in IT likely to influence demand for physical space throughout the industrialized world over the next five years. A review of recent literature and expert opinion about IT and changing patterns of commerce suggests the following trends for the U.S. and other post-industrial economies:

- Increased telecommuting from home or from satellite offices. Elimination of offices for sales forces could lead to up to 30 to 40 million workers in the U.S. telecommuting by 2006.
- Hoteling, whereby workers share offices serially, such as when accountants and consultants reserve space in buildings their firms manage when they have to be in that particular location.

In 2000, as reported in the U.S. Census, there were about 141 million workers employed in the

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U.S. A conservative estimate of employment effects following from the two IT trends just mentioned is that:

- 10% of U.S. workers (14 million) will spend most of their time with clients and need no permanent offices;
- 5%–10% (7–14 million) will work from home at least one day a week; and
- 5%–10% (7–14 million) will share offices.

Therefore, by 2006, there might be 30% less demand for office space throughout the U.S. and at least 10% conversion of existing office space to hoteling.

Now assume 14 million U.S. workers by 2006 need no permanent office, 10 million workers spend one day a week at home, representing two million full-time-equivalent workers without offices, and 10 million workers share offices. The result is 26 million workers not housed full-time in private offices. This total is 18% of all jobs in the U.S. economy today and a much greater percentage of workers with offices, since not all of today's 141 million workers have offices. The 30% estimated reduction in demand for office space is conservative.

A trend toward "value merchandising," or large stores like Wal-Mart competing on price, will increasingly involve the continuous replenishment of fast-selling items and extremely tight inventory control through supply chain management. Meanwhile, e-commerce will increasingly substitute virtual stores for physical stores and supplement physical stores with Internet-based alternatives.

Estimates and predictions of future business performance from these trends are difficult to quantify due to the newness of the e-commerce business model. And exclusively Internet merchants have experienced a high rate of failure. But e-commerce is inevitable, and the surviving e-commerce vendors and next generation of online merchants are likely to be more successful than their pioneering counterparts, as consumers become more comfortable with online shopping and merchants learn more about online selling. However, extrapolating from the more apparent trends, the U.S. commercial real estate market will, by 2006, experi-

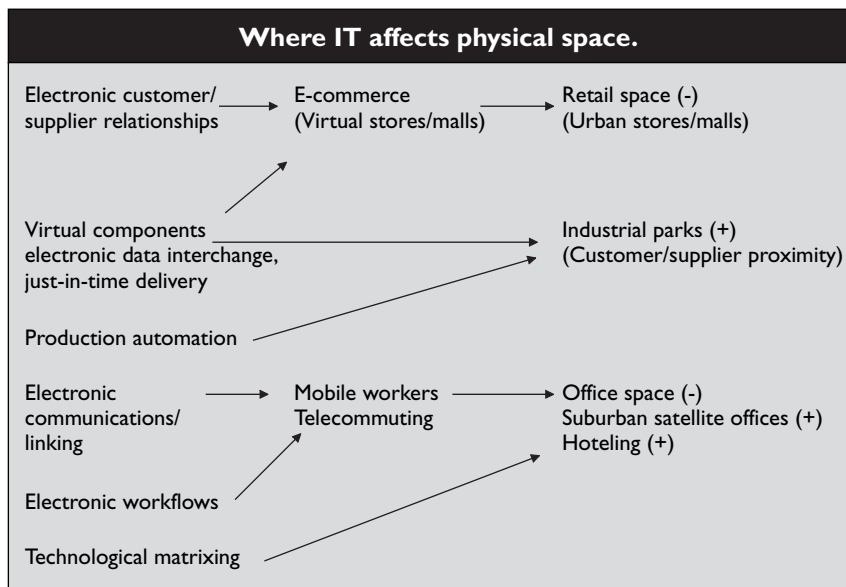
**Table 1. IT organization design variables, which can be combined with their more traditional counterparts, such as span of control, to create new organizational forms, including those with the characteristics of T-form organizations, as in Table 2.**

Design Variable	Definition
Virtual components	Components that appear to belong to the organization but do not really exist or are part of another organization, such as a virtual raw materials inventory for just-in-time production.
Electronic linking	Connecting two entities electronically, such as through EDI links.
Technological leveling	Use of communications technology to increase the span of control for managers and eliminate the need for layers of management through direct communications between upper and lower levels.
Production automation	Classical automation of production processes.
Electronic workflows	The capture and routing of information in electronic form rather than on paper.
Electronic communications	Communications through email and groupware.
Technological matrixing	Matrix management enabled by email and groupware, reducing or eliminating the need for extensive physical contact among members of the matrix.
Electronic customer/supplier relationships	Extensive electronic linking with customers and suppliers through email, EDI, groupware, and direct links to speed the flow of information and reduce paperwork.

ence the following changes:

*30% less need for retail space.* In a 2000 report, the U.S. Department of Commerce noted: "The share of households with Internet access soared by 58% since the last Census, rising from 26.2% in December 1998 to 41.5% in August 2000. More than half of all households (51.0%) have computers ... There were 116.5 million Americans online at some location in August 2000 ... The share of individuals using the Internet rose by a third, from 32.7% in December 1998 to 44.4% in August 2000. If growth continues at this rate, more than half of all Americans will be using the Internet by the middle of 2001."

As many as 379 million people in 21 countries were connected to the Internet as of March 2001—a number that can be expected to increase steadily for many years. Internet users are likely to be more affluent and spend a greater share of their incomes in retail stores than their non-Internet-using counterparts. The U.S. population, as reported in the 2000 Census, was about 281.4 million. If half of them now have Internet access, and if a quarter of that half purchases something online, about 34 million people in the U.S. will make use of business-to-consumer e-commerce by the end of 2001. This number of people buying things online is growing, so a 30% decline in the need for



- The repopulation of rural areas by remote workers; and
- Less commuting between home and job, with less time lost and less environmental damage due to fewer cars on the road than has been the case in the U.S. over the past half century.

It should be noted that these predictions imply a change in the place and time of work and in the allocation of physical space within cities and between cities and suburbs. They do not imply the end of urban areas or even necessarily their decline. Recognizing these changes and the trends responsible for them should allow policymakers and

planners to respond with strategies for positioning cities for their changing roles in the emerging global economy.

These predictions rely on several assumptions. One of the most important is the continued expansion of Internet access from homes and offices. Because it appears that at least 50% of U.S. homes are online, companies and other organizations now know they can reach this part of the population on the Internet, especially consumers with the most desirable demographic characteristics. The growing availability of broadband connections to the Net should accelerate access. Inexpensive personal computers and Web-enabled PDAs and cell phones should provide added impetus for connecting to the Internet and participating in e-commerce.

**Table 2. Characteristics of technology-enabled organizations; italics indicate characteristics influencing demand for physical commercial office, retail, and warehouse space [3].**

Flat organization structure
Substitution of technology for layers of management
<i>Flexible fast-response organizations</i>
<i>Matrix management using technology</i>
<i>Decentralized decision making</i>
Trust between superiors and subordinates
Concern over logical rather than physical structure
Shifting reporting relationships
Remote work
<i>Extensive interorganizational systems</i>
<i>Electronic connections with customers and suppliers</i>
<i>Virtual components</i>
Strategic alliances with other organizations
Ability to manage IT
Robust technological infrastructure, including networks
<i>Participation in electronic markets</i>
Increasing complexity
Capacity for fast response

retail space is a reasonable estimate.

These changes will affect construction of new office, retail, factory, and warehouse space throughout the U.S.; in particular we can extrapolate that there will be:

- Much less need for new office and retail space, thus reducing the amount of new construction;
- A significant decline in the growth of construction of new shopping malls throughout the U.S.;
- A revived role for cities and urban areas as places for people to meet, live, and work;
- Potential significant loss of property tax revenue for cities;

## Basis for Predictions

These predictions are also based on the profound effect IT is having on organizations and their workers. IT design variables make it possible to create new structures and entirely new types of organizations (see Table 1). The first-order effect of these design variables is the emergence of new types of organizations (see Table 2); the second-order effect is on the demand, market, and allocation of physical space (see the figure here).

In the figure, e-customer/e-supplier relationships and virtual components encourage e-commerce through virtual stores and malls. E-commerce is changing the nature of markets and the role of intermediaries. Can we expect there will still be a need for branch banks, brokerage offices, other financial services locations, and real estate agencies?

Virtual components, electronic data interchange (EDI), and just-in-time (JIT) inventory management and production automation influence demand for

industrial space. JIT production relies on suppliers to faithfully deliver materials on schedule. As a result, suppliers may choose to locate close to customers. A JIT plant can be smaller than a traditional production facility. Better control of inventory means less need for warehouse space.

Electronic communications and linking encourage corporate management to eliminate offices for mobile workers, substituting telecommuting for traditional physical office space. Electronic communications and technological matrixing are prime reasons for hoteling, or the time-sharing of office space.

These trends point to greatly reduced demand for space over the next five years in a variety of U.S. businesses. There will be less need for office space as employees work remotely, both alone and in groups, and give up their private offices. More alliances and virtual arrangements allow organizations to reduce their size compared to the vertical integration characterizing earlier periods of business history. Alliances and outsourcing reduce the amount of physical space needed to conduct business and manufacture products.

Concomitantly with changes in office and manufacturing operations, we can expect significant reduction in the need for retail space for consumer sales. Moreover, there will be far fewer intermediaries, as e-markets and services replace middlemen. Simply, e-commerce means customers have fewer reasons to visit traditional brick-and-mortar retail stores.

While my main focus here is commercial office, retail, and factory space in the U.S., challenges abound in managing the new organizational forms that could slow their development. As long ago as 1996, the cybercommerce experience reported by Nathaniel Borenstein of First Virtual remains helpful in understanding some of the management issues in organizations enabled by IT design variables [1]. First, there is more electronic contact between coworkers, rather than traditional physical interaction. Many temporary relationships are project/client-oriented, as workers spend less time in a given physical office location. However, while it may seem attractive to work anytime anyplace, this option may lead to a new outbreak of workaholicism with its negative effect on personal and family relations. To balance the negative, managers hope their employees are both more efficient and more effective. If new organizational forms enable more productive performance, employees should presumably be more satisfied with their productivity and contribution to their organizations.

## Evidence for Predictions

Urban studies, involving demand for and allocation and use of physical space, especially in cities, includes

the relationship between cities and telecommunications based on one of four broad models: technological determinism; futurism and utopianism; dystopianism and political economy; and the social construction of technology [4]. Some researchers, including the authors of [4], reject the first two—technology determinism and futurism and utopianism—as too simple and devoid of notions of social influence. These models also suffer from the assumption that technology has a generally benign and positive effect on demand for physical space. To understand telecommunications and cities, according to [4], one should start by blending insight from urban political economy and social constructivism, focusing on the notion that “telecommunications-based innovation in cities is ... socially, politically, and culturally shaped, rather than being purely technical” [4].

My view is primarily one of the technology imperative and futurism, though I don’t assume technology is independent of social, political, or cultural influences. The technological imperative identifies crucial advances in technology that influence society and affect economic decision-making that, in turn, influences the adoption and use of technology.

A number of insightful ideas can be found in [2, 4] on the relationship between cities and the modes of telecommunications. However, these sources were written before the Internet was available for commercial use and do not refer to Internet-based technologies. They also do not contain much information about the effect on demand for physical space following the business use of technology.

Business IT certainly has had a dramatic effect on the U.S. economy and on demand for commercial office, retail, and factory space. Businesses use IT to restructure themselves, establish new relationships with customers and suppliers, open new distribution channels, and communicate with investors and the public. Technology goes well beyond telecommunications to include computational devices, large databases, fax machines, and a variety of wireless options.

However, despite moving toward more virtual organizations, experience in e-commerce and corporate IT development over the past few years has shown face-to-face contact is still important. Cities remain hubs in the worldwide transportation system and are natural places for face-to-face interaction. Urban areas are likely to see changes in the allocation of physical space and in some categories of commerce the reduction of the need for space overall.

It is possible to model demand for office space, though it turns out the models are not much help in predicting IT’s effect on demand for physical commercial retail, office, and factory space. First, the mod-



els tend to be proprietary, generally available only to financial analysts and other professionals in the real estate and construction industries. A macroeconomic accelerator model developed by MIT's William Wheaton helps predict demand for office space based on estimates of manufacturing employment, wholesale employment, after-tax cost of capital, vacancy rate, and certain adjustments. The model is estimated with lagged independent variables, as current demand for office demand is based on past economic activity.

The IT variables I've discussed here do not have a major effect on the independent variables in Wheaton's model, except where new forms of commerce increase total economic output. E-commerce is still so new it hasn't yet had enough time to affect this particular model, given its lagged independent variables. IT variables and trends portend a shift in economic activity because they remove constraints of time and place and the need to tie activities to a physical office. It is therefore difficult to quantify this effect and include it in models.

Thus, it does not appear that existing econometric models provide evidence for the predictions I mentioned earlier. What about extrapolating from examples of new businesses and services enabled by IT and the possibilities they suggest? Following are some examples, along with their implications for demand for space throughout the U.S.

**Retail.** IT's effect on retail space results primarily from networks, e-commerce, and the related bypassing of intermediaries. (It is estimated that 75% of demand for office space in the U.S. commercial real estate market is for financial, insurance and real estate firms, all businesses that can be expected to use technology to reduce their need for space.) The recent well-documented difficulties of e-commerce merchants are temporary; e-commerce will continue to develop at the retail level, though for the next few years merchants with physical stores as well as a Web site are likely to experience the greatest success. Electronic kiosks in brick-and-mortar stores allow customers to order items not in stock while allowing merchants to carry less merchandise in smaller stores.

**Banking.** Over the past 10 years, a major trend in the retail banking industry has been the proliferation of branch banks across the U.S. Given the benefits and tradeoffs of IT and Internet-based telecommunications, one must question whether there is a need for physical branch banks at all, except possibly for a few specialized locations offering safe-deposit boxes.

One example of a branchless bank is First Direct of Leeds, England, with more than 250,000 customers but no branch locations. It uses technology to create personal relationships with its customers. Technology

makes a customer's complete record available to any of its bankers answering the 24,000 calls a day that come into the bank. By having complete client information available, a bank representative can look to cross-sell add-on products and services to customers on the phone and answer questions about their relationships with the bank. First Direct is a division of Midland Bank and appeals to affluent professionals; the average account balance is 10 times greater than at Midland overall. The bank's overall costs are 61% less than its costs for dealing with its traditional customers; it makes money on 60% of its customers compared to 40% at the average British bank. This is all accomplished in a single large building resembling an aircraft hanger in an industrial part of Leeds, as reported in *The New York Times*, September 3, 1995.

Hugh McColl, Chairman of NationsBank, speaking at an NYU seminar in 1997, indicated his bank closed 150 branches in 1996 while installing almost 1,000 ATMs around the U.S. (NationsBank has since merged with Bank of America, another leader in home banking.)

The Web means any potential banking customer need not rely on bankers or physical branches; each of us can be our own banker if we so choose. Moreover, home banking is a major application on the French Minitel system, suggesting the likelihood that a similar application could be popular on the Internet as well.

**Stock markets and brokerages.** The proliferation of electronic stock exchanges prompts the question of whether or not we will need physical exchanges in the future. The London and Cincinnati stock exchanges are electronic, as is Nasdaq. There are also many markets similar to stock exchanges, including the flower market in Holland and automobile and livestock auctions in the U.S. The last few years have also seen a proliferation of electronic communications networks (ECNs) for trading securities, including Archipelago and Island, which handles 6% of all Nasdaq trades. Posit, another network, matches orders electronically for institutions seeking to bypass the exchange floor. One day recently, it traded 30 million shares, a total equal to the combined volume of three regional U.S. exchanges. The U.S. Securities and Exchange Commission has ruled that ECNs can apply to become stock exchanges, as reported in *The Wall Street Journal*, July 27, 1999. These networks threaten physical exchanges, as brokerages route trades to them instead of to traditional exchange floors.

Capital.com provides advice and assistance for raising capital through a network of partners in the U.S. Other entrepreneurs on the Web help their customers reduce trading costs by eliminating contact with relatively high-priced human stockbrokers. If a substantial

percentage of the investing public makes its own decisions, how many retail brokerage offices will we ultimately need? There are currently at least 55 companies offering brokerage services on the Internet, according to [www.gomez.com](http://www.gomez.com). Charles Schwab is the leader with a 30% market share of Internet trading, the greatest Web presence among discount e-brokerages; in a recent quarter, over 80% of the company's trades were online. At one point, Schwab's market capitalization exceeded that of Merrill Lynch, an established full-service broker. Merrill resisted e-trading on the Internet until 1999 when competition forced it to begin offering this option to remain competitive.

**Real estate.** The real estate market offers a natural fit for Web support. On the retail side, most brokerages in the U.S. form a cartel controlling a multiple-listings service, jointly setting fixed commissions for selling homes. It is easy to envision a market in which one describes the location and characteristics of a home and lets a potential purchaser search for homes for sale matching these preferences. Today, one can find a significant presence of traditional real estate brokers from around the U.S. on the Web. And individual homeowners are beginning to list their homes on Web sites catering to the residential real estate market. Does this trend suggest the eventual end of the residential real estate industry, as sellers and buyers seek to spare themselves from paying traditional 5%–7% commissions?

**Insurance.** The retail insurance agency as we know it may also disappear, as consumers purchase insurance through the Web rather than through human agents. However, the 650,000 insurance agents in the U.S. will probably not surrender easily to a network. Although only a few thousand people shop for retail insurance on the Internet today, the potential for this kind of business is great. Most insurance being sold on the Web is term-life, a relatively simple insurance to purchase because it lacks investment features. For current quotations, see [www.insweb.com](http://www.insweb.com), [www.quickquote.com](http://www.quickquote.com), and [www.quotesmith.com](http://www.quotesmith.com).

**Groceries.** The number of grocery providers on the Web is shrinking, especially following the 2001 bankruptcy of the well-financed and highly publicized Webvan. Not clear is whether buying and selling groceries through the Web will ever be popular, though some grocers continue to experiment with Internet sales in both the U.K. and the U.S. However, if Net grocers do succeed, practically any kind of merchant may come to believe it is possible to sell electronically. Buyers are used to seeing and inspecting vegetables and other produce. Can Web grocers offer good enough quality to eliminate the need for buyer inspection? Today, some Web grocers still charge a premium,

attracting customers among dual-wage-earner families and busy professionals, as reported in *BusinessWeek*, July 26, 1999. The effect of Web grocers on traditional grocery store locations will be limited for at least the next five years; any reduction in the number of traditional grocery stores is likely to be offset by Web grocers' warehouse requirements.

**Retail shopping.** The U.S. population's automobile dependency, history, and culture, together with the emergence of the suburbs, in the second half of the 20th century helped create the shopping mall, which eliminated retailing from a number of urban locations. The emergence of dual-wage-earning families and the quest for more leisure time has helped generate a huge market in the U.S. in mail-order sales for brand-name products. A skeptic might have thought the mail-order business model would never work for clothing; customers need to see and try on the merchandise. But some of the most successful mail-order companies, like Lands' End and L.L. Bean, sell clothing by mail. By establishing a reputation for quality and offering the option of free returns, they have succeeded in luring millions of American consumers out of stores.

It is easy to envision almost all mail-order companies moving their retail operations to the Internet; for example, see [www.llbean.com](http://www.llbean.com). Meanwhile, about 50% of Dell Computer's \$32 billion in sales in its fiscal year 2001 came directly through its own mail-order-type Web site ([www.dell.com](http://www.dell.com)). Why not a virtual shopping mall? There are some products potential customers simply have to see, touch, listen to, and try out; for example, who would buy a \$20,000–\$60,000 car online? Today, a number of people use the Net to solicit bids for cars but only after they've visited dealers and specified the model they might want; an example site is [Autobyte.com](http://Autobyte.com) ([www.autobyte.com](http://www.autobyte.com)). In a similar vein, Lands End offers its customers the option of creating a computer model of themselves so they can see how a variety of clothes (represented virtually) look on them when shopping online.

Another fast-growing Internet phenomenon is the online auction, as provided by such sites as [Amazon.com](http://Amazon.com), [eBay](http://eBay), and [Yahoo](http://Yahoo). Auctions replacing traditional outlets mean less demand for retail space. However, we can expect to continue to need retail space to see products and possibly buy some of them. Not clear is whether many merchants will maintain their commitments to physical space purely to let customers see products they might otherwise buy conveniently online.

**Disappearing stores.** Initiatives suggested or under way make it likely that some familiar retailers will operate without traditional brick-and-mortar stores.

For example, phone and cable companies would like to replace the ubiquitous retail video store by providing video-on-demand services via electronic distribution. Today you can order CDs on the Web (www.CDnow.com and www.Amazon.com), and recording labels are experimenting with selling music on the Internet, now that they've practically eliminated the Napster free file-sharing model from the network. It is easy to envision electronic distribution for music, motivating the music store to go virtual. If Napster survives, it will make music available only with the cooperation of music publishers. While few consumers seem to want to download a book, they may find it easier to order a book via the Web than by visiting a bookstore. (Despite the emergence of special-purpose book computer devices, sales are modest.) Moreover, we will download software via the Internet and use it to consult online software manuals and tutorials that go beyond the help function in packaged programs; there is likely to be little need for stores selling software.

**Travel agents.** The corner travel agent is another familiar physical presence, like the branch bank, brokerage office, and retail shopping mall. Computerized airline reservation systems are credited with saving travel agencies when the U.S. government deregulated much of air travel in the 1970s and 1980s. Since that time, travel agencies' share of tickets went from less than 30% to 80%, as they installed reservation systems. Airlines would like to have you book directly with them to save the commission they pay travel agents. Most major airlines have established Web sites to allow individual travelers to make their own reservations; some offer special discount fares when booking on their own sites. American Airlines offers check-in terminals at some airports so travelers can make reservations on the Internet, choose an e-ticket, then check-in at an airport computer terminal to avoid standing in check-in lines.

Travelocity, a neutral service aimed at individuals making their own travel plans, lists flight and seat options for almost all airlines worldwide. Cheaptickets, Expedia, Priceline, and Travelocity are all popular Web sites for individual flyers making their own travel arrangements.

While some travel agents may survive, it is less likely that the local office will be needed in the future, as individuals make their own reservations, generating e-tickets, and printing their itineraries to take to the airport. E-tickets now account for about one-third of all trips on airlines in the U.S.

**Office space.** It has been estimated that 10%–20% of a firm's annual revenues go to renting, leasing, or buying space in the U.S.—the second largest cost after

employees, as reported in *Management Today*, January 1996, and *The Financial Times*, November 17, 1995. Hoteling has been implemented in some locations around the U.S. by such major companies as Accenture, Coopers & Lybrand, Ernst & Young, IBM, Reuters, and Touche Ross. Ernst & Young saved 30% in the amount of space it needed and in the costs it had to pay for that space, and IBM saved 25% in two projects, as reported in *Management Services*, September 1995. Meanwhile, Accenture accommodated up to 40% more people in the same site in one office building, as reported in the *Detroit News*, July 9, 1995. Some mobile workers in AT&T and Xerox have no offices at all. The recently retired CIO of VeriFone has two homes from which he worked but no office. If other companies follow these leads, the effect on demand for office space throughout the U.S. will be dramatic.

The city of Telluride, CO, promotes itself as a pioneer location for telecommuters. City officials obtained a state grant to set up an Internet server and make it available to people there. As a result, many professionals with second homes in Telluride have become year-round residents, telecommuting wherever they need to go.

IT continues to represent an opportunity for governments to invigorate local economies. Policymakers have additional strategies they can use to reverse the decline of a city or region or increase the number and type of business opportunities available to their residents. While the 1980s saw a decline in population in most rural counties throughout the U.S., the trend is reversing, according to Census reports; today non-metropolitan counties in the U.S. are seeing an influx of new residents.

Although I've argued here that IT can be expected to reduce demand for office space in general over the next five years, the IT industry also creates demand for offices, and has, until recently, been one of the fastest growing industries in the world. For example, the trend toward huge server farms with thousands of computers requires considerable amounts of physical space. From Silicon Valley in California to Silicon Alley in New York, the IT industry itself offsets in a small way the second-order effects of IT in reducing demand for space.

**Industrial space.** The formation of alliances among manufacturers and use of virtual components, along with EDI and JIT manufacturing and management practices, also affects demand for industrial space. With JIT production, manufacturers need to keep only minimal supplies of raw material and, in process inventory, reduce the need for physical storage space. Suppliers, linked through EDI, produce to a stable

manufacturing or build plan, minimizing their finished-goods-inventory requirements. Another trend among manufacturers is to work only with a limited number of high-quality suppliers that may choose to locate small local plants near major customers to facilitate JIT production.

To enhance the ability of companies to establish customer-supplier links, CommerceNet is working to establish standards for data interchange on the Internet. In an early test, the Bank of America and Lawrence Livermore National Laboratory used the Internet for EDI-like exchanges. Other firms encourage customers to order from them using Web browsers, rather than waiting for EDI on the Internet. Intel, the world's leading manufacturer of semiconductors, was surprised to find itself booking \$1 billion a month in orders within a year of establishing a Web order-entry capability. Development of XML standards can be expected to increase the electronic exchange of information among partners in the supply chain in practically any market.

The trend of organizations establishing JIT relationships and alliances suggests a decline in the need for physical warehouses. Very large retailers like Wal-Mart electronically connect directly to their suppliers, who then replenish store shelves, thus reducing the need for Wal-Mart to maintain physical warehouse space. Two opposing trends also simultaneously influence the need for physical space by retailers. Web merchants, including Amazon.com, are building physical warehouses to supply their customers. As Nomura Securities pointed out, the demand for warehouse space is actually increasing in certain areas of the U.S. due to burgeoning foreign trade; the U.S. imports and exports about 10% of its gross domestic product. Warehouse space was reported to be tight on the West Coast (before the Asian economic crisis in the late 1990s) due to extensive trade between the U.S. and Pacific Rim countries. Meanwhile, the increasing use of air freight has stimulated demand for and construction of new warehouse space near airports throughout the U.S. Thus, demand for warehouses is influenced by conflicting trends. It is therefore difficult to predict whether or not increased trade and warehouses for e-merchants will offset the effect of IT in reducing the general need for warehouses.

These trends in society and technology reinforce each other, suggesting the need for office and retail space will decrease substantially in the next five years. As reflected in the figure here, e-commerce and virtual stores can be expected to continue to help reduce overall demand for retail space. More mobile workers and telecommuting will do the same for office space, while increasing demand for satellite offices and hoteling.

Within five years, the decline in the need for physical space in the U.S. real estate market will alter commuting and living patterns, communications, and social relationships, as well as urban and rural environments throughout the country. Less demand for space will also affect wealth in the U.S. Real estate represents 40% of the combined wealth of U.S. industry and 20% of the entire U.S. gross domestic product, as reported by Bloomberg Business News, February 4, 1996. Will new business activity and wealth stimulated by IT make up for the effect of technology on real estate value?

## Conclusion

IT facilitates the design of new types of organizations, institutions, and partnering arrangements. Their implementation has second-order effects on demand for physical space for manufacturing, retailing, and offices in the U.S. I've sought to demonstrate the possibilities for new ways of doing business in which IT substitutes for physical space. If my predictions are correct, we will see dramatic changes in our physical environment in the U.S., as well as throughout the industrialized world. Cities will continue to be meeting places for business, but rural areas will gain population at the expense of their urban counterparts. The nature of retailing and its demand for space will also change. While the effects of these changes on employment and the construction industry are difficult to forecast, we should all expect to benefit from less pollution from reduced commutation and urban density.

Most exciting about IT's second- and third-order effects is they represent a vast store of new options for business managers. Along with consumers and policymakers, they now have alternatives that did not exist before the development of IT design variables. Our common challenge is to recognize IT's potential for changing our environment, shaping it in a way that provides the greatest benefit to the greatest number of people. ■

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