Will Computer Communication End Geography?

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Executive Summary

Many people have said that developments in transportation and especially in communications have led to the decline of geography as a factor in industry and government. This study examines what is known about these developments and what differences they make. Specifically, how have organizations made use of smaller, faster, cheaper, and better computer and communications products and services to eliminate or, at least, reduce the constraints of space and time on their activities?

The study concludes that, much as with transportation, as computer communication approaches ubiquity, it increasingly diminishes the influence of physical geography and expands the choices available to decisionmakers. Nevertheless, rather than just attenuate geography, computer communication transforms it by creating new and expanded spatial terrains on which organizations can operate.

Computer communication appears to be following the pattern historians document for the process of electrification. Electricity began as a spectacle featured in every "Great White Way" that lighted up the night in cities across America. As with most technologies, its unique value as spectacle gave way to routine when the real process of electrifying society took place, as electricity powered enormous gains in productivity, transformed social relations, and widened choice everywhere. All this occurred even as electricity literally and figuratively vanished into the woodwork.

Taking up the lessons electrification offers for the contemporary spectacle of the Information Superhighway, the study concludes by examining the factors likely to grow in importance as computer communication shifts from spectacle to become a very powerful resident in today's woodwork.

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Taking up the lessons electrification offers for the contemporary spectacle of the Information Superhighway, this paper concludes by examining the factors likely to grow in importance as computer communication shifts from spectacle to become a very powerful resident in today's woodwork.

Transportation Shrinks the Map

A large body of research documents the impact of technological change in transportation on the speed of travel. For most of human history, transportation was slow and inefficient and the cost of attenuating geography prohibitively high. By the end of the eighteenth century, with the exception of a few stagecoaches and ships, vehicles could not move faster than a person could walk.[1] Until the turn of the nineteenth century, the means of travel differed

[1]Though a fresh wind might give them a best speed of six to seven knots, the English Pilgrims sailed to what became the United States in 1620 at an average of two miles per hour (Vance, 1986).

little from what prevailed in biblical times: "shanks mare and draft animals on land, oar and sail on water."[2]

As Pool has documented,[3] this meant little significant change in the geography of cities, as the city, dependent on pedestrian traffic, grew from a radius of four miles to the eight-mile radius of the horse-using city but little further. Geographers have described the changes brought about by technological innovation over the last two centuries (see **Figure 1**). The nineteenth century saw the application of steam power as a means of propulsion and the use of iron and steel for ocean-going vessels, trains, and track. The twentieth century introduced the gasoline-powered internal combustion engine, which made truck and automobile travel widely available. Large, ocean-going "superfreighters," containerization, and commercial jet aircraft reduced travel times further[4] (see **Figure 2**).

In their attempt to comprehend the significance of transportation-based changes, Malone and Rockart (1991) identify three orders of effects. The first order substitutes new technologies for old, when people ride steam trains and later cars, rather than horses and horse-drawn carriages. Improvements in technology lead to the emergence of a second-order effect, i.e., people travel more, whether to work every day, to visit distant friends, or to attend business meetings. Finally, a third-order effect is marked by the rise of new transportation-intensive social patterns, which include principally suburbanization, shopping malls, and, more recently, the global, "edge," or "100-mile" city.[5]

The rate of change in what geographers refer to as *time-space convergence*[6] is worth reflection. For example, assuming a foot speed of three miles per hour, until the sixteenth century the effective distance between Portland, Maine, and San Diego, California, was two years. Horseback reduced this distance to eight months by the seventeenth century. By the mid-nineteenth century, the stagecoach and wagon halved that distance to four months, and, by the turn of the next century, trains made the trip in four days. By 1950, air travel reduced that distance to ten hours, and today it is five. According to Lowe and Moryadas (1975), San Diego is, in effect, fifteen miles from Portland. Alternatively, in terms of transcontinental or intermetropolitan area travel time, the U.S. is now as large as a medium-size state, New York

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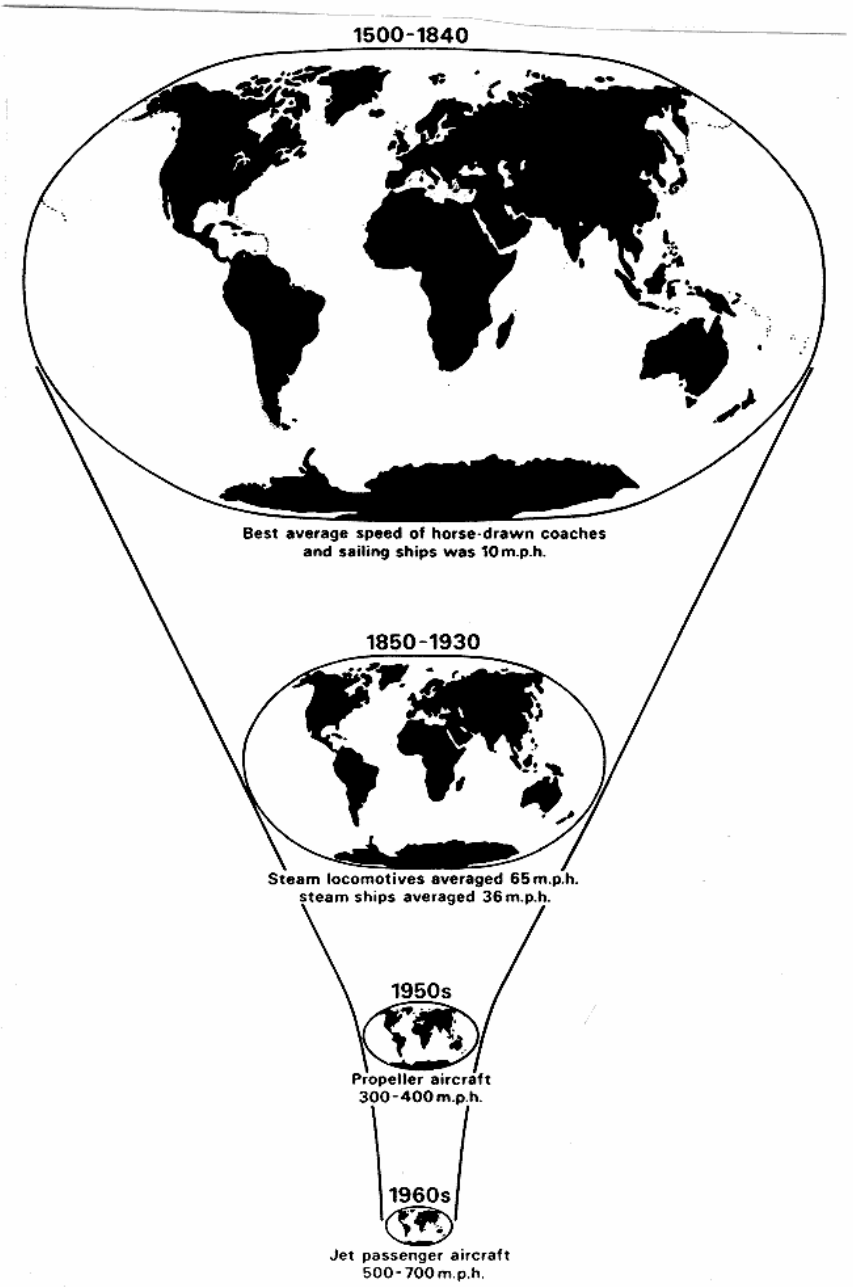
[2]Woytinsky and Woytinsky, 1955: 306.

[3]1983: 45.

[4]Dicken, 1986. Blainey's (1982) study of Australia's development provides some of the richest descriptive detail on the relationship between transportation and geography. Lawrence (1983) reminds us that it was not simply the speed of travel that attenuated geographical constraints but the regularity of service. For example, the development of packet ship service between New York and Liverpool was significant, because it regularized service, including message distribution service, between the two points.

[5]Sassen, 1991; Garreau, 1988; Sudjic, 1992.

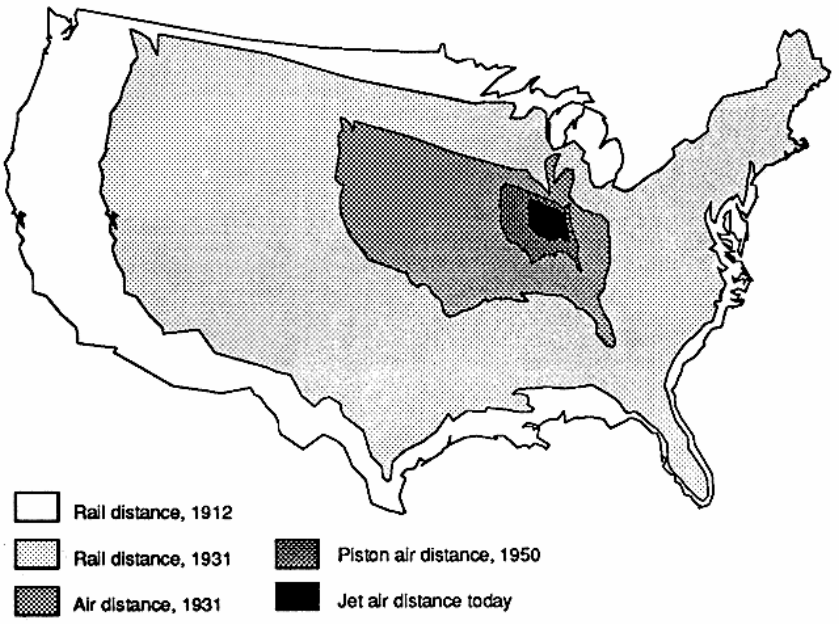
[6]Janelle, 1991.



Source: "Global Shrinkage," from Peter Dicken, *Global Shift* (New York: HarperCollins, 1986); reprinted with permission. Based on J. McHale, *The Future of the Future* (N.Y.: George Braziller, 1969), Figure 1.

Figure 1

The Shrinking World:
The Impact of Transportation Technology on Effective Distance



Source: John C. Lowe and S. Moryadas, *The Geography of Movement* (Boston: Houghton Mifflin, 1975), 51; reprinted with permission.

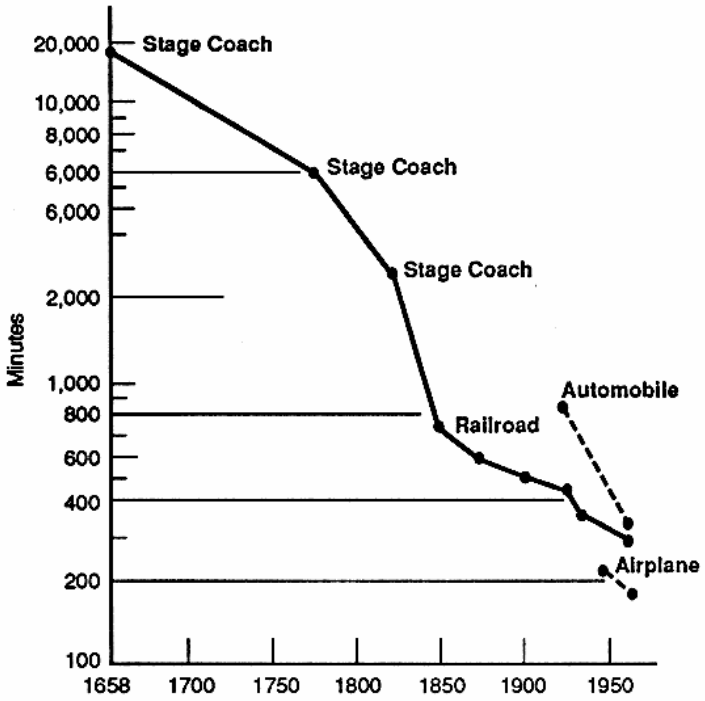
Figure 2

The Shrinking United States:
Transportation and Effective Distance, 1912–1970

now closer to Tokyo than it was to Philadelphia in colonial times.[7] Similarly, innovations in vehicle and road technologies reduced the distance between London and Edinburgh from twenty thousand minutes by stagecoach in 1658, to 2,500 by the modernized stage of 1840, to eight hundred minutes by rail in 1850 (four hundred in 1950), and down to two hundred by air in 1970, for an annual rate of convergence between the two cities of about twenty-nine minutes a year, though, with each innovation in transportation, locations converge at a decreasing rate. Since 1840, when the best average speed of horse-drawn coaches and sailing ships was ten miles per hour, the speed of transportation has increased seventy times with jet passenger aircraft.[8]

[7]Woytinsky and Woytinsky, 1955.

[8]It is hard to question the declining price-performance ratio of transportation technologies. Nevertheless, the curve does not travel in one direction for everyone who would travel. For example, recent attention has been directed to the impact on small towns of declining bus service (Kilborn, 1991).



Source: John C. Lowe and S. Moryadas, *The Geography of Movement* (Boston: Houghton Mifflin, 1975), 52; reprinted with permission. Reprinted from Donald G. Janelle, "Central Place Development in a Time–Space Framework," *The Professional Geographer* **20** (1968), 5-10.

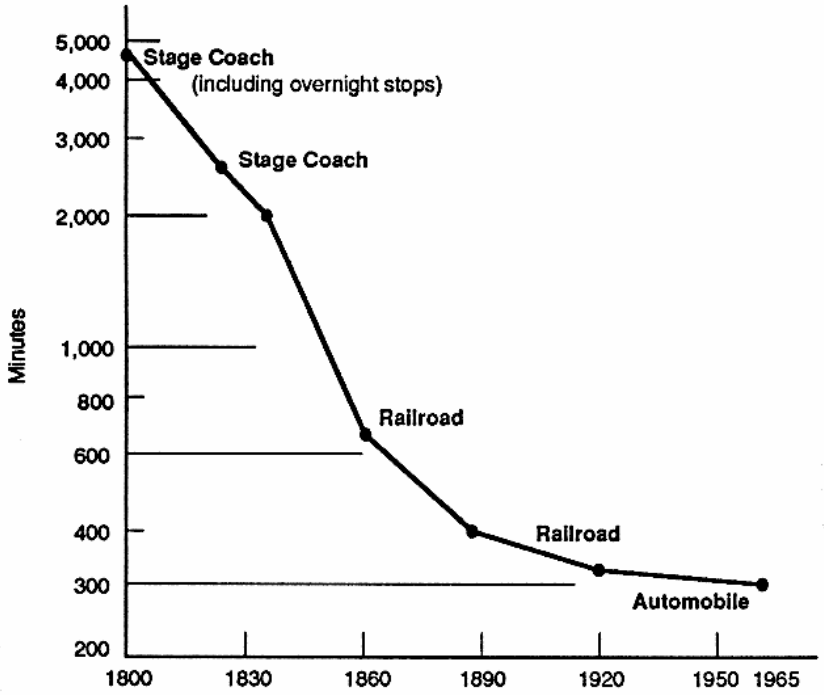
Figure 3

Time–Space Convergence between Edinburgh and London, 1685–1966

Communication Shrinks the Map and Expands Choice

Until electricity and mechanics combined brought the telegraph in the nineteenth century, transportation and communication were effectively conjoined, because information could only move as fast as transportation systems could take it. Pred (1973) has documented and mapped the time necessary for information to circulate both within the U.S. and between it and foreign centers in the pre-telegraph era (see **Figures 5, 6,** and **7**). Although he notes significant advances, these depended entirely on improvements in transportation technologies. For example, the postal act of 1836, which supported "express" mail routes, coupled with the growth of steamboat traffic decreased the public information time lag between Cincinnati and New York from nineteen to seven days.

Although semaphore, bonfire, and smoke signals offered earlier transport-independent (but not weather-independent) means of communication, the telegraph and the submarine cable are chiefly responsible for severing the link between transportation and communication, with



Source: Donald G. Janelle, "Global Interdependence and Its Consequences," in *Collapsing Space and Time*, edited by Stanley D. Brunn and Thomas R. Leinbach (London: HarperCollins Academic, 1991; Routledge), 51.

Figure 4

Time-Space Convergence between New York and Boston, 1800-1965

significant consequences for geography. No longer would it be necessary to use rail or ship to send a message across the country or across the seas. Telegraphy enabled a message to cross the country instantly; undersea cable took messages across oceans. Chandler's (1977) research demonstrates how communication and transportation systems worked together to lay groundwork for the modern American business system: the telegraph extended the reach of timely price information, and the railroad sped the product to market. Along with them came organizational innovations, required to run railroad companies, and new "transaction" jobs, e.g., commodity dealer, wholesale jobber, retailer, that tied together networks formed out of the extended reach of new transport-communication systems.[9] Today transportation and communication systems are integrated to improve the flows of people and vehicles that grew with innovations in transport technologies.[10]

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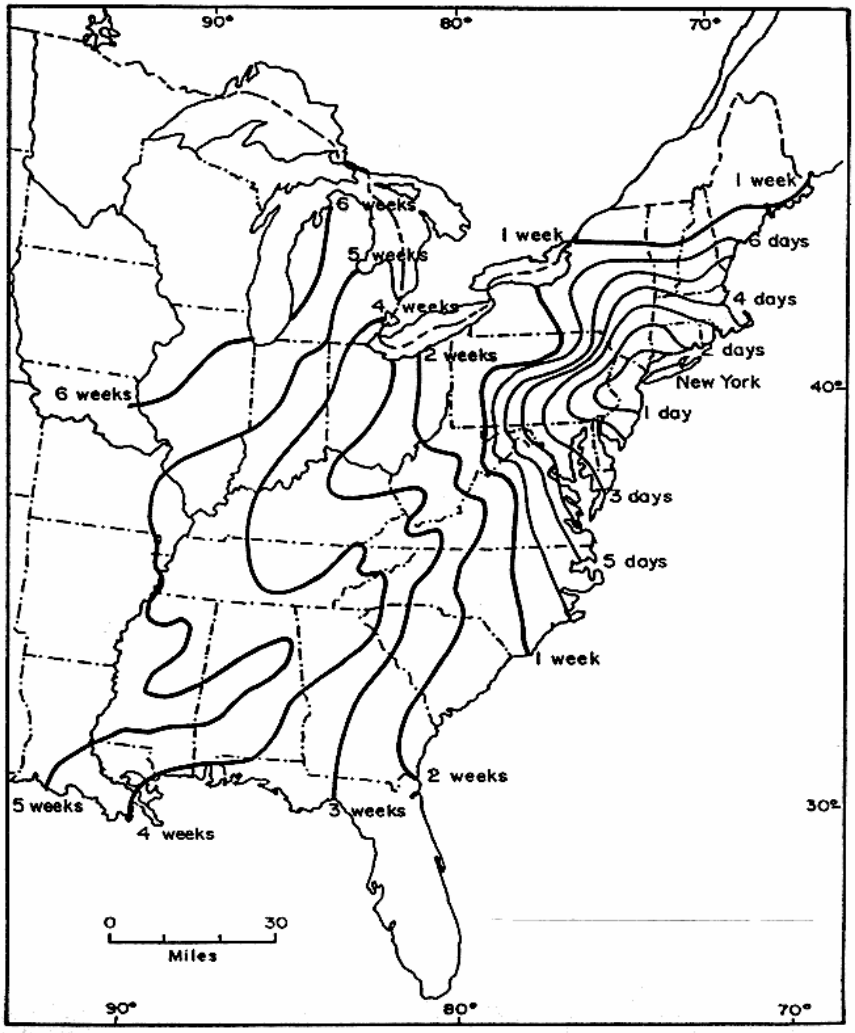
[9]Cf. Beniger, 1986.

[10]Hepworth and Ducatel, 1992.



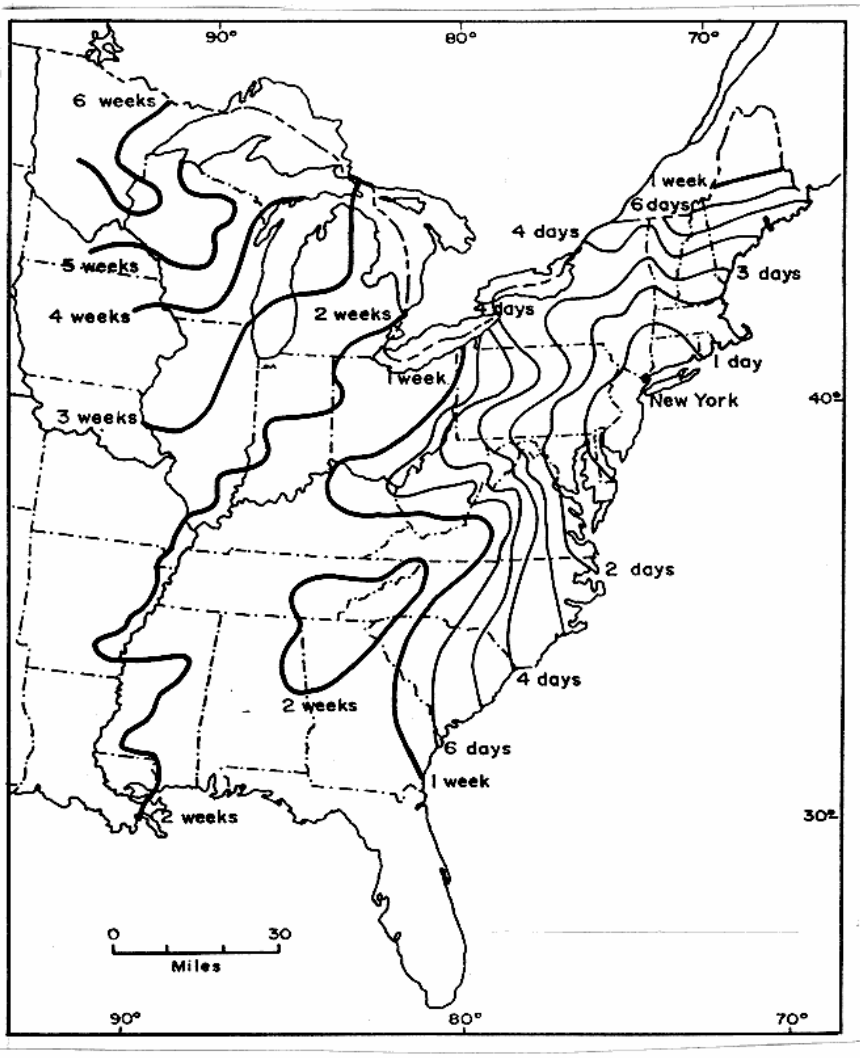
Source: Allan R. Pred, *Urban Growth and the Circulation of Information: The United States System of Cities, 1790–1840* (Cambridge, Mass.: Harvard Studies in Urban History, Harvard University Press, 1973), 176.

Figure 5

Rates of Travel from New York, 1800

Geographers have applied the idea of time-space convergence to map the impact of communication. For example, it took fourteen minutes to carry a voice message from San Francisco to New York City in 1920. Improvements in network structure and technology reduced that to less than thirty seconds by 1970, a standard that now applies to much of the world and amounts to near perfect time-space convergence.[11] The difference between advances in network structure and technology describe the difference between improvements

[11]Abler, Janelle, Philbrick, and Sommer, 1975: 38-39.



Source: Allan R. Pred, *Urban Growth and the Circulation of Information: The United States System of Cities, 1790–1840* (Cambridge, Mass.: Harvard Studies in Urban History, Harvard University Press, 1973), 177.

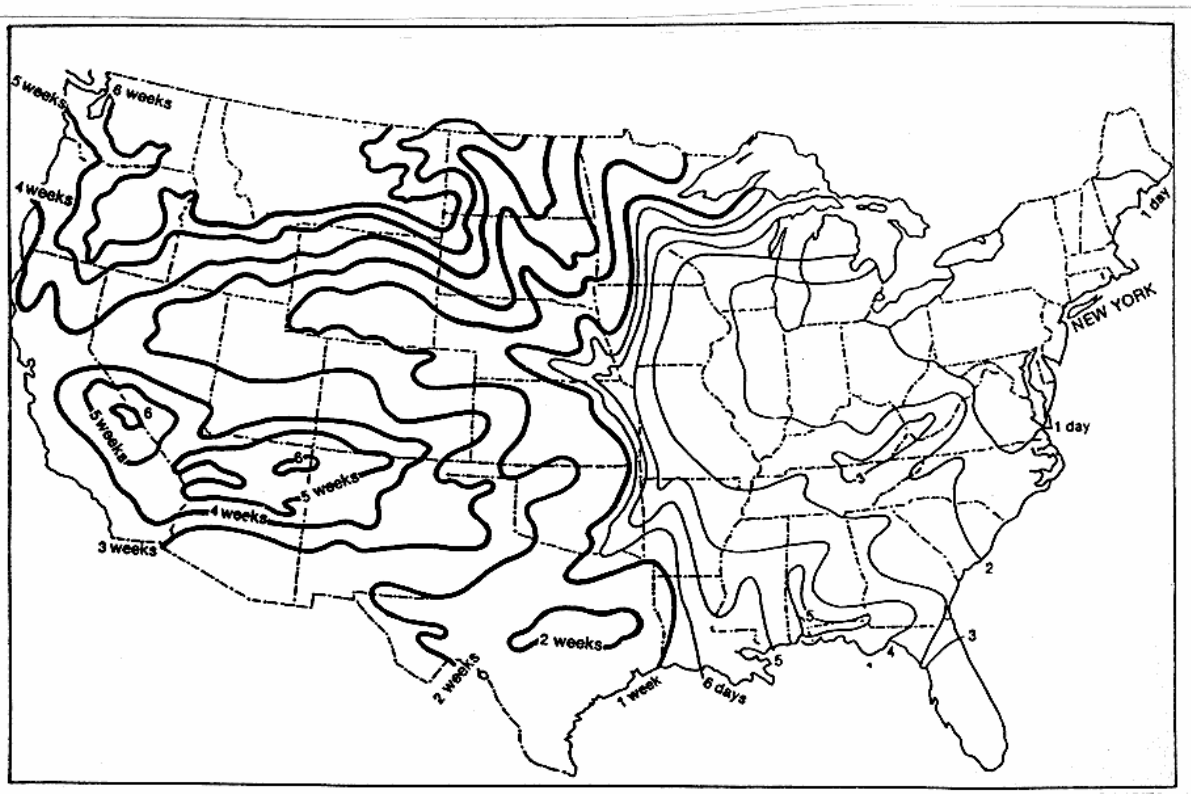
Figure 6

Rates of Travel from New York, 1830

in *system* speed—or the organization of people, institutions, and technologies—and in the speed of *technology*—or what the technology alone can accomplish[12] (see **Tables 1 and 2**).

Research has also taken up time-space convergences for specific types of information. For example, Pred (1980) examined spatial biases in the circulation of specialized economic information in the U.S. from the colonial period. He found that during that time

[12]Lawrence, 1983. For example, there is no difference between the speed of telephone message transmission in 1900 and 1994, but the system that brings people together in a telephone network has expanded over the years.



Source: Alfred D. Chandler, Jr., *The Visible Hand: The Managerial Revolution in American Business* (Cambridge, Mass.: Harvard University Press, 1977), 85.

Figure 7

Rates of Travel from New York, 1857

New York City had become central both as entry point and as dissemination node for such information. Information moved more rapidly and frequently between New York, Philadelphia, Boston, and Baltimore than between any of the latter three cities and almost all hinterland locations. In additional, economic information flowed more rapidly and frequently to and from New York and the southern ports of New Orleans, Richmond, Charlestown, and Mobile than among the those four cities (see **Table 3** and **Figure 8**).

Since by the 1990s communication has trivialized, if not entirely flattened, most graphs of time against distance, geographers have turned to more interesting dimensions of the measure, such as *cost-space convergence*, that is, the cost of moving a message over a given distance. Janelle[13] describes the declining cost of a telephone connection between San Francisco and New York from more than $15.00 in 1920 to less than $1.00 today. Oettinger

[13]In Brunn and Leinbach, 1991.

Table 1

Speeds of Information Transfer Mechanisms

670,000,000 mph	Electronic: telegraph, telephone, radio
670,000,000 mph	Visual: semaphore, bonfires, smoke signals
660 mph	Sonic: drums, horns, whistles
100-600 mph	Aircraft
60 mph	Carrier Pigeon
30-60 mph	Vehicle: motorcycle, automobile, truck, railroad
15-30 mph	Ship
9 mph	Horse: postrider, coach
6 mph	Man

Source: Stephen H. Lawrence, *Centralization and Decentralization: The Compunications Connection* (Cambridge, Mass.: Harvard University, Program on Information Resources Policy, Incidental Paper, July 1983, I-83-2), A1-3.

(1980) mapped telephone cost-space convergence from the geographical center of the U.S., and Neuman (1991) adapted Abler's research to describe general telephone price convergence.

The development in the 1960s of the geosynchronous-orbiting satellite provided the technological means to remove the friction of distance in the determination of communication costs, leading researchers to conclude that in terms of time *and* cost geographical distance is less and less meaningful for communication and information purposes[14] (see **Figures 9, 10,** and **11**).

Malone and Rockart (1991) extend their analysis of orders of effect in transport technology to communication, or what they call "coordination technology." A first-order impact of reducing communication costs is the substitution of information technology for human coordination, which occurs when computer systems eliminate clerks in the back offices of banks and insurance firms and directory-assistance operators from telephone companies. Declining communication costs have a second-order effect of increasing the overall amount of communication used to manage activities. As a result, travel agents can more easily consider a wider range of travel options for their customers, and airlines can offer a wider range of

[14]According to McLaughlin (personal communication, 1993), however, despite the elimination of distance as a cost factor, people need to operate within reasonable proximity to major telecommunications networks. As networks expand, proximity will diminish as a problem.

fares. Otis Elevator uses highly trained, multilingual operators who process trouble calls from a national toll-fee number, record problems in a database, and electronically dispatch local repair personnel.

Third-order effects emerge with the shift to communication-intensive structures. These include intrafirm structures, such as at Frito-Lay, where some ten thousand route sales personnel, using hand-held computers, record all sales of each of two hundred grocery items even as they also deliver products to customers. Every night the information is summarized for forty senior executives, who can make quick price, product, and marketing adjustments. Communication-intensive structures cut across firms to link a chain of, for example, textile suppliers, manufacturers, and retailers into an interfirm network committed to reducing inventory and responding to changing fashions. The Benetton company pioneered the

Table 2

The Development of Information Transmission Systems

500 B.C.	Persian Empire	Postrider	9 mph
0-500 A.D.	Roman Empire	Postrider	9(+) mph
1305-early 1800s A.D.	von Taxis (Europe)	Coach	4 mph (summer) 3.5 mph (winter)
Early 1500s A.D.	Aztec Empire	Runner	11 mph
Late 1500s A.D.	Elizabethan England	Coach	7 mph (summer)
1627 A.D.	d'Medici (Florence-Rome)	Semaphore	5 mph (winter)
Late 1700s A.D.	British Postal Service	Coach	9 mph
1800 A.D.	French Empire	Tachygraphe	120 mph
1860 A.D.	United States	Postrider	8.6 mph
1850 A.D.	United States	Telegraph	670,000,000 mph (between telegraphers)
1900 A.D.	United States	Telephone	670,000,000 mph

Source: Stephen H. Lawrence, *Centralization and Decentralization: The Compunications Connection* (Cambridge, Mass.: Harvard University, Program on Information Resources Policy, Incidental Paper, July 1983, I-83-2), A1-5.

Table 3

Mean Public Information Time Lags for New York, 1817 and 1841 (in Days)

Public-Information Source	1817	1841	Percentage Decrease
Charleston	8.2	5.5	32.9
Savannah	10.2	6.3	38.2
Cincinnati	19.0	7.0*	63.2
Detroit	18.0	7.5*	58.3

*"Since eastbound and westbound mails were of equal frequency, and since both Cincinnati and Detroit possessed daily papers in 1841, New York-to-Cincinnati and New York-to-Detroit time lags were presumably not significantly different from delays in the opposite direction."

Sources: Allan R. Pred, *Urban Growth and the Circulation of Information: The United States System of Cities, 1790–1840* (Cambridge, Mass.: Harvard Studies in Urban History, Harvard University Press, 1973), 56; *New York Evening Post*, 1817, *New York Daily Tribune*, 1841.

application of inventory-reducing just-in-time controls to the clothing industry.[15] These networks can bring together competitors, as in the Rosenbluth International Alliance, an electronic consortium of travel agencies that share customer records, services, and software.

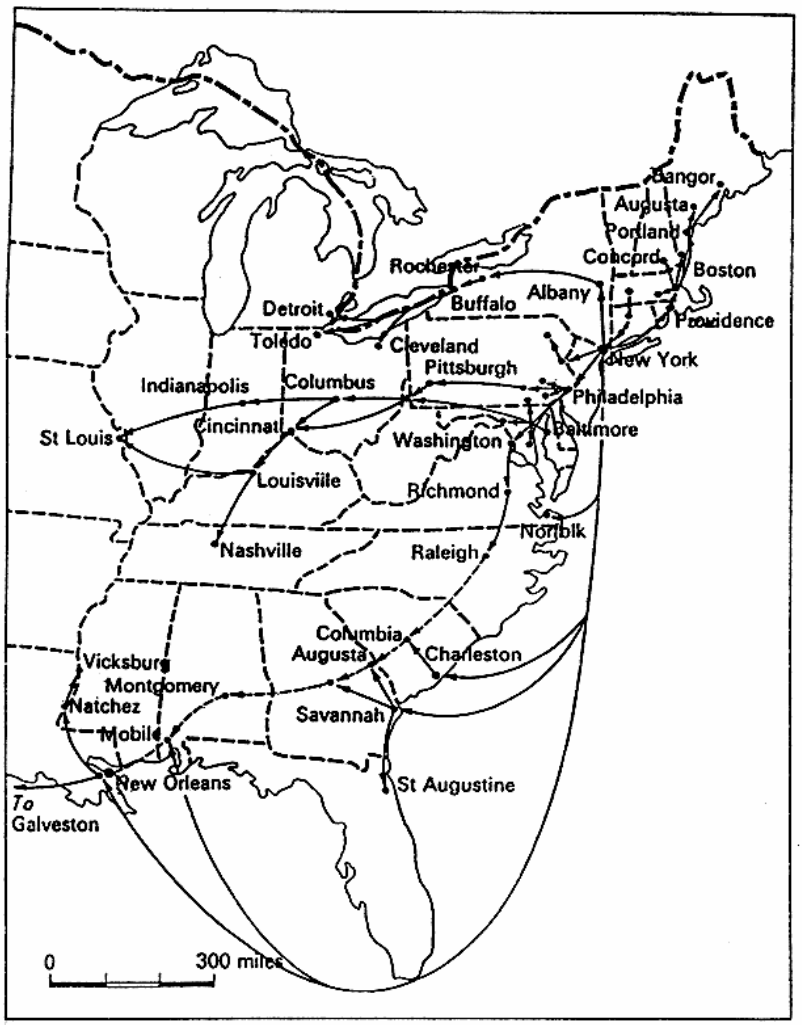
Researchers have developed measures of *social space* to denote the number of social contacts over a specific territory, one variation of which, the mean information field (MIF), measures the probability of communication against the distance between communicators.[16] For example, for a sample of telephone calls in a region, the log of the number of calls can be plotted against the distance over which the calls move. The result suggests a general decline in the density of communication with distance and defines, for that region, the MIF. The slope of the MIF in simple societies is steep, indicating that most communication occurs over short distances, and it is shallower in complex, mobile societies. For some of today's heavy users of electronic networks like the Internet, the slope of the MIF is reversing from its historical downward tendency because the community of interest extends over great distances.

[15]General Motors (GM) learned the hard way that just-in-time inventory controls can have harmful consequences. These controls so tighten the network of producer-suppliers that in the event of a strike assembly plants close down more quickly. An August 1992 strike at the GM plant in Lordstown, Ohio, led almost immediately to plant shut-downs from Baltimore to Oklahoma. According to an industry consultant, "It just means you close it down in one day instead of two weeks" (Saunders, 1992). Ganley (1992) described the opportunities and challenges that telecommunications raise for networks of financial services companies.

[16]Hagerstrand, 1968; Abler, Adam, and Gould, 1971.

Measures of social space are used most in research on patterns of innovation and diffusion to measure the time required, for example, for a new technology to move from one area to another.

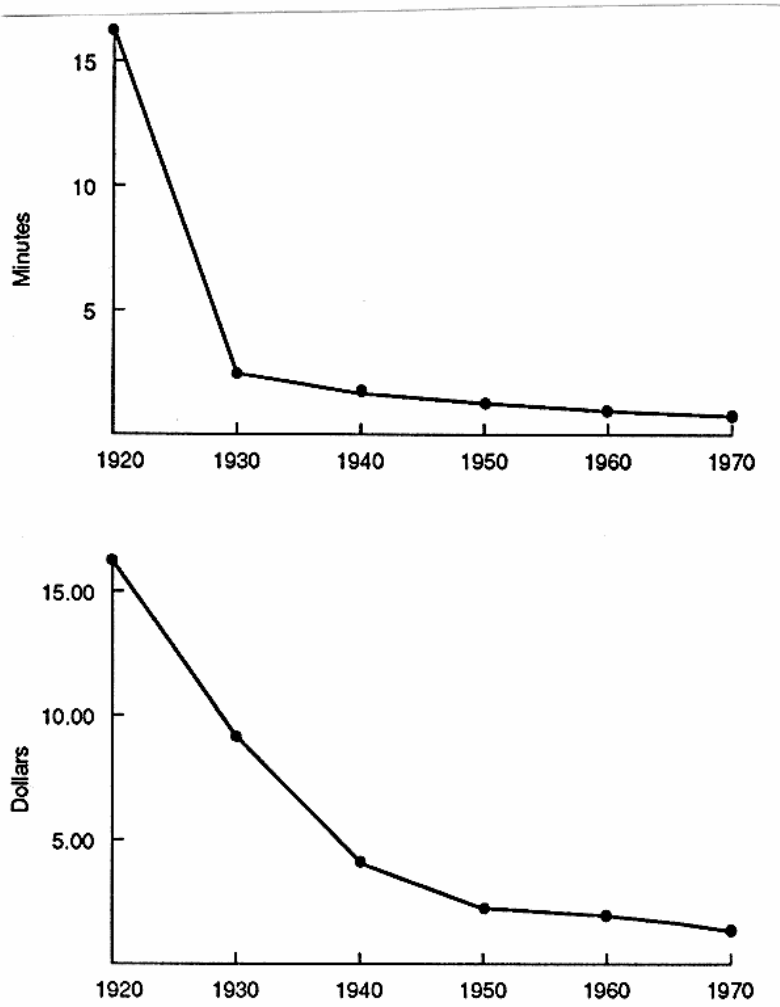
In addition to these objective measures of time-space convergence, geographers take into account the *perceptual* or cultural dimension of convergence. In fact, Abler suggests that



Source: Allan R. Pred, *Urban Growth and the Circulation of Information: The United States System of Cities, 1790–1840* (Cambridge, Mass.: Harvard Studies in Urban History, Harvard University Press, 1973), 33.

Figure 8

Flows of Pre-Telegraphic Information from New York Newspapers to the Rest of the Country



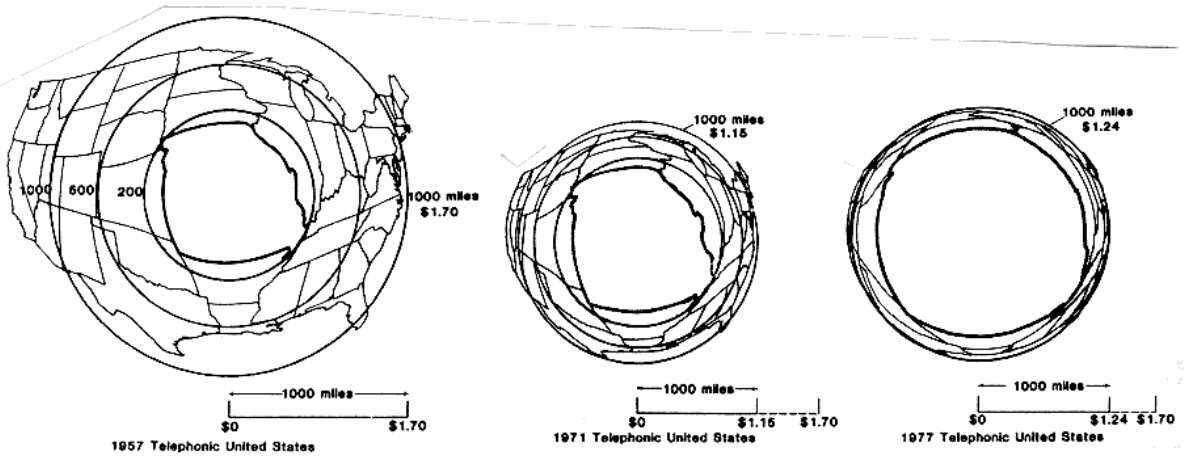
Source: Ron Abler, "Effects of Space-Adjusting Technologies on the Human Geography of the Future," in Ron Abler, Donald G. Janelle, Allen Philbrick, and John Sommer, *Human Geography in a Shrinking World* (Belmont, Calif.: Wadsworth, 1975), 39, 40.

Figure 9

Telephone Time–Space and Cost–Space Convergences

What people *think* about distance and space is more important in the long run than the "real" nature of space and distance. Even if time- and cost-, and N-space convergence succeed in producing a functionally dimensionless world, people will continue to have strong feelings about places and what they perceive to be distance.[17]

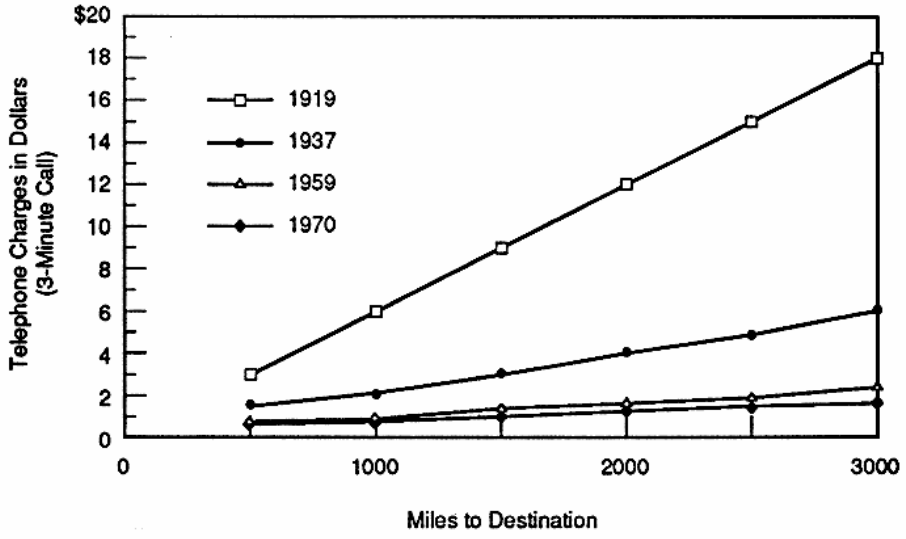
[17]1975: 53.



Source: Anthony G. Oettinger, "Information Resources: Knowledge and Power in the 21st Century," *Science* 209 (4 July 1980), 192.

Figure 10

Telephone Cost Distances from Missouri, 1957–1977



Source: W. Russell Neuman, *The Future of the Mass Audience* (N.Y.: Cambridge University Press, 1991), 58.

Figure 11

Declining Costs of Long-Distance Communication

While in one sense convergence means the end of geography, in another it means that we pay greater attention to the intensity and immediacy of communication, qualities that, admittedly, are more difficult to measure than time- or cost-space convergence. Convergence measures vary with the individual's place within society. Although agreeing that time-space and cost-space convergence demonstrate that places are generally moving closer together, Abler suggested in 1975 that "for those possessing lesser means, time-space convergence may be negligible. In fact, there is reason to believe that convergence contributes to the polarization of the 'haves' and 'have nots.'"[18] He cites research suggesting that, in large U.S. cities, for example, the average distance between home and work decreased for whites but increased for blacks. More recently, McLaughlin (1992) suggested that convergence may be creating a growing gap within the corporate world, dividing businesses that, owing to management practices or to regulatory policies of their host nations, are either more or less able to take advantage of computer communication.

The research literature offers a number of general conclusions. The declining price-performance ratio of transportation and communication technologies has contributed to spatial convergence.[19] The extent of the convergence is widespread but varies with cultural, social, and political conditions. Cultural conditions include the values embedded in specific places and in the distances between them. For example, a person based in Akron, Ohio, headed for New York City has a different perception of New York and the distance from Akron depending on whether the trip is viewed as a chance to visit the center of civilized life or as a descent into barbarism. Social variations include an individual's place in various economic, educational, and social status hierarchies that can either make convergence a taken-for-granted reality or, at the other extreme, practically unthinkable. Finally, politico-economic decisions about transportation (what is the condition of Akron's airport? which, if any, carriers, fly between Akron and New York, and what is the fare?) and communication (the quality and price of mail, facsimile, and telephone between the two cities) influence the nature of convergence.

Rather than contribute to what O'Brien (1992) calls "the end of geography," convergence transforms geography by increasing the spatial flexibility of those who can take advantage of smaller, faster, cheaper, and better computer communication technology and by underscoring the significance of nontechnical factors that can enhance or impede convergence. As Abler puts it, "A world without distance will not be an undifferentiated, isotropic sphere;

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[18]1975: 9.

[19]Schnaar (1989) offers numerous examples of failed technological applications, what he calls "megamistakes," that document the need to focus on price-performance capabilities as an antidote to technological wanderlust.

because it would allow preference free rein, such a world would be immensely varied and differentiated."[20]

The Analogy to Electricity, or the Information Superhighway Meets the Great White Way

Who now writes about electricity in the language of this reporter, impelled to hyperbole by the lighting display at the 1894 Chicago World's Fair?

> Look from a distance at night, upon the broad space it fills, and the majestic sweep of the searching lights, and it is as if the earth and sky were transformed by the immeasurable wands of colossal magicians and the superb dome of the structure that is the central jewel of the display is glowing as if bound with wreaths of stars. It is electricity! When the whole casket is illuminated, the cornices of the palaces of the White City are defined with celestial fire...the thunderbolts are harnessed at last.[21]

For the brief period when it held out most promise and before it moved into the relative obscurity brought about by universality and mundane function, as one historian put it, "electrification was placed quite consciously at the apex of an evolutionary framework."[22] This "spectacle" phase of the new technology lasted for a few decades. In 1880 a crowd gaped at one arc light in a shop window and in 1885 another was drawn to gawk at a lighted mansion. But with the first lighted signs of the 1890s, the novelty began to wear thin. Soon, lighting took a back seat, even at the great fairs. By 1901 attendees of the Buffalo fair paid more attention to the design of lighting than to the sheer amount of light, and at the 1915 San Francisco the lights were hidden in order to focus attention on the buildings and objects illuminated. By 1925, Nye concludes, lighting had shifted from a spectacular device designed to attract crowds to world fairs to an essential part of business and of life on the street. In that process, as historians describe,[23] electrification opened a wide range of opportunities in business, the military, and social and cultural life, even as its spectacle value diminished. The major payoff in electrification arrived when it ceased to be considered the wonder of the century and became, instead, the full-time preoccupation of small groups of experts who

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[20]1975: 53. For example, much has been made of the likelihood that communication replaces transportation. But, for some, the reverse is likely to be the case, as the productivity gains from communication expand opportunities to travel, as communication broadens the range of social and economic relationships, and as it disperses residential settlements and deconcentrates businesses. Moreover, as the growth of transportation-based rapid-response systems demonstrate, electronic communication increases the productivity of transportation, i.e., call for a pizza over cooking dinner.

[21]Cited in Nye, 1990: 38.

[22]Nye, 1990: 35.

[23]Hughes, 1981.

electrified transportation, communication, and lighting in factories, offices, homes, streets, and highways. It came long after people had lost a sense of rapture in the face of many Great White Ways, those heavily lit main streets that publicity-conscious lighting companies created in cities across America. The irony of electrification, as with many new technologies, is that its full power was unleashed only after they are seen as particular spectacles and after they have become taken for granted as integral to systems, such as transportation, which they have enhanced in, yes, spectacular ways.

The history of electrification contains food for thought about computer communication, specifically for the debate about the Information Superhighway. Some of the questions posed about the development of electricity are relevant today. What were the political and economic factors contributing to the construction, ownership, management, and spatial distribution of the electricity infrastructure? What were the implications of these historical choices for the spatial organization of social and economic life? Following Nye's analogy, computer communication is in its spectacle phase, with the Superhighway its Great White Way. Although people are beginning to think about the integration of microprocessors in cars, dishwashers, and watches, etc., they persist in viewing computer communication, particularly the computer itself, as a discrete marvel. Computers are still advertised with the indiscreet charms of power and sexuality once bestowed on an earlier spectacle technology, the automobile. Computers elicit the same kinds of promises as those proffered by electrical boosters, who saw the Brush arc light and its successors ending crime and night's other terrors when what they called this new "white magic" led to the "electrical millennium."[24]

In the 1990s, computers in general are far from ordinary features of daily life. But, if technological history is any guide, a time will come when few write of computers in the hyperbolic language of the journalist celebrating the vision of the Chicago World's Fair. People may someday ask, as scholars now do about electricity's Great White Way, who now writes about the Information Superhighway? History suggests, as computers are becoming sufficiently commonplace to be banal, their real power—the power to enhance systems, enable people, and breed choice—is growing. Reflections on the Information Superhighway may soon be reserved to historical accounts of a time when the computer was spectacle, when, like electricity, "it provided a visible correlative for the ideology of progress."[25] This is no small accomplishment. Visions of progress are important levers to pry open societies reluctant to embrace new technologies. Admittedly, the Great White Way helped to electrify America, but it also contributed to mobilizing a policy apparatus behind a wide range of schemes that, among other things, amounted to creating literal monopolies of power. Will the Information

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[24]Nye, 1990: 66.

[25]Nye, 1990: 35.

Superhighway, which is arguably spreading the word about computer communication, also offer a case of, in the words of baseball philosopher Yogi Berra, "déjà vu all over again?"

After the Spectacle: Computer Communication Breeds Choice in Business Location

When deciding where to locate a business, few ask, "how close are we to the electrical grid?"[26] Although once this was an important question, constraining the search for sites, just as proximity to a body of water once limited location, proximity to electricity or water plays little role today in decisions about where to set up shop. Proximity to telecommunications networks still matters, but that, too, is declining in importance as networks access the hinterland. Again, if the history of electrification can serve as a guide, computer communication will fade in salience to locational decisionmaking, even as it grows in power as a breeder of choice. As a result, like electrification before it, it will make other locational factors more important. What is known about these other factors?

Beyond academic jargon and methodological hairsplitting, research on the significance of geography for organizations has primarily contributed useful checklists of factors that managers need to take into consideration when determining where to locate. Raymond Vernon, a long-time student of the field, noted that most scholars recognize that the phenomenon of locational choice is far more enigmatic than the literature and its theoretical approaches have been able to address.[27]

The systematic study of location began with ideas pulled together first in 1909 in the work of Alfred Weber.[28] Weber and his followers aimed to help businesses determine the least-cost location for factories and offices. To that end, they calculated transportation, manufacturing—particularly labor—and marketing costs, which they used to identify the least expensive site. Weber's major discovery was that businesses benefited from concentrating plants and offices in one location, what is now referred to as *agglomeration economies*. The next generation of location scholars, influenced by Weber's work, added to the traditional concern with making and moving goods the costs of making and moving information.[29]

The most useful research in the field provides different types of lists that firms should consider in making locational choices. For example, Hepworth and Ducatel (1992) identify factors, including the cost of information, over the range of business activities: planning, purchasing, manufacturing, storage and distribution, and marketing (see **Figure 12**). Greenhut

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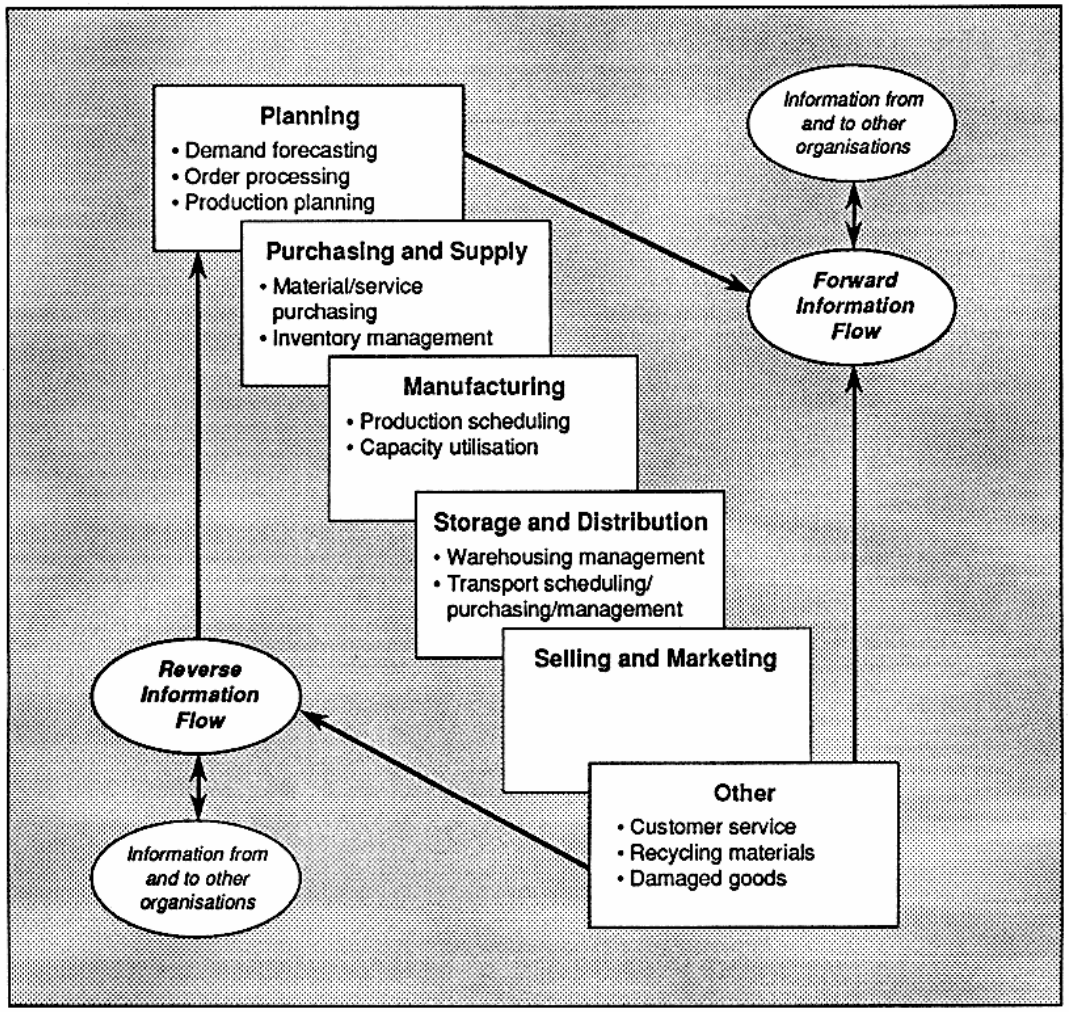
[26]An aluminum plant is one among the exceptions.

[27]Interview by the author, December 1992.

[28]Chapman and Walker, 1987; Hoover, 1937; Isard, 1956.

[29]March and Simon, 1958.



Source: Mark Hepworth and Ken Ducatel, *Transport in the Information Age: Wheels and Wires* (London: Belhaven Press; Transnet, the London Transport Technology Network, 1992), 56.

Figure 12

Locational Factors by Business Activity

(1956) put together demand, cost, and personal factors (**Table 4**) and Townroe (1976) organized determinants along geographical lines: regional, community and site (**Table 5**).

Research has slowly turned to the role of computer communication in locational decisions. Studies typically elaborate on the general conclusion that technology expands on the possible locations available to organizations, because it overcomes the need to be physically near information resources. Transportation and power technologies once lessened the need to locate near bodies of water; now the spread of computer communication networks around theworld has reduced the need to choose a specific location because of its proximity to telecommunications networks. According to an AT&T executive, locational decisions are

Table 4

Demand, Cost, and Personal Considerations in the Location Decision

Demand Factors

1 The shape of the demand curve for a given product

2 The location of competitors, which in turn partially determines
- (a) the magnitude of the demand, and
- (b) the cross-elasticity of demand at different places.

3 The significance of proximity, type of service, and speed of service; predjudices of consumers.

4 The relationship between personal contacts and sales.

5 The extent of the market area, which itself is partially determined by cost factors and pricing policies.

6 The competitiveness of the industry in location and price; certainty and uncertainty.

Cost Factors

2 The cost of land, which includes
- (a) the rent of land;
- (b) the tax on land;
- (c) the availability of capital, which partially depends upon
  - (i) the banking facilities and financial resources, and
  - (II) personal contacts;
- (d) the cost of capital, which is also partially dependent upon
  - (i) the banking facilities and financial resources and
  - (II) the type of climate;
- (e) the insurance rates at different sites, which in turn partially depend upon
  - (i) the banking facilities and financial resources,
  - (II) the police and fire protection, and
  - (iii) the type of climate;
- (f) the cost of fuel and power, which is partially dependent upon
  - (i) natural resources,
  - (ii) topography, and
  - (iii) climate.

2 The cost of labor and management, which is influenced by
- (a) the health of the community, the park and education facilities, housing facilities, wage differences, etc., and
- (b) state laws.

3 The cost of materials and equipment, which is partially determined by
- (a) the location of competitors (sellers and buyers),
- (b) the price system in the supply area, (f.o.b. mill, equalizing or other forms of discriminatory delivered prices),
- (c) the extent of the supply area, which in turn is partially dependent upon
  - (i) personal contacts and
  - (ii) price policy.

4 The cost of transportation, which is partially determined by
- (a) the topography
- (b) the transport facilities and
- (c) the characteristics of the product.

Purely Personal Factors

1 the importance of psychic income (size of plant),

2 environmental preferences, and

3 the security motive.

Source: Melvin L. Greenhut, *Plant Location In Theory and in Practise: The Economics of Space* (Chapel Hill: University of North Carolina Press, 1956), 279-281.

Table 5

Locational Factors by Region, Community, and Site

Key Regional Factors

1 Government regional policy
2 Strategic communications
3 Labour relations
4 Markets

Key Community Factors

1 Transport and communications
2 Ties with parent plant
3 Labour/supply/cost/training
4 Supplies of materials and components
5 Access to services
6 Local and central govenment services
7 Amenity

Key Site Factors

1 Intra-urban locaton
2 Physical characteristics
3 Tenure
4 The availability of buildings
5 Access to services and utilities
6 Price

Source: Based on data in Peter M. Townroe, *Planning Industrial Location* (London: L. Hill, 1976), Ch. 4.

increasingly based on the view that people can communicate reasonably well from anywhere to anywhere. Decisions are therefore based on the remaining opportunities and constraints, such as labor force, customers, and environmental considerations.[30]

Those who look closely at the issue of computer communication in locational decisions focus on the likely mix of technologies and systems to hasten distance insensitivity. Accordingto Carol C. Knauff, who oversees research on global business video services for AT&T, one of the critical steps in overcoming the barrier of distance in business is to integrate video services with the personal computer.[31] Knauff anticipates that this integration will take place for large and medium-size businesses by the end of the 1990s. Access to live

[30]Interview by the author with John Petrillo, December 1992.

[31]Interview by the author, March 1993.

video extends the physical presence of the communicators beyond the text. One of the keys is the development of inexpensive digital video-compression techniques. Although many large businesses now use general digital video extensively, they are just beginning to integrate digital video into computer terminals. The next wave will be the application of digital video to medium-size firms. According to Knauff's research, as might be expected, people collaborate most effectively once a relationship based on face-to-face contact has been established. As might not be expected, people care more about the quality of the audio and its synchronization with the video than about the quality of the video. They can tolerate degraded, even jerky video but not poor audio or a bad sync. Further, they respond well to multilocation meetings situated in a room that looks like a face-to-face meeting room.

Centralization or Dispersal: Choose Both, Wisely

Early studies of the impact of transportation and communications considerations on the locational choice of corporate headquarters found two prominent patterns. First, firms tended to locate either near their manufacturing facilities or close to other corporate headquarters. For example, Leone distinguished between the advantages of a New York City location "given the proximity to the financial community, access to the educational and legal establishment, and so on." However, "in the past these advantages have frequently been counterbalanced by the diseconomies of separating control functions from operating functions."[32] Drawing on this research, Lavey noted (1974) a growing tendency for firms to locate in large cities, even when doing so put some distance between headquarters and manufacturing operations. He speculated that "this evidence supports the importance of face-to-face communication" in the choice of headquarters location.

Recent assessments confirm the tendency to separate the headquarters location from manufacturing facilities.[33] The steel company Armco is a typical case. In 1990 Armco moved its top management from Middletown, Ohio, to Parsippany, New Jersey. According to its Chairman and CEO, Robert Boni, the firm moved the fifty-nine top managers to New Jersey to get them away from the company's roots and make it easier for them to gain the "strategic objectivity" necessary to expand the company's steelmaking and other facilities around the world."[34] Specifically, the relocation would "separate the executives from the town steelworks, the retired Armco executives at the country club, and from the local press focus on hometown responsibilities." More positively, according to Boni, it placed Armco

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[32]Leone, 1974.

[33]Solomon, 1990; Lublin, 1992.

[34]Solomon, 1990.

managers "into the midst of their major corporate peers," including bankers, investment counselors" and sources of premier corporate directors.[35]

Partly as a result of advances in computer communication, interest is growing in moving the corporate world headquarters of U.S. firms offshore[36] (see **Table 6**). The principal reason cited is that the risk of losing of control is offset by proximity to major customers and competitors in fast-changing markets far from home. According to an analyst with McKinsey & Co., businesses increasingly "recognize that they can't rule the world from one singlelocation,"[37] leading to the prediction that, by the year 2005, half or so of the Fortune 500 companies will make the move. Among the companies that have already done so is AT&T, which moved the headquarters of its corded telephone business from New Jersey to France.

Additional case research supports the view that advances in transportation and especially in communication make it easier for firms to operate at a distance and thereby take advantage of benefits enjoyed in locations that were once not cost-effective.[38] More specifically, according to Sassen the dispersal of work "was a result of the introduction of new technologies designed to separate low-wage, routine tasks from highly skilled tasks therewith maximizing locational options."[39] New technologies have enabled the *decentralization* or dispersal of work in manufacturing, the office, and in retail services over a wide range of locations. Both GM and Ford use computer-aided tools to design, source, and manufacture components in different countries.[40] Credit card companies have relocated to South Dakota and Delaware, because these states are among the most liberal about credit card fees and interest rate regulation.[41] Both Canadian and U.S. customer service and telemarketing firms have moved to rural New Brunswick and Manitoba, where a low-wage, bilingual work force provides the major incentive.[42]

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[35]Solomon concludes that relocation can also create disaffection. The Middletown plant erupted with its first strike the year top management moved and union members travelled to New Jersey to set up a picket line. Moreover, to overcome the feeling among corporate staffers in Ohio that they were "orphans" of a "caste system," Armco increased visits between Middletown and Parsippany and set up a staff newsletter.

[36]Lublin, 1992.

[37]Ibid.

[38]Langdale, 1989.

[39]1991: 25.

[40]Davenport, 1993: 53.

[41]Saunders, 1989.

[42]Fine, 1992: C8.

Table 6

Multinational Firms Moving Headquarters Abroad

Moving the Home Base to Foreign Soil *Some multinational corporations moving global headquarters of major business units overseas:*				
Company	**Home Country**	**New Location**	**Operation Shifted**	**Year Moved**
AT&T	U.S.	France	Corded telephones	1992
Du Pont	U.S.	Japan	Electronics	1992
Hyundai Electronics Industries	South Korea	U.S.	Personal computers	1992
IBM	U.S.	U.K.	Networking systems	1991
Siemens	Germany	U.K.	Air-traffic management	1991
Siemens	Germany	U.S.	Ultrasound equipment	1991
Du Pont	U.S.	Switzerland	Agricultural products, and parts of fibers and polymers businesses	1991
Hewlett-Packard	U.S.	France	Desktop personal computers	1990
Siemens	Germany	U.S.	Nuclear-medicine products and radiation-therapy equipment	1989
Cadbury Schweppes	U.K.	U.S.	Beverages	1987*
Du Pont	U.S.	Switzerland	Lycra business	1987

*Moved back to London in 1991.

Source: From Joann S. Lubin, "Multinational Firms Moving Headquarters Abroad," *The Wall Street Journal*, Dec. 9, 1992, B1. Reprinted by permission of *The Wall Street Journal* © 1992 Dow Jones & Co., Inc. All rights reserved worldwide.

Computer hardware and software companies have moved to Bangalore and other parts of India to take advantage of labor cost savings. As a result, Bangalore-based software engineers working for Texas Instruments have customized the automated inventory system of Dayton Hudson Corp.'s Target chain of U.S. discount stores, developed a new digital-signal processor for Ericsson of Sweden, and produced a tailor-made programmable chip for AT&T. One Indian project manager refers to the "globalization of software" where "the user is in one country, the developer in another place, the project manager in another."[43] A major reason for relocating software engineering is to save on personnel costs. At Motorola in Bangalore a

[43]Brauchli, 1993: A4.

mid-level engineer earns $800 a month.[44] Similarly, Nippon Telegraph and Telephone (NTT) Data Communications, the largest computer systems integrator in Japan, has identified Beijing and Shanghai as prime locations for a software production center in China, on the expectation that the new facility will reduce personnel costs.[45] General Electric has relocated technical drafting departments to computer-aided design facilities in India and Eastern Europe.[46] Other large companies have found the Philippines an inexpensive haven for everything from data-input to software design.[47] Research suggests that firms are increasingly able to save on labor costs by eliminating, as well as dispersing, labor. For example, when it took over the Bank of New England, the Fleet Street Bank increased its investment in computer communication. By 1992, it had become the largest bank in New England, with $44 billion in assets. In the process, its work force dropped from seven thousand to four thousand. Using technology, the company reduced from twenty-four to three the number of its check-processing offices, from eighteen to one the number of data centers, and its annual back-office budget from $180 million to $90 million.[48]

Considerable research also supports the view that communication and information technologies have facilitated the choice to *centralize* corporate functions. The first studies of centralization focused on manufacturing by pointing to the tendency of small, specialized firms to group together in new industrial zones.[49] For example, several hundred small factories concentrated in the Emilia Romagna region in northern Italy serve as flexible subcontractors to manufacturers around the world. Studies have shown that by remaining small they can respond more flexibly to changes in global demand. Territorial concentration enabled them to form loose associational networks for joint research, investment, and marketing, which make it possible for groups of firms to act like and enjoy some of the scale economies of larger firms. Cohen and Zysman describe the dynamics of these firms:

> Manufacturers, facing increased labor costs and restricted ability to manage flexibly inside their plants, took to subcontracting production.... These subcontractors often began to innovate themselves and to produce new production equipment and products. An entire sector of smaller firms sprang up.... Eventually, these small producers broke loose from

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[44]Gargan, 1993; Brauchli, 1993. Nevertheless, India's software firms have begun to worry that they may be stuck in the low value-added segments of the computer software industry.

[45]*Japan Telescene*, Oct. 1, 1992.

[46]King, 1993.

[47]MacDonald, 1991.

[48]*Boston Globe*. Nov. 22, 1992: 81.

[49]Piore and Sabel, 1984; Scott, 1988.

> their subcontracting role to begin a different pattern of dynamic flexibility. They have become innovative suppliers in world markets.[50]

This tendency suggests that some parts of the economy may take on the look of an earlier family farm economy, in which relatively small farms supplied and sold to large organizations, such as railroad, seed, and grain companies. Focusing on transnational firms, a 1993 study carried out by McKinsey & Co. concluded that the most successful global firms "tend to centralize their international decisionmaking in every area except new-product development."[51]

New Wave in Location: The Growth of Producer Services

Increasingly, research has turned to centralization in the producer services sector, that is, services produced for organizations, including private and public sectors, rather than for final consumers.[52] These technically "intermediate outputs" cover financial, legal, and management services, as well as advertising, communication, wholesale distribution, insurance, accounting, and professional associations.[53]

Firms specializing in producer or consumer services tend to follow different locational patterns. There is a stronger tendency for consumer service firms to locate on the basis of the size of the market for final consumers.[54] Communication technology has abated this tendency, as demonstrated by the geographical dispersal of telemarketing firms. Yet evidence[55] strongly supports the hypothesis that consumer service firms are more evenly distributed than those in producer services. Consumer services lack a strong contrast between central and peripheral locations.

On the other hand, producer services firms tend to concentrate particularly in the major international cities of New York, London, and Tokyo, central points for the coordination and

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[50]1987: 148. Offering a detailed analysis of what is now generally referred to as "the Third Italy," Best explains the value of geographical proximity for maintaining a sense of collective identity: "A carefully nurtured collective identity can potentially provide the social fabric which sustains cooperation in an industrial district as in a corporation. Here again, the role of geographically concentrated small firms is important for an industrial district. For geographical proximity makes it possible for individuals to interact socially and politically as well as economically" (1990: 237-238).

[51]Lublin, 1993: B4.

[52]Sassen, 1991.

[53]Sassen, 1991; see also Castells, 1989.

[54]Daniels, 1985.

[55]Daniels 1985; Sassen 1991.

control of economic processes.[56] According to this view, as these places lost their manufacturing bases, they also surrendered their importance as sites of production and took on the role of coordinator of services for production activities taking place elsewhere. In the 1990s observers view global cities as *production* sites, though not, as in the past, principally for manufactured goods or for final consumer services. Rather, they are primarily organized for the production of *specialized services* that organizations require to run spatially dispersed networks of factories, offices, and consumer service outlets. International cities are responsible for the production of financial instruments and innovations and for making markets, both essential for the health of the financial services industry.[57]

According to that research, the high density of producer services activity concentrated in the central business districts of global cities and their increasingly disproportionate share of all financial transactions challenge the contention that agglomeration and density decline as global communications make possible resource and population dispersal. The spatial dispersion of manufacturing production and consumer services, including their internationalization, has contributed to the growth of centralized nodes for the production of management, regulation, and control functions necessary for coordination of globally dispersed economies.

Why do producer services firms concentrate in global city locations? Research tends to focus on the particular characteristics of such firms' production and markets. Unlike consumer services, producer services do not depend on proximity to final consumers. For them, it is more important to be close to other firms producing key inputs or providing opportunities for joint production of services. For example, consulting and accounting firms benefit from proximity to law firms, marketing companies, and computer programmers. Thrift found that financial services firms are likely to locate in world cities, because they need to be near clients, including the headquarters of banking and industrial firms, as well as government departments.[58] In addition, financial services companies need to be close to markets, many of which work out of fixed exchanges. Finally, they need to tap into information on both clients and markets rapidly and efficiently.

In general, major business transactions require the organized participation of numerous specialized companies that provide financial, legal, accounting, management consulting, media and public relations, and other services. Research in different national settings confirms this conclusion.[59] For example, according to Moulaert, Chikhaoui, and Djellal, French high-technology consultancy firms tend to concentrate in Paris (and, to a lesser extent, in Rhônes-

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[56]Friedmann, 1986.

[57]Castells, 1989; Sassen, 1991; O'Brien, 1992.

[58]1987: 208.

[59]Hepworth, 1989; Sassen, 1991; Moulaert, Chikhaoui, and Djellal, 1991.

Alpes and Provence) because of "the sector's need for both backward and forward linkages." These linkages include access to higher levels of decisionmaking in clients' organizations and proximity to the high-technology industry. Ettinger and Clay (1991), in their examination of national occupational data over the period 1983-88, noted the tendency for "high-order corporate services" to concentrate in major metropolitan areas, while routine services, such as data entry and related clerical work, have been dispersed to peripheral regions.[60] Research shows that the urban concentration of producer or corporate services has multiplier effects which deepen the tendency. For example, further concentration arises out of the needs and expectations of higher-income workers employed by corporate services firms who prefer the cultural and lifestyle amenities within global cities.[61]

One source of confusion in the analysis of dispersal and concentration lies in the definition of a central location. For example, some researchers distinguish between metropolitan centers and "edge cities," sites located thirty or so miles away that have grown out of office parks and shopping malls.[62] Those making this distinction identify dispersal with movement from a central to an edge location, such as the movement of the research divisions of NEC, Samsung, Matsushita Electronics, Hitachi, and Toshiba to Princeton, New Jersey (dubbed Video Valley for its focus on high-definition television research), constitutes dispersal. One reason for the move, however, is proximity to the metropolitan centers of New York and Philadelphia (as well as Washington, D.C.), to Princeton University, and to one another, so that the move might be regarded as a form of metropolitan agglomeration. One Matsushita executive noted that the company passed up less expensive sites precisely in order to take advantage of geographical synergies.[63]

Telecommunications has advanced the dispersal of some organizational activities, primarily manufacturing and, increasingly, consumer services. Partly because of relative ease and partly because of cost savings, organizations have tended to disperse more routine functions. Although telecommunications has multiplied the products or corporate services available, these have not been dispersed. Some maintain that the process of dispersal in manufacturing and consumer services has itself intensified the need to coordinate and control these functions in centralized locations. Analysts such as Sassen and O'Brien conclude that dispersal and centralization are part of the process comprising the structural transformation of contemporary economic geography. According to Sassen, writing in 1991, "the spatial dispersion of production and the reorganization of the financial industry over the last decade

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[60]See also Kirn, 1987; O'hUallachain, 1989; Wheeler, 1988.

[61]Sassen, 1991: 12.

[62]Garreau, 1988.

[63]Peterson, 1992.

have created new forms of centralization in order to manage and regulate the global network of production sites and financial markets."[64] Writing specifically about financial services, O'Brien (1992) identifies two counterforces at work under "end-of-geography" conditions. On the one hand, because communication enables experts to work together electronically, a case can be made for the decline of financial centers. Even the City of London is no longer confined to the Square Mile. On the other hand, communication makes it possible to take advantage of scale economies and concentrate markets in one location, selling the same product from one center across an even greater area.

Yet the durability of this pattern of dispersal and centralization remains an open question. Organizations have applied telecommunications to speed the dispersal of manufacturing and, more recently, consumer services. When, and with what consequences, will telecommunications be applied to the entire complex of managerial and professional services at the top of organizational hierarchies? This depends on both technological and social considerations.

The nature of producer services work requires both close coordination and flexibility among a wide range of professionals, activities that benefit from the physical proximity that brings easy access to people and their information resource networks. Current research on the tools to produce virtual proximity, such as advanced videoconferencing, aims to apply telecommunications to what may be the last friction barrier to overcoming geographical constraints but has not yet had much impact.[65]

The social consideration is rooted in the ability to sustain tendencies toward polarization in the labor force of global cities[66] that mark a deepening division between the professionals, managers, brokers, and others at the command centers of producer services and, at the other extreme, those who fall into the growing category of low-wage, part-time, temporary workers whose jobs are readily subject to automation and relocation. The automation and dispersal of manufacturing and some services work have led to the decline of the middle class, whose income and job security helped purchase the social stability that contributed to social order. Now, the same commentators speculating on the growing pattern of homelessness in global cities employing increasing numbers of high-income professional workers wonder how long

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[64]1991: 324.

[65]The producers or marketers of technologies are not the only ones optimistic about the possibilities. According to a long-time student of business and cities, "High-definition TV and holographic processes promise to bring startlingly life-like quality to images projected on TV screens, perhaps enough to satisfy the needs of bankers negotiating with borrowers and auctioneers dealing with art buyers. It is possible that these developments will reduce the advantages of face-to-face communication sufficiently to weaken the centripetal pulls that have contributed to the growth of central business districts" (Vernon, 1991: 5).

[66]Castells, 1989, Sassen, 1991, Sudjic, 1992.

the pattern of dispersal and centralization can sustain what appears to be a changing social structure. This suggests the need for the advanced economies to rethink industrial economic development strategies.

Redrawing the Map and Rethinking the Organization

Computer communication is not the only factor that leads decisionmakers to redraw industry maps and rethink their firms. The growth of a well-educated middle class in parts of the developing as well as the advanced economies and the universal spread of English as an international language of business make it possible to loosen the traditionally rigid hierarchies once necessary to manage global firms. Nevertheless, research confirms the significance of computer communication as companies redraw their organizational maps to encompass global markets. Effective telecommunications is replacing organizational restructuring as a central factor in the success of firms changing locations. In a 1993 study, the management consultants McKinsey & Co. showed that the most successful international firms shared several common traits. Superior international performance appears to require widespread use of telecommunications to "link international managers with global electronic networks, such as video-conferencing and electronic mail,"[67] considered far more important than altering a company's international organizational structure through creation of global divisions, centers of excellence, and international business units. According to an executive with a successful international firm, although communication has expanded the geographical reach of the span of control, with people reporting from Singapore, Sidney, Tokyo, Toronto, and Nashville, the persistence of the hierarchical reporting structure itself has not been challenged.[68] Though the McKinsey study was limited to forty-three large U.S. consumer companies, it does suggest that, in an international environment, telecommunications may play a more important role than organizational change in determining the success of a firm in overcoming distance constraints.

Studies suggest that when telecommunications changes the geography of firms, it leads managers to rethink production. For example, Pine's (1992) research on the process of production shows that multilocale companies linked by computer communication can shift from mass to specialized production or to "*mass customization.*" Pine distinguishes three types of transition from mass production to mass customization, starting with a slow, incremental shift, typified by Toyota. The second type transforms the business in a short period of time, exemplified by Motorola, which, under strong competitive pressure, revamped the production of its pagers with a fully automated production process. Orders for customized

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[67]Lublin, 1993.

[68]Lotochinski, 1992.

pagers are transmitted to the Motorola plant in Florida, where they are manufactured, tested, and readied for delivery in less than two hours. Finally, some companies create new businesses geared to produce customized products at mass produced prices, for example, the on-demand CD. Furthermore, research on the process of production used to relegate transportation and communication to the distributional function, ancillary to the central act of making a good or service. Thinking is changing as, in Hall's view, companies "extend the concept of the integrated production line to include the wide-area transportation and communication network which supports that production line."[69]

Changes in the ways managers think about the relationship between location and production are connected to changes in their thinking about the location of labor, leading researchers to look at new forms of work dependent on advances in telecommunications. These include pure forms of telecommuting, in which workers carry out full-time jobs from computer communication links in the home. According to Mokhtarian, research on this pure form raised doubts about its long-range prospects, because the benefits did not outweigh the negative impacts, "including the psychological and professional need for face-to-face interaction, the desirability of a buffer between work and home, the importance of visibility to professional advancement."[70] Recent research responds to these concerns by rethinking the pure form of telecommuting. For example, though computers facilitate telecommuting, much of the information-related work completed in the home is done with plain old pen, paper, and telephone. Telecommuting, however, is rarely a full-time occupation, but, more often, a formalization of the practice of bringing work home from the office or simply a part-time job. It is part of a generally recognized trend toward a more flexible workplace, including more part-time workers, and what a recent report referred to as a "contingency work force."[71] Finally, studies point to the growth of telecommuting work centers located outside but close to home. These provide the employer with greater confidence in worker productivity, greater control over liability risks, and higher levels of security. For the worker, they offer opportunities for interaction, a work space away from home, and shared access to facilities and services not available at home. For example, the advertising agency Chiat\Day includes numerous mobile or virtual offices that provide professional staff with temporary work spaces, conference rooms, and portable telephones, fax machines, and computers, etc., for work locations that shift throughout the day. Chiat\Day executives resist calling their work reorganization telecommuting, because "Rather than a suite in a skyscraper, a den at home or

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[69]Cited in Davidow and Malone, 1992: 137.

[70]Mokhtarian, 1991: 320.

[71]Fierman, 1994.

even the front seat of a car, proponents of the virtual office see it as a bubble of information created by new technologies."[72]

In general, computer communication, and the instantaneous linkages and delinkages it can provide, is leading businesses to question the boundaries between firms. For example, companies have used computer communication to tighten connections between retail companies and their producers and suppliers. Kmart linked its computer system with those of its top two hundred suppliers to provide warehouse and sales information on-line in return for faster, more frequent deliveries. As a result, suppliers can more easily forecast demand and Kmart is able to strengthen its supply network. Similar linkages connect airlines to travel agents, manufacturers to terminals in the truck cabs of their distributors, and governments to customers seeking access to data. For some analysts, these new interdependencies signal a new "co-operative competitiveness" as firms share resources, such as banks operating over the same financial networks, to improve their individual competitive positions *and* to strengthen the overall position of the industry.[73] Aside from their admitted usefulness, terms like cooperative competitiveness suggest that computer communication are compelling a rethinking, perhaps a redefinition, of the firm.

Computer communication is leading to a rethinking of sovereignty or the appropriate boundaries in governance. Vernon and Spar (1989) and Wriston (1992a; 1992b) conclude that developments in computer communication hold profound implications for the location of sovereignty. The former see it as a fundamental driving force in the growth of interstate alliances, a qualitative change, they contend, in international political and economic relations:

> This spectacular decline in the cost of moving goods, people, and—especially—information across national borders has left governments with little room for unilateral action and little choice but to find changed forms of mutual accommodation. With facsimile and telex facilities on tap in such far-off places as Beijing and Monrovia, with the containerization of sea and air freight available to all, international economic relations differ in kind as well as in volume from those of the 1950s.[74]

They anticipate a period of tension, because governments are not yet prepared to give up control over their traditional domain. Wriston, concentrating on the declining ability of governments to control flows of finance, concludes that these developments amount to the "twilight of sovereignty." Contrasting the present to a time, not too long ago, when a finance minister could declare that the nation was not satisfied with the rules of the international

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[72]Patton, 1993: C2.

[73]Tapscott and Caston, 1993; Heskett, 1986.

[74]Vernon and Spar, 1989, 3.

financial game and opt out, Wriston concludes, "Today, the new information standard is far more draconian than any previous arrangement, such as the gold standard or the Bretton Woods system, since there is no way for a nation to opt out."[75]

Conclusion: Computer Communication Breeds Locational Choice

First transportation and now computer communication are shrinking geographical space and expanding choice. One by one, temporal, economic, social and cultural barriers have fallen to new waves of technology. The introduction of computer communication technology is similar to the process of electrification, beginning as a unique spectacle and evolving into an ordinary feature empowering practically all of life. The "Great White Ways" gave way to a powerful, if unspectacular, resource for breeding choice. Computer communication is still a distinct spectacle, the burgeoning Information Superhighway our Great White Way, but it, too, is on the way to normalization. If this pattern holds, computer communication will expand opportunities across the full range of social activities as it fades into the woodwork. The importance for decisionmakers of proximity to communication networks will recede in importance, just as proximity to water for transportation and power receded and, then, the electrical grid. The process of normalization includes the integration of technologies into day-to-day life, enrichment of those systems infused with computer communication, the general expansion of choice, and the growth of factors other than telecommunications in decisionmaking about business location. The last includes labor costs, proximity to markets, suppliers, and competitors, as well as environmental considerations.

Smaller, faster, cheaper, and better computer communication technologies have not only diminished the importance of geography for business, they have also transformed it. In particular, telecommunications has advanced the dispersal of some organizational activities, primarily manufacturing and, increasingly, consumer services. Partly because of relative ease and partly because of cost savings, organizations have tended to disperse their more routine functions. Though telecommunications has multiplied the products or corporate services available, these have not been dispersed. The process of dispersal in manufacturing and consumer services has intensified the need to coordinate and control these functions in centralized locations. In essence, dispersal and centralization are part of the same process, making up the structural transformation of contemporary economic geography. How long this pattern can be sustained depends on how long it will take for computer communication to produce the virtual proximity needed to achieve the coordination and control producer services require. It also depends on the social consequences of tendencies toward a deepening

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[75]1992a: 11. In the same work Wriston highlights the case of President François Mitterrand's Socialist government, which came to power in 1981 and "the market took one look at his policies and within six months the capital flight forced him to reverse course."

division between the professionals, managers, brokers, and others at the command centers of producer services and, at the other extreme, those who fall into the growing category of low-wage, part-time, temporary workers, whose jobs are readily subject to automation and relocation.

Much of the policy debate surrounding the introduction of new computer communication technologies has focused on the Information Superhighway. It has contributed to attracting wider attention to computer communication, but not always the right attention. The Great White Way drew people to electrification, but, as historians have shown, it also skewed public policy to emphasize electricity as a unique spectacle. Similarly, public policy about computer communication ought to mean more than maintaining the spectacle of the contemporary version of the Great White Way, because progress depends not on maintaining the distinct spectacle but on eliminating it, so that computer communication can grow into obscurity.

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Acronyms

GM	General Motors
MIF	mean information field
NTT	Nippon Telegraph and Telephone

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