Issues in Electronic Commerce 2

Recognizing the increased importance of computers and communication technologies for economic growth and development, many countries have taken steps to assure that their businesses have access to these technologies and the skills and other requirements needed to benefit from them. In contrast, in the United States, there have been fewer focused efforts of this kind. In assessing what kind of role the government might play in the future, OTA found that information and communications will clearly be critical factors in determining business success. However, if American businesses are to take advantage of new technologies to the benefit of the entire nation, a number of issues will need to be addressed.

THE TECHNOLOGY TO SUPPORT BUSINESS NEEDS

Because advanced information and communication technologies can reap considerable benefits for both business and the economy as a whole, the question arises as to whether enough is being done to assure that these technologies will be available in an appropriate, timely, and equitable fashion. OTA found that technology, per se. is not likely to be a major barrier to the success of electronic enterprises. Although there is a continued need for investment in research and development, there is no lack of state-of-the-art technology. And, with the important exception of software, much of the technology required for the electronic enterprise or for use in electronic markets either exists or is in the making, and its cost is falling precipitously as its capabilities continue to rise. Reaping the benefits of an increasingly competitive environment, American businesses have access to a wide variety of product offerings, which will 1ikely increase in the future given industry's repositioning and realignment to develop new products based on tech-

Technology alone is not enough. If the nation economy is to benefit from advanced networking technologies, a number of technological, organizational, and institutional criteria must be met.

nology convergence. Despite such advantages, the actual diffusion of technology, and more importantly its implementation in economic settings, has been quite uneven. It has also been limited, to a significant degree, to high-tech businesses that are geographically well positioned.

Electronic commerce can only occur when the communication and information networks to support it are widely available.[1] Technology diffusion, however, is typically a long-term and uneven process that depends on a number of factors, making it very difficult to assess its likely evolution in any particular situation.[2] As a general rule, the diffusion of new technologies takes the form of an S-shaped curve. This pattern reflects the forces of supply and demand, and the way in which users respond to new technologies. Vendors market new technologies slowly at first because investment and product development costs are high, while demand and profitability are low. As costs and prices fall and demand and profits rise sharply, vendors will greatly increase their supply.[3] Users reinforce this pattern. Their initial reaction to new technologies is very cautious, but their demand will eventually quicken and reach a critical mass as prices fall, knowledge of and familiarity with the technology spreads, and applications multiply and are adapted and readapted to new and different tasks.[4]

Achieving a critical mass is especially important in the case of networks, which are comprised of a number of interdependent parts.[5] Because these networks represent a large installed base, users are generally reluctant to purchase incompatible components. Instead, they may postpone the adoption of new, superior technologies until their entire network can be written off.[6] On the other hand, once there is a critical mass, users will likely "jump on the bandwagon." This happens because network users and network services are, like network components, also interdependent. The value that users attach to a network will generally increase in proportion to the number of users it has and the services it can support. Thus, when a critical mass of users adopts a new technology, others are quick to follow, fearing they will be left behind.[7]

Even after a critical mass has been achieved, however, diffusion will continue to be patchy. In the case of the telephone, for example, the pattern followed a sequence of connecting ever lower order cities: major trunks linked Northeastern cities first, followed by lines to smaller towns in their immediate hinterlands, then connections to major Midwestern cities, and so forth. Although the tele-

[1] See Robin Mansell, "Rethinking the Telecommunications Infrastructure: The New 'Black Box,'" *Research Policy*, vol. *19*, *1990*, pp. 501-515.

[2] For a cross-cultural and cross+ sectoral analysis, see Fabio Arcageli, Giovanni Dosi, and Massimo Moddi, "Patterns of Diffusion of Electronic Technologies: An international Comparison With Special Reference to the Italian Case," *Research Policy*, vol. *20*, 1991, pp. 515-129.

[3] Christopher Freeman, *The Economics of Industrial Innovation* (Cambridge, MA: MIT Press, 1982); and Edwin Mansfield, "The Diffusion of Eight Major Industrial Innovations," N.E. Terleckjy (ed.), *The State of Science and Research: Some New Indicators* (Boulder, CO: Westview Press, I 977).

[4] Everett M. Rogers, *Communication Technology: The New Media in Society (New* York, NY: The Free Press, 1986), pp. 116-149; and Ronald Rice and Everett Rogers, "Reinvention in the Innovation Process," *Knowledge: Creation, Diffusion, Utilization, vol. 1,* No. *4,* June 1980, pp. 499-5 14; see also Paul Attewell, "Technology Diffusion and Organizational l-earning: The Case of Business Computing," *Organizational Science*. vol. 3, No. *1,* February 1992, pp. 1- 1*9.*

[5] See Cristiano Antonelli, "The Economic Theory of Information Networks," in Cristiano Antonelli (cd.), *The Economics of Information Networks (The* Netherlands: North Holland, 1992).

[6] Joseph Farrell and Garth Saloner, "Horses, Penguins and Lemmings," H. Landis Gabel (cd)., *Product Standardization and Competitive Strategy* (North Holland: Elsevier Science Publishing Co., 1987); and Paul A. David, "The Dynamo and the Computer: An Historical Perspective on the Modern Productivity Paradox ," *American Economic Papers and Proceedings,* May 1990, pp. 355-361.

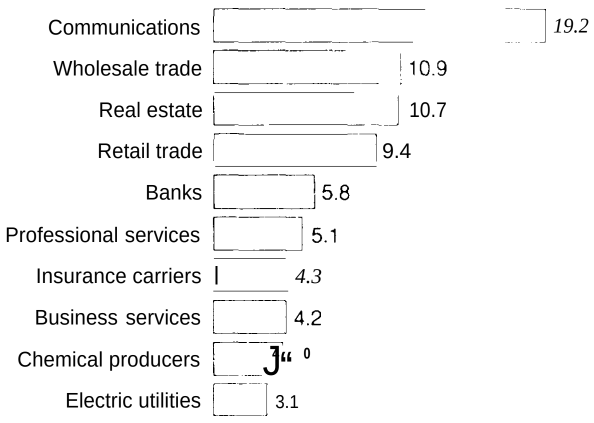
'Ibid,

phone was patented in 1876, it did not reach Chicago until 12 years later, and transcontinental service was not inaugurated until 1915. For rural areas the situation was even worse. As late as 1949, many of these areas were still without service. As a result, favorably situated businesses in the Northeast enjoyed a headstart of several decades in utilizing regional and inter-regional telephony.[8]

With deregulation and a highly competitive industry environment, it is unlikely that the deployment of new, information-age technologies will deviate greatly from this earlier pattern.[9] In a competitive, market-driven environment, deployment will mirror the state of demand. Today, the demand centers around large businesses that have the financial resources and expertise required to monitor technological developments, integrate disparate systems and technologies, and provide ongoing maintenance and support. These firms also have a clear strategic vision of the role of technology, and their organizational structures are generally directly linked to its use. Most of them are highly information intensive (see figure 2-1). Employing technology in a strategic fashion, these businesses gain valuable know-how, which can provide them with both a competitive advantage and the wherewithal to develop and deploy new technology applications.

In contrast, most small and medium-sized businesses have yet to realize these kinds of technology benefits. Some are simply unaware of them.

FIGURE 2-1: America's Leading High-Tech Users (Shares of High-Technology Capital Stock: 1992)



SOURCE Morgan Stanley Economics 1994

Others lack the resources and expertise required to match their organizational needs to what may be an overwhelming variety of technology choices. Businesses need to decide whether to purchase technology; outsource to a third-party prov ider; or lease a hybrid, virtual private network. Technology and service vendors also need to be selected. and network architectures and standards options need to be worked out as well. More difficult still. all of these choices need to be evaluated and decisions made on the basis of an accurate determination of the firm's specific needs for speed, capac -

[8] Richard Kielbowicz "The Role of Communication in Building Communities and MarLets," contractor report prepared for the Office of Technology Assessment, November 1987.

[9] As attested to by Noam "But it will be impossible to maintain the old traditional redistributive system of generating subsidies and transferring them internally within the same carriers from one category of users to another category. Several things will disrupt this arrangement. in a network of competing carriers, an internal redistribution is not sustainable once other carriers without redistributive burdens forget the users whose price is above cost as the most likely customer." Eli M. Noam, "Industry Structure in 2000: From the Network of Networks to the System of Systems."' Presented to the National Association of State Utility Consumer Advocates, "Telecommunications 2000 What's at Stake for Consumers in the Next Century," Apr. 17, 199.3, p. 9.

[10] See Stephen Davies, *The Diffusion of Process Innovations* (Cambridge. UK: Cambridge University Press, 1979); and John Kimberly and Michael Evanisko, '"Organizational Innovation: The Influence of Individual, organizational, and Contextual Factors on Hospital Adoption of Technological and Administrative Innovations," *Academy of Management Journal*, vol. 124, No. 4, pp. 689-713.

[11] Stephen Roach, "America's Technology Dilemma. A Profile of the Information Economy," A Special Economic Report, Morgan Stanley Economics, New York, NY, Apr. 22, 1987.

ity, reliability, and security. Such decisions take time, expertise, and financial resources, which many businesses either lack or are unwilling to expend without further assurance of the benefits. Thus, when small businesses invest in systems such as electronic data interchange and computer-integrated manufacturing, it is generally not in response to their own business needs, but rather at the request of their larger trading partners. Although technology transfer can occur under such circumstances-especially given a trading partner support—all too often technology remains at the periphery of the smaller firm's activities, and additional learning, innovation, and diffusion fail to take place.

Interoperability and Standards

Interoperability and standards area matter of considerable importance in any networked environment. However, their role will likely loom even larger in the future, as networks come to provide the basic underpinnings for many economic activities. Under such circumstances, standards and interoperability will affect the cost and technical characteristics of networks. More importantly, they will influence the overall efficiency and competitiveness of the economy; the cost, quality, and availability of products and services; and market structure. A lack of standards and appropriate levels of interoperability is also likely to be a formidable barrier to businesses seeking to use networks as a basis for extending their operations globally, improving their productivity, creating new value--added products, and linking up more effectively with their suppliers and customers. Given the slow pace of development of standards and open systems, the failure to achieve interoperability will likely present a major obstacle to attaining these ends.

Standards were essential to the success of mass production, and will likely be critical for the development of new, more flexible production processes. However, whereas mass production required standardized components to meet the demand for standard processes and standardized products, flexible production calls for standardized networks that provide the essential platform for carrying out small-batch production needed to satisfy a more customized demand.

A case in point is just-in-time production, which for many industries is rapidly becoming the norm. [12] Quick response production requires a communication network that allows for information-sharing and continual feedback and interaction among manufacturers, suppliers, retailers, and consumers. To ensure effective communication, however, the partners to such an arrangement will need to adopt standards for universal product codes, electronic data interchange, shipping container bar codes, and point-of-sale technologies. [13] These standards are extremely difficult to develop, requiring agreement on technical interfaces and terminology as well as business processes themselves. Because the stakes are so high, many businesses are reluctant to adopt standards. At the same time, opportunities are lost for failing to do so. Estimates are, for example, that the apparel industry can save $12 billion a year by implementing quick-response systems.

Agile manufacturing, so often touted as the paradigm of the future, also requires interoperable systems. [15] With agile manufacturing, firms estab-

[12] Janice H Hammond, "Quick Response in Retail/Manufacturing Channels," Stephen P. Bradley, Jerry A. Hausman, Richard L. Nolan (eds.), *Globalization, Technology, and Competition: The Fusion of Compilers and Telecommunications in the 1990s* (Boston, MA: Harvard Business School Press, 1993). See also Y.P. Gupta, and S. Heragu, "Implications of Implementing Just-in-Time Systems," *Technovation*, vol. 11, No. 3, 1991, pp. 143-160.

[13] John Skibinski, "Automated Information Sharing Cuts Time-To-Market," *Manufacturing Systems*, May 1992, pp. 60-61.

[14] Hammond, op. cit. footnote 12. See also, Thomas Bailey, "Organizational Innovation in the Apparel Industry" *Industrial Relations*, vol. 32, No. 1, winter 1993, pp. 30-48.

[15] For a discussion of the impact of standards on automated manufacturing technology, see Gregory Tassey, "Technology Infrastructure," *Research Policy*, vol. 20, 1992, pp. 345-361.

lish relationships with suppliers or other partners more or less on an ad hoc basis. In this way, they reap the gains of downsizing and, for each project team. they can match the best people to the job. Agile manufacturing is hardly practical, however, in a closed networking environment. Suppliers, manufacturers, and retailers would have much less flexibility in their choice of partners: connectivity instead of efficiency could very well drive the select ion.[16] In fact, many firms use proprietary systems when they want to gain control of a partnering relationship: by using closed systems, they can often 'block-in" their customers or suppliers.[17]

If interconnection becomes too costly, electronic markets may also be inefficient. reducing the efficiency of the overall economy.[18] Whereas highways and railroads fostered the development of a national market, electronic networks could have the opposite effect, with some groups and geographic regions no longer able to fully participate. Moreover. in an electronic environment, firms can use standards as barriers to entry, if not, in fact. as restraints on trade.[19] This aspect of networking may present problems not only for the U.S. domestic economy-as evidenced by continued antitrust suits against computer reservation systems. real estate multiple-listing services, and automated teller machine providers-but for the global market as well.[20] Thus, for example, although the demand for electronic data interchange (EDI) is growing rapidly, the international EDI market barely exists at present.[21] This delay is partly due to the fact that the United States has adopted one standard (ANSI x. 12) and the Europeans another (EDIFACT). As a result, EDI users are still unsure about which standard they should be using to link up with their trading partners. Standards can also be used as trade barriers, which increasingly has occurred over the last several years.[22]

Although many users have been pressing for open systems, vendors have been slow to deliver. They are reluctant to move toward more open systems because standards limit their ability to differentiate their products, and thus can reduce their profits. There is also the classic "chicken and egg" problem, which is characteristic of networked systems. Venders are unwilling to design their products to specific standards until they can be assured of a market, while users are reluctant to purchase networked products unless their interoperability is guaranteed.[23]

In addition. standards-setting processes are, themselves, subject to market failures because

[16] B.R. Konsynski, "Strategic Control in the Extended Enterprise," *IBM Systems Journal*, vol. 32, No. 1, 1993, p. 131

[17] Max D. Hopper, "Rattling Sabre—New Ways to Compete on Information," *Harvard Business Review*, May-June, 1990, pp. 118-125, See also James E. Short and N. Venkatraman, "Beyond Business Process Redesign, Redefining Baxter's Business Network," *Sloan Management Review*, fall 1992. pp. 7-21

[18] See F, Bar and M. Borrus "From Public Access to Private Connections II: Network Strategy and National Advantage in U.S. Telecommunication," Report for OECD Seminar on Information Network and Business Strategies, Paris, France, October 1989.

[19] Ajit Kambil, "Information Technology and Vertical Integration: Evidence from the Manufacturing Sector," in Margaret E, Guerin-Calvert and Steven S. Wildman (IA.), *Electronic Services Networks: A Business and Public Policy Challenge* (New York, NY Praeger Publishers, 1991). pp 22-38.

[20] U.S. Congress, office of Technology Assessment, *Global Standards: Building Blocks for the Future*, OTA-TCT-512 (Washington, DC U.S Government Printing office, March 1992).

[21] The European EDI service market generated $100 million in revenues in 1991, and is predicted to reach $500 million in 1996. The North American EDI market, which suffers from less fragmentation, is expected to reach $1.5 billion by 1998. See Donne Pinsky, "AT&T, BT, and IBM Connect Euro EDI," *CommunicationsWeek International*, Oct. 19, 1992, p. 48.

[22] OTA, op. cit., footnote 20.

[23] Carl Cargill, *Information Technology Standardization: Theory, Process, and Organizations* (Boston, MA: Digital Press, 1989).

they exhibit "public good" characteristics.[24] Public goods are those goods whose benefits are available to everyone and from which no one can be excluded, and no one can fully appropriate the benefits. As a result, public goods are underproduced.[25] Standards often fall into this category. Other market failures may also weaken standards-development processes. If the most efficient standards choices are to be made, for example, all interested parties must have access to accurate and timely information.[26] However, information about standards, like standards themselves, is a public good, and is therefore likely to be underproduced.[27]

Compounding the situation, the United States standards-setting process has a number of unique problems. Unlike most other countries where governments have entered into formal agreements with private-sector standards bodies—agreements that recognize and actually stipulate that these organizations serve public as well as private sector goals—the U.S. government has made no such agreements. Instead, private-sector bodies have been delegated the task of setting standards on the assumption that, by acting in their own interests, they are bound to act not only in the interest of their user clients, but also in the national interest as well. This has proven to be less and less the case, however.

As documented in the OTA report, *Global Standards: Building Blocks for the Future,* the U.S. standards-setting process has become increasing y paralyzed from a lack of leadership and intense rivalry among standards-setting bodies.[28] This situation has detracted from the main purposes of setting standards; it has also served to undermine the legitimacy of the system in the opinion of standards bodies at home and abroad. Impatient with the lack of progress, some vendors have circumvented the traditional process by establishing special consortia to develop standards in specific areas.[29] Although these consortia have been successful in speeding up standards' development, their membership is purposefully limited; they are established with the competitive

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24 Pure public goods will not be produced privately. There are only a few pure public goods, one example being national defense. Other goods, like education and standards, are impure public goods. These combine aspects of both public and private goods. Although they serve a private function, there are also public benefits associated with them. Impure public goods may be produced and distributed privately in the market or collectively through government. How they are produced is a societal choice of significant consequence. If decisions about impure public goods are made in the market, on the basis of personal preferences alone, then the public benefits associated with them may not be efficiently produced or equitably distributed. See Edwin Mansfield, *Microeconomics Theory and Application (New* York, NY: W.W. Norton, 1 *970).*

25 C. Kindelberger, "Standards as Public, Collective, and Private Goods," *Kylos, vol. 36,* pp. 377-395; and Sanford Berg, 'Technical Standards as Public Goods: Demand Incentives for Cooperative Behavior," *Public Finance Quarterly,* vol. *17,* January 1989, pp. 35-53.

26 For a discuss [(m of market failures due to lack of information, see Joseph Farrell and Garth Saloner, "Coordination Through Committees and Markets," *Rand Journal of Economics, vol. 19,* summer 1988, pp. 235-252; and Joseph Farrell and Garth Saloner, "Standardization, Compatibility, and innovation," *Rand Journal of Economics, vol. 16,* spring 1985, pp. *70-83.*

27 Even when standards-related information can be packaged for sale like other commodities, thus yielding an adequate return, its price may limit its distribution so that people have insufficient information to make sound decisions.

28 In the United States, most standards are establ ished through a voluntary, consensual process that is orchestrated and carried out by approximately 400 private sector standards development bodies. These groups are organized and function independently, although they all arrive at decisions through a process of consensus and provide some level of due process. All have mechanisms for participation, comment, and appeal. OTA, op. cit., footnote 20.

29 Consortia have been established, for example, to set standards for switched multimegabit data service (S MDS), Fiber Distributed Data Interface (FDDI) over twisted pair, asynchronous transfer mode (ATM), and frame relay technologies. See, for a discussion, Martin Weiss and Carl Cargill, "Consortia in the Standards Development Process," *Journal of the American Society for Information Science*, vol. *43,* No. 8, September 1992, pp. 559-565.

strategies of vendors in mind, rather than the interests of users or **the** economy as a whole.

INCREASING IMPORTANCE OF SOFTWARE

Increasingly, all electronic networks--whether public, wide area networks that provide essential transmission services or private networks that support interorganizational business applications --are software driven and software dependent. Software provides structure and functionality to these networks. determining such critical features as interconnection, interoperability, ease of use and rates of technology diffusion.

Given its role in networking, software will also become a more significant factor determining economic relations. Already software-defined proprietary networks can function as market barriers, while distributed computing systems can encourage economic activities that are horizontally rather than vertically integrated. Equally important. software-defined business applications will not only affect the structure of work relationships; they will also help to determine the very nature of work.

Unfortunately, the ability to develop a broad range of **high** quality, reliable software to support **business** networking applications has failed to **keep pace with software's greatly enhanced role.** This gap can inhibit network development and deployment, and the resultant economic gains. It **also constrains** the kinds of social choices that are available to the nation in determining how to best structure economic activities and outcomes.

Software development is being driven by mounting computer sales[30] and by the growing **need for** more versatile and complex applications.[31] Businesses, for example, need software that can support: 1) system simulation and integration, not just data processing: 2) distributed systems as well as centralized computing; and 3) **graphics and** nultimedia-based systems rather than simple text-based ones. Embodying the logic of complex systems, software will also be used to reengineer business processes. Software can be designed to affect the way in which people and machines interact, conceptualize problems, carry out processes and routines, design jobs and role assignments, and define authority and power relationships.[32] Many businesses are using groupware, workflow software, and distributed computing to empower employees and enhance team-based work (see box 2-1). Software quality and speed of delivery are also becoming increasingly important. It is estimated, for example. that software defects and delays can increase business project costs by as much as 50 percent.[33]

Internetworking among firms and across markets is also becoming increasingly dependent on soft ware, which represents an element of network design and operation that is increasingly more costly and complex.[34] The intelligent network, for

30 It is noteworthy in this regard that, whereas at the end Of the 1980s there were more than 1 million computers in the United States, that numher is estimated to exceed 100 million by 1995. John Teresko, "Software: (Still) Made in the U.S.A.," *Industry Week,* Jan. 4.1993. p. 41.

31As described by Rockart and Hofman:"The kinds of information Systcms that are needed to support the process-oriented, interdependent, and information rich organization of today are vastly different. The organization that works across functional (and sometimes divisional) bounderies needs to support cross-functional transacting systems. where the focus is on satisfying end-to-end business events or service strategies rather than discrete activities. . .two implications are clear. First, new systems development, long overwhelmed by maintenance of existing systems, will be necessary if proccess-oriented systems are to be created.The investment will be major. Second, not only the nature of the systems has changed, the speed with which they are needed and. more important, with which they must be changed, has increased as wall."" John F. Rockart and J. Debra Hofman, "Systems Delivery: Evolving New Strategies."' *Sloan Management Review,* summer 1992. pp. 24-25.

32See, for discussions. Shoshana Zuboff, In *the Age of the Smart Machine: The Future of* Work *and Power (New* York, NY: Basic Books. 1988); and Thomas H. Davenport and James E. Short,"Thc New Industrial Engineering: Information Technology and Business Process Redesign."" *Sloan* Management *Review,* summer 1990. pp. I I-27.

33 W. B. Foss, "Software Piecework," Computerworld, Sept. 23, 1991, p. 69.

34 Mansell, op. cit., footnote 1, p. 510.

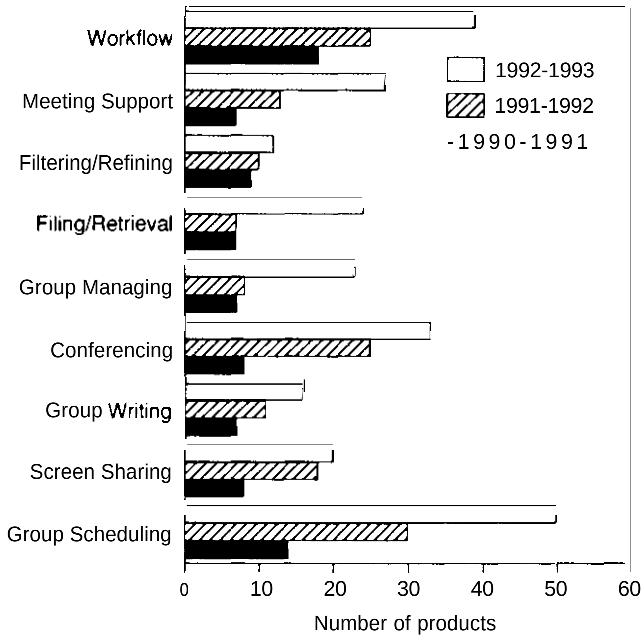
BOX 2-1: Groupware Product Growth by Product Category

"Groupware" is a general term for software (and sometimes hardware) applications that are designed for the use of collaborate work groups. For example, basic groupware combines simple messaging software such as electronic mail with common databases of work records and memos. Workflow software allows processes to be redesigned and streamlined, and automatically routes work from employee to employee Meeting and conferencing software and hardware facilitates conferencing with audio, video, or just simultaneous text entry Finally, scheduling software coordinates meetings using each colleague's electronic appointment book

Groupware is on the rise In 1989, the Institute for the Future began systematically tracking the groupware market according to nine categories as shown. Between 1991 and 1992, they found the total number of products nearly doubled from 77 to 140.

SOURCE Office of Technology Assessment 1994

FIGURE 2-2: Groupware Product Growth by Product Category



SOURCE Institute for the Future, 'The Electronic Enterprise, " contractor document prepared for the Office of Technology Assessment, May 1993, p 25

example, could not exist without the support of software-driven switches and databases[35] (see box 2-2). Employing such software, telephone companies now spend $9 billion annually on information technology, which amounts to about $60 (expense plus capital) per access line, or more than 30 percent of total basic monthly charges.[36] How this software is deployed, and where its contro] resides, will determine the quality and evolu-

[35] Using intelligent switches and databases, together with common channel signaling, the intelligent network allows network control f~nctions to be separated from network switching functions. This capability permits the net work to select the most appropriate services and optimal routes, and to introduce new value-added services via simplified and modularized software. Among the services that the intelligent network can provide are dynamic call routing, call forwarding, call queuing, credit and billing, reverse charging, control of calls based on data held in a central database, and virtual private networks.

[36] Robert G. Docters, Martin G. Hyman, and Raul Katz, "Are You a World-Class Software Developer?" *Telephony*, Apr. 19, 1993, pp. 41-43, 48.

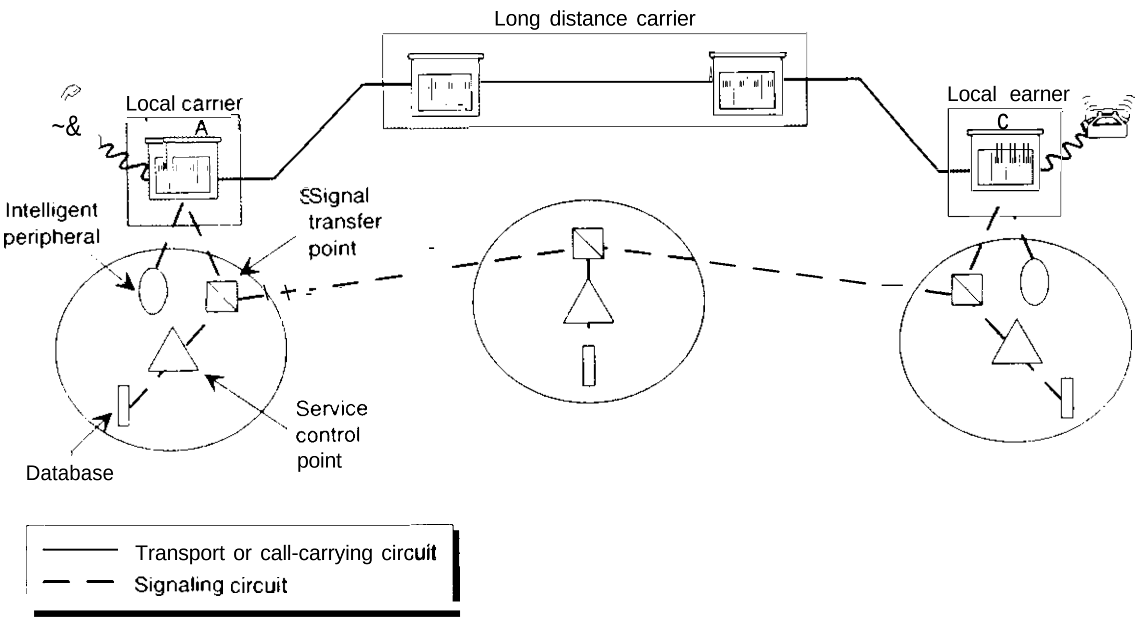
BOX 2-2: Intelligent Network

The advanced Intelligent network, elements of which are currently installed in today's public switched telephone network envisions greatly Increased operating efficiency as well as a broad array of sophisticated network services by separating the call transport (i e , the voice circuit) function from the signaling and control function and employing the powerful software in the switches

Imagine, for example, an instance where a caller places a call to a family member who, while on vacation has Indicated that calls from certain numbers are to be rerouted to the new location and given a unique ring to indicate priority In this illustration, the vacationer would have preprogrammed the priority telephone numbers (other calls might be routed to an answering service or machine) and the new destination number by dialing into the Intelligent peripheral and inputting these data When the caller dials the number, the local switch queries the signal transfer point for billing and accounting information It also ascertains from the service control point a clear path through the local network to the point of presence of the caller's long-distance carrier of choice The signaling networks of the two local exchange companies and the long distance earner Interact to learn the status of the called party and thus how to set the call up, in this case, the call has been redirected to a telephone address in a new location, so a third local company is involved and once again the status of the called party is learned (for example if the line were in use, the network would direct local carrier A to transmit a busy signal to the caller) and establishes a calling path Local earner C is also Instructed to deliver the special ring

SOURCE Office of Technology Assessment 1994

FIGURE 2-3: Intelligent Network



SOURCE Office of Technology Assessment 1994 tion of networking; it will also affect network providers and their competitive positions vis a vis one another in the marketplace.[37]

Because of its increasing importance, software could easily become a barrier to networking development and business use.[38] Rates of innovation and development are already failing to keep pace with those of other information and communication technologies. Whereas the price/performance ratios for hardware have been falling dramatically for a number of years, the costs of developing a line of software code is approximately the same as it was 20 years ago.[39]

Even now, businesses are feeling the pinch of lagging software development, and the situation will be hard to reverse.[40] The slow pace of development stems in part from the lack of unifying technical concepts and proven software engineering tools and methods. These problems are compounded by the need to customize software tools to specific business users' needs.[41] Software development costs are also being driven up by the need for maintenance, upgrades, and documentation, all of which are expensive.

Although software development tools, such as Computer Aided Software Engineering (CASE) and object-oriented methods, are advancing and becoming widely available, the use of these technologies is still limited.[42] Vendors have been discouraged from developing and marketing software development tools because of the lack of standards and the high costs entailed in creating domain-specific interfaces to suit the needs of different users. Moreover, software developers have not been inclined to adopt these tools because they require the development of new skills and practices and the abandonment of old systems and ways of doing things.[43]

Future efforts would likely yield greater results if more emphasis were placed on stimulating commercialization, technology diffusion, and the continued innovation that takes place throughout the entire life-cycle process.[44] The Japanese experience is especially instructive in this regard. Focusing on planning and team development rather than on the engineering technologies, the Japanese have made impressive productivity gains. Today,

[37] Mansell, op. cit., footnote 1.

[38] As described by Fichman and Kemerer: "This Imbalance has reached such proportions that it has been termed the software crisis. Software production represents the single biggest obstacle to the successful use of IT in organ izations: all precepts such as 'using IT for strategic advantage, ''reengineering the business, ' and ' informating the workplace, ' become mere slogans if the necessary software is not properly delivered on time." Robert G. Fichman and Chris F. Kemerer, "Adoption of Software Engineering Process Innovations: The Case of Object Orientation," *Sloan Management Review*, winter 1993.

[39] John A. Alic, Jameson R. Miller and Jeffrey A. Hart, "Computer Softw are: Strategic Industry." *Technology Analysis & Strategic Management,* vol. 3, No. *2, 1991,* pp. 177-190.

[40] Foss, op. cit., footnote 33, p. 69.

[41] As described by Rosenthal and Salzman: "The design of effective software is fraught with subtle complexity. Seemingly technical decisions about the in formation to be contained on a screen, the sequence of screens, and the types and forms of data entry can fundamentally influence how workers and customers interact. Technical decisions are really decisions about how and what service will be delivered, the structure of customer-worker interactions, and more generally, the firm's operational model of service delivery. These are often not obvious to the software engineer, who views systems design as a technical enterprise involving the automation of clearly defined procedures." Stephen R. Rosenthal and Harold Salzman, "Hard Choices About Software: The Pitfalls of Procurement," *Sloan Management Review*, summer 1990, p. 82.

[42] Jonathan A. Morell, Louis *G.* Tornatzky, and James Behm, *CASE Implementation: Dynamics Through the Technology Life Cycle (Ann* Arbor, Ml: Industrial Technology Institute, 1990), and Maryann Olavi, " Making CASE an Organ izational Real ity," *Information Systems Management, vol. 10,* No. 2, spring 1993, pp. 15-20.

[43] Fichman and Kemerer, op. cit., footnote 38, p. 8.

[44] See Edward Yourdon, The *Decline and Fall of the American Programmer (New* York, NY: Prentice Hall, 1992). As the author notes: "Attention to peopleware issues can literally cause 10-fold productivity improvement, while investments in CASE methodologies, or other technologies, rarely cause more than a 30-40 percent improvement," p. 28. See also Morrell et al., op. cit., footnote 42.

it is said that Japanese programmers produce 70 percent more code than their U.S. counterparts, and with fewer than half as many defects.[45]

For best results, users as well as vendors need to be more involved in the processes of software development and acquisition.[46] While user involvement is necessary for the development of all innovations, it is particularly important in the use of software, which is itself a process tool that has far-reaching organizational impacts. Too often, software fails to measure up to expectations. It may even give rise to unintended consequences because, in the early stages of development, design parameters are not carefully matched to organizational needs.[47]

Need for a New Regulatory Approach

There is a growing gap between advances in networking technology and the regulatory framework that governs how these technologies are brought together to comprise a national infrastructure. Although information and communication technologies are increasingly being mixed and matched and used interchangeably to create a variety of networks serving different purposes, national regulators continue to compartmentalize them, setting economic ground rules as if these technologies were quite distinct and unrelated. Moreover, regulators and lawmakers are, at times, so focused on establishing the appropriate rules for how the wide range of vendors and service providers should relate to one another that they often fail to consider the larger consequences that the ensuing network architecture may have for the economy as a whole. Even less attention is paid to the evolution of private networks and network components that, while falling outside the bailiwick of the Federal Communications Commission's (FCC's) traditional regulatory mission, still constitute part of the infrastructure that supports and sustains economic activities.

Although the divestiture of AT&T had a revolutionary impact on telecommunications worldwide, its effect on U.S. regulatory policy has been much more circumspect.[48] Despite the convergence of information and communication technologies and the emergence of new complementary and competing networking components, the FCC continues to deal with each technology-as it has in the past—according to a distinct set of rules. Such an approach makes it difficult to develop a comprehensive and strategic picture of how systems will interconnect and services might best be delivered in the future.

This regulatory approach has major implications not only for infrastructure development, but also for business and the national economy. In economic activities, the value of information and communication technologies greatly increases when technologies are effectively networked together, making it imperative that they be considered in relationship to one another. Thus, for example, American Hospital Supply (AHS) (now Baxter Corp.) did not simply use its EDI network to reduce the cost of exchanging trade data. Instead, it added value to its product by packaging the information generated by the system and bundling it for sale together with its hospital supplies.

[45] Michael A. Cusumano, "A Quantitative Analysis of U.S. and Japanese Practice and Performance in Software Development," *Management Science*, vol. 36, No. 11, November 1989, pp. 1384-1405, Neil Gross, "Now Software Isn't Safe From Japan," *Business Week*, Jan. 11, 1991, p. 84, Mark Crawford, "Software industry Braces for Foreign Onslaught," *New Technology Week*, Nov. 18, 1991, pp. 1,9: and Douglas Marden, "The Japanese Approach to Software Development'" *Chief Information Officer Journal*, vol. 5, No. 4, March April 1993. pp. 18-21.

[46] See for instance, Sue Newell, Jacky Swan, and Peter Clark, "The Importance of User Design in the Adoption of New Information Technologies," *international Journal of Operations and Production Management!*, vol.13, No. 2, 1993, pp. 4-22. See also, Joan Greenbaum and Morten Kyng, *Design at Work" Cooperative Design of Computer Systems* (Hillsdale, NJ: Lawrence Erlbaum Associates, 1991).

[47] Newell et al., op. cit., footnote 46.

[48] For discussions of the post-divestiture regulatory environment, see Robert W. Crandall and Kenneth Flamm (eds.), *Changing the Rules: Technological Change, International Competition and Regulation in Communications* (Washington, DC': The Brookings Institution, 1989); see also Barry Cole (ed.). *After the Break-Up: Assessing the New Post-AT&T Divestiture Era* (New York, NY Columbia University Press, 1991).

BOX 2-3: American Information Exchange (AMIX) Network

The American Information Exchange (AMIX) is an example of one of the Innovative new electronic marketplaces AM IX, which has been in operation since June 1991, is a computerized forum for buying and selling software, research data, newsletters, and consulting services, according to its operators, the network is designed to "shave transaction costs to the bone."[1] The network facilitates the unbundling of Information, instead of buying one large, expensive report, buyers can access and pay for as much, or as little, Information as they need. Sellers post their products and services online, and if a buyer is interested, the materials are downloaded and the price is debited from his or her credit card. The network pays the seller and keeps a commission Buyers can also use AMIX to advertise their data needs if there is no corresponding seller, the network will provide a mechanism by which buyers and sellers can negotiate a contract to create customized information To be part of the network, all one needs is a personal computer, a modem, a telephone line, and AMIX software

(continued)

1 Benjamin Wright, "High-Tech Juice Keeps Electronic Emporiums Humming" *Computerworld*, Oct 12, 1992, P 112 See also Esther Dyson, "Information, Bid and Asked, " Forbes, Aug 20, 1990; Joel N Orr "Join the Information Economy, *Computer Aided Engineering* April 1992

SOURCE Office of Technology Assessment, 1994

In this fashion, AHS was able to differentiate its product from its competitors, and thereby gain a strategic advantage.[49]

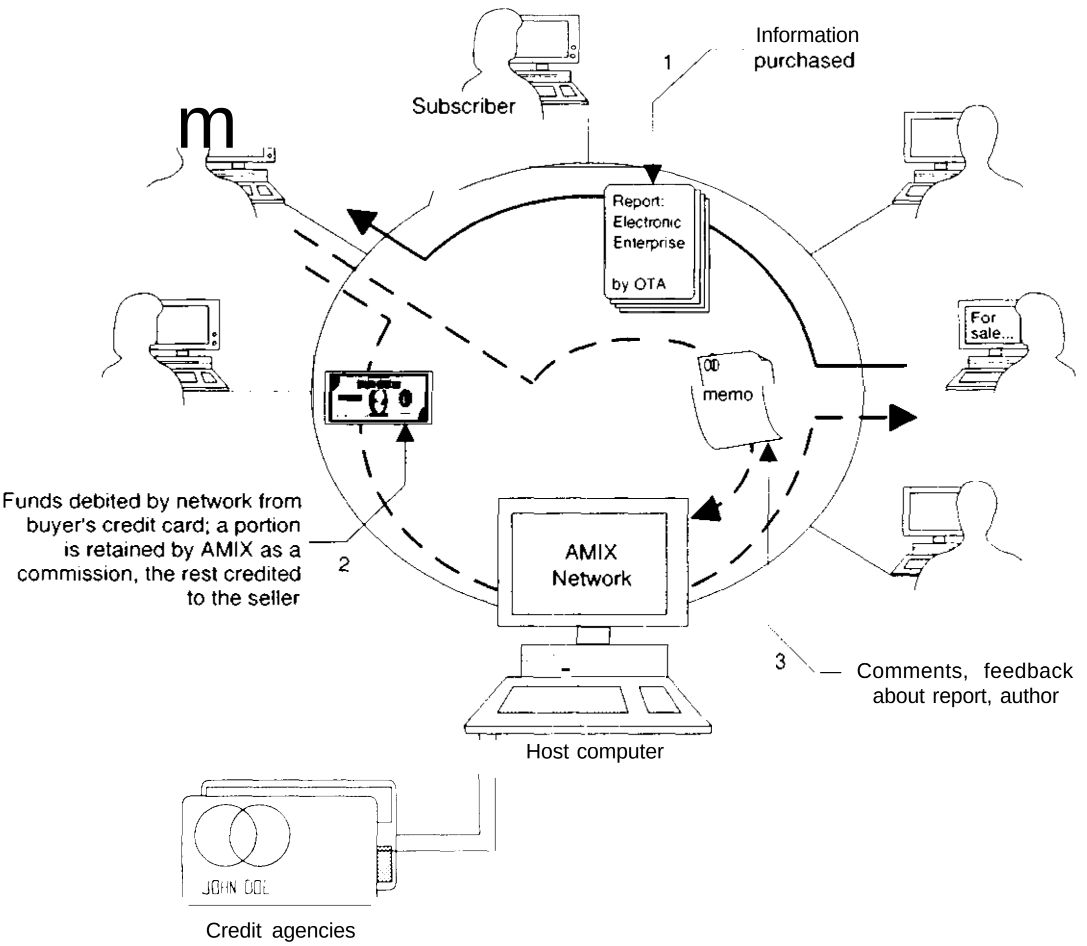
The internetworking of communication and information technologies adds value in the marketplace as well. For example, an electronic catalog may be useful, but its value is considerably increased if it is put online. It is then accessible to more users and can be updated in real time. Additional value can be added if this network is linked to both an intelligent network that offers 1-800 services and a credit card authorization system. By connecting all these services, an actual exchange can take place. Further benefits can be derived by connecting to an electronic funds transfer system and/or an automated clearinghouse. If, as in the case of the AMIX system, multiple buyers and sellers are linked together on a network, true electronic commerce can occur (see box 2-3). Whether, and under what circumstances, the appropriate interconnections allowing for electronic markets will take place, however, will be determined in part by federal and state regulations.

Communication regulations defining vendor relationships and network interconnections will also affect the distribution of economic costs and benefits among American businesses. For example, the FCC regulatory decision to allow interconnection to the public switched network fostered competition and the unbundling of what was once a single, unified telephone system. At the same time, however, this decision shifted the transaction costs entailed in network integration and management from the supplier to the user. These costs are considerable, given the growing variety of technologies from which to choose, the lack of standards and common interfaces, and the complexities involved in assembling networks. Large businesses have thrived in this environment, taking advantage of lower service costs and the opportunity to customize their networks to better meet their needs. Because of their size and resources, large businesses have been able to achieve sufficient economies of scale and scope, making it economical] y feasible for them to develop networks of their own. Given their specialized

[49] Hopper, op. cit., footnote I 7

BOX 2-3: American Information Exchange (AMIX) Network (cont'd).

FIGURE 2-4: American Information Exchange (AMIX) Network



SOURCE Office of Technology Assessment 1994

networking capabilities, many of these businesses—such as Sears and J.C. Penney—have been able to market their communication services or use them strategically to their competitive advantage.[50]

Small businesses, on the other hand, have often been disadvantaged by this situation. If, for example, a small business does not have in-house capabilities to develop its own proprietary EDI system, it will have to bear the full costs of system integration by paying a value-added network (VAN) provider, such as GEIS or EDS, to provide the service. Under such an arrangement, the trading companies rent EDI mailboxes through which or-

[50] See Eli Noam, "The Future of the Public Network: From the Star to the Matrix," *Telecommunications*, March 1988, pp. 58-59, 90; and J. Cash, W. McFarlan, and J. McKenney, *Corporate Information Systems Management*, 2nd ed. (Homewood, IL: Irwin, 1988); and Peter G. Keen, *Competing in Time: Using Telecommunications for Competitive Advantage* (Cambridge, MA: Ballinger Press, 1988).

ders and invoices are sent and received. This setup can be costly, and it is often inconvenient. Because of the high costs of interconnection, many companies access their mailboxes as infrequently as possible. Restricting usage, however, can defeat the purposes of EDI, which strives to support "just-in-time" de ivery. A company that checks its mailbox on] y once a day could be confronted with a delivery even before any paperwork has been done.[51]

The small user could overcome this problem, however, given a different set of interconnection arrangements. With software that is now being developed, businesses will be able to circumvent the VAN and link up their ED] systems through a less expensive transmission medium. such as an architecture like the Internet. In this case. the mailbox would reside on the user workstation instead of with (he VAN provider, Exchanges would likely take place much more frequently, since the user would have more control and the cost would be much less. Equally important, trading partners would be able to send unstructured E-mail messages along with structured EDI messages, which would greatly enhance the effectiveness of the trading partnership. If the Internet were linked to the X 400 E-mail standard, it would also be possible to transmit binary data, computer-aided design and computer-aided manufacturing (CAD-CAM) data, and graphics in this fashion.

It was relatively easy to establ ish rules and regulations governing interconnection when there was a single unified telephone system that was quite distinct and unrelated to other media, such as print and radio-based technologies. All were regulated according to a distinct set of principles. The telephone system operated as a common carrier; print media in accordance with the first amendment; and radio-based media as defined by the "public interest standard."[52] As communication and information technologies converge, and service providers merge accordingly, regulators and lawmakers will need to determine which set of principles should apply.

With the growth in competition, the packaging together of information with communication networks, and the development of private networking, fewer and fewer services are likely to fall within the traditional realm of common carriage. While this development may make sense with respect to the changes that are taking place within the telecommunication and information technology market, it might be problematic with respect to the economy as a whole. Common carriage rcgulation assures equitable access and interconnection to essential facilities. To the extent that networked information systems come to operate increasingly as true electronic markets, more and more issues relating to the principal of essential facilities will certainly arise.[53]

LINKING TECHNOLOGY AND ORGANIZATIONAL INNOVATIONS

Many business and government leaders look to information and communication technologies to

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[51]Personal communication, Jonathan Morell, Industrial Technology Institute, Sept. 7, 1993.

[52]Ithiel de Sola Pool, *Technologies of Freedom* (Cambridge, MA: Harvard University Press, 1983); see also U.S. Congress, Office of Technology Assessment, *Critical Connections: Communication for the Future*, OTA-CIT-407 (Washington, DC: U.S. Government Printing Office, 1990), esp. ch. 4.

[53]Wildman and Guerin-Calvert, op. cit., footnote 19. See also Konsynski, op. cit., footnote 16, who, in response to the question of whether government will still have a role, replied: "Yes, because the government has an abiding interest in ensuring that systems built to facilitate business among competing companies are not designed or used in ways that give any business unfair competitive advantage. This principle has been enforced with much controversy in the United States, where the airline reservation systems have come under government orders to alter the ways their systems perform in order to eliminate systemic unfair competitive practices that were facilitated by the designs. We can expect similar concerns to arise with respect to horizontal EDI systems, and in many cases, government agencies are likely to look upon such systems as analogs of "common carrier" networks such as the telephone system. Although such systems can be privatized, as in the Singapore Tradenet System, the government will probably be required to have an ongoing role, ensuring that key social objectives are upheld in the actual functioning of the system."

help American business regain its competitive position and adapt to its rapidly changing economic environment. Experience to date, however, demonstrates that technology alone will not be enough. In cases where technology has made a critical difference it has been employed in conjunction with successful organizational change. Similarly, most obstacles to success have been organizational rather than technological. To develop appropriate technology-based strategies that are sufficiently responsive to the fundamental changes taking place around them, businesses will need to reengineer their business relationships and their ways of thinking about the nature of the business enterprise itself.

Over the past two decades, American business has invested heavily in information and communication technologies to boost productivity. Between 1970 and 1988, for example, the share of information technology as a percentage of stock of capital equipment increased from 16.4 percent to 20.7 percent in the service sector, and from 1.6 percent to 10.6 percent in manufacturing.[54] In 1990 alone, American businesses spent over $61 billion on hardware, $18 billion on software, and over $75 billion on data-processing and computer services.[55]

In spite of the enthusiasm with which American businesses made these sizable investments, the results to date have been disappointing. Although U.S. business investment in information technology has exceeded that of all other major industrial countries, U.S. productivity has not followed suit.[56] Until very recently, productivity gains have been essentially stagnant in services, the very sector in which information technology investment has been highest.[57] Only very recently has this trend begun to reverse, with productivity gains in services averaging 2.6 percent over the last seven quarters.[58]

Economists and other business analysts have explained the elusiveness of technology benefits—the so called "productivity paradox"—in a variety of ways.[59] Some have argued that existing productivity measures are out of date. They point out that, while the ratio of output to inputs may have sufficed to measure growth rates in an era of mass production, such a measure is inadequate in a service economy where time, convenience, and customized production are so highly valued. Others caution against confusing cause and effect, noting that, had investment in information technology not taken place, productivity gains

[54] David L. Schmitt, "Reengineering the Organization Using Information Technology," *Journal of Systems Management*, January 1993, p. 4.

[55] U.S. Department of Commerce, *US Industrial Outlook 1991* (Washington, DC: U.S. Government Printing Office, 1991).

[56] R. J. Gordon and Martin Neil Baily, "Measurement Issues and the Productivity Slowdown in Five Major Industrial Countries," *Technology and Productivity: The Challenge for Economic Policy* (Paris, France: OECD, 1991).

[57] Stephen S. Roach, *Making Technology Work* (New York, NY: Morgan Stanley, Special Economic Study, Apr. 16, 1993), p. 3.

[58] Ibid., p. 5.

[59] For overall discussions, see Martin Neil Baily and Robert J. Gordon, "The Productivity Slowdown, Measurement Issues, and the Explosion of Computer Power," Brookings Papers on Economic Activity, vol. 2, 1988; Gordon and Baily, op. cit., footnote 56, Paul Strassman, The *Business Value of Computers* (New Canaan, CT: The Information Economics Press, 1990); and Paul Attewell, "Information Technology and the Productivity Paradox," version 3.1, July 1992, funded in part by a grant #1ST 8644358 from the Information Technology and Organizations program of the National Science Foundation. For an alternative point of view, see Erik Brynjolfsson, "Is Information Systems Spending Productive: New Evidence and New Results." MIT Sloan School, Working Paper #3S71-93.

[60] OTA Workshop on the Productivity Paradox, Harvard University, May 10, 1993. See also, Peter R. Richardson and John R.M. Gordon, "Measuring Total Manufacturing Performance," Management Review, winter 1980, pp. 47-57, Young Kyu Son and Chan S. Park, "Economic Measure of Productivity, Quality and Flexibility in Advanced Manufacturing Systems," *Journal of Manufacturing Systems*, vol. 6, No. 3; and Timothy Bresnahan, "Measuring Spillovers from Technical Advance: Mainframe Computers in Financial Services," *American Economic Review*, vol. 76, No. 4, 1986, pp. 742-755.

may have been even lower.[61] Still others question the existence of a productivity paradox, noting that it can take a number of years to reap the benefits of a new technology, especially in cases involving networked technologies.[62]

Although differing in their assessments of the productivity paradox, many analysts agree that information and communication technologies will not yield substantial gains unless American businesses use them to instigate major organizational change.[63] Embodying social relations and supporting social interactions, communication and information technologies are indeed powerful forces for change. However, if they are to have their intended effect, new technologies will need to be carefully integrated into their organizational environment, taking full account and advantage of the "way people work, learn, and innovate."[64] These technologies will also need to revolutionize the mind-set of those working within business organizations, awakening them to the full range of new organizational possibilities.[65] The lack of mutual adaptation will serve to undermine these efforts[66] (see box 2-4).

Problems of this nature have already become apparent, for example, in the case of business networks. Cooperative partnerships offer a wide range of benefits.[67] In a rapidl y changing environment, they permit firms to enjoy a measure of stability without sacrificing all their flexibility.[68] Partnering benefits can be distributed in two ways. Linked to a large customer or supplier, for example, a small firm can gain access to new markets; share in cost reductions resulting from greater economies of scale; reduce the time required to develop new products; gain access to technology and process innovations; improve quality; provide mutual assistance in a crisis; receive greater market feedback; and receive better financial

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[61] William Bowen, "The Puny Payoff from Office Automation," *Fortune*, May 26, 1986.

[62] David, op. cit., footnote 6.

[63] As Hayes and Jaikumar note "Still, most U.S. managers are having difficulty reaping these advantages. For years, manufacturers have acquired new equipment much i n the way a fam i ly buys a new car. Drive out the old, drive in [he new, enjoy the faster, smoother, more economical ride—and go on with li fe as before. With the new technology, however, "as before" can mean disaster. Executives are discovering that acquiring an FMS [flex ible manufacturing system] or any of the other manufacturing systems is more like replacing that old car with a helicopter." Robert H. Hayes and Ramchandran Jaikumar, "'Manufacturing's Crisis: New Technologies, Obsolete Organizations," *Harvard Business Review*, September-October, 1988, pp. 77-85.

[64] As Brown and Duguid note: "Organizational survival may far less depend on more sophisticated technology devices than on a more sophisticated understanding of the way people learn, work, and innovate," John Seely Brown and Paul Duguid, "Innovation in the Workplace A Perspective on Organizational Learning," paper prepared for the Carnegie Mellon University Conference on Organizational Learning, May 1989, p. 3. See also Steven Stanton, Michael Hammer, and Bradford Power, "Reengineering: Getting Everyone on Board," *IT Magazine*, April 1993, pp. 22-27.

[65] Ibid., p. 7.

66 Henry Mintzberg and Frances Westley, "Cycles of Organizational Change, " *Strategic Management Journal*, vol. 13, 1992, pp. 39-59, As the authors point out, organizational change can take place from both the top down and the bottom up. But, as in the case of al I innovations, organizational changes will be redeveloped and reinterpreted to address the situation at hand.

[67] Mark D.)]] inger and Peggy Golden, "Interorganizational and Collective Strategies in Small Firms: Environmental E; ffects and Performance," *Journal of Management*, vol. 18, No. 4, 1992. As the authors point trot: "The future looks more cooperative than we believe. Perhaps the sun i\ ors of the competitive game are the ones who now participate in the cooperative game. As the global economy evolves, strategic alliances are the future and competition will primarily take place among alliances. The advantage of participating in these alliances are multiple and manifest and firms scramble to be members. In other words, firms compete to cooperate "

[68] Andrea Larson "Partner Network: Leveraging External Ties To Improve Entrepreneurial Performance '" *Journal of Business Venturing*, vol. 6, 1991, pp. 173-188. See also, Peter Smi th Ring and Andrew H. Van de Ven, "Structuring Cooperative Relationships Between Organizations," *Strategic Management Journal*, vol. 13, *1992*, pp. 483-498.

BOX 2-4: Organizational Restructuring: The Cases of Saturn and Ford

The great successes in recent years of foreign-based automobile manufacturers in the American small-car market have led the big three American automakers to reassess managerial approaches and production processes Faced with declining market share and well publicized management troubles, General Motors (GM), the nation's largest automobile manufacturer, launched the Saturn Corp in 1983 to compete in this Important segment of the market

The Saturn Corp was created from scratch as a subsidiary of GM, but with sufficient distance from the parent company to allow a new corporate philosophy. In order to compete against Honda, Toyota. and Nissan, Saturn IS experimenting with markedly new ways of designing, building, and even selling cars The company's hallmark IS its reemphasis on people—both its workers and customers Instead of a dichotomy between management and labor, Saturn organizes the company in teams, each of which IS responsible for its performance, budget, and hlring, further, the involvement of team members in decisions about production and the product IS a significant departure from normal practice and IS often credited with Improving the quality of the work environment and the product itself A second innovation IS the integration of computers into the design and production of Saturn cars With support from GMs EDS subsdiary, Saturn electronically connects the various departments—for example, directing purchasing to order parts to match a production schedule—as well as Important suppliers the network even links with dealers to track information on customer preferences and automobile maintenance

The Ford Motor Co , in 1926, faced an analogous predicament declining market share was proof that the philosophy and manufacturing process that had worked so successfully for the Model T had become obsolete In order to build a new product line, it was necessary for Ford to rebuild its company

During the first two decades of the 20th century, Henry Ford and his motor company revolutionized manufacturing with the introduction of assembly -line mass production for the flagship Model T Ford and emphasized maximum production at minimum cost, though there were numerous refinements of the process in the course of the Model T's illustrious 20-year history, the product itself remained remarkably similar Ford's hallmark was to build cars in very large quantities using machine tools specifically designed for a single task similarly, Ford realized significant Improvements in productivity by breaking down human tasks into very small pieces Ford refined the assembly-line system of production to such a degree that no competitor could match Ford on price however, this great efficiency came at the expense of Innovation, and GMs Chevrolet division Instead won over consumers in Increasing proportions on the basis of more modern styling and a greater variety of features and options, such as colors other than black

By 1926, when the 15-millionth Model T came off the assembly line, Ford's market share had slipped to 30 percent from a peak of over 50 percent in 1921 In that year, Ford announced that it would stop making the Model T and Introduce a new car, the Model A. In doing so, Ford largely revamped its own organization, purging the company of the old management, the company also relocated to a new facility and redesigned the production tools and process in preparation for the new Model A

SOURCES David A Hounshell *From the American System to Mass Production* 1800-1932 (Baltimore MD The Johns Hopkins University Press 1984) pp 217-301 Kevin Doyle "Can Saturn Save GM?" *Incentive*. December 1992, pp 30-37 Keith A Linton and Lisa W Churitch Managing and Measuring the Performance of Vehicle Design at Saturn, ' *1993* AACE *Transactions* Jeremy Main Computers of the World Unite! *Fortune* Sept 24, 199(, PP 115-122, John Teresko "Engineering Where Competitive Success Begins *Industry Week Nov* 19 1990 pp 30-34 terms.[69] Larger firms that are parties to such arrangements also gain; most important, small firms can help them gain access to future markets as well as provide a stimulus for innovation and change .70

Establishing such arrangements is not without difficulties, however. Above all, successful networking takes time and continued effort; it requires that trust be established over time through a process of repeated successful transactions.[71] It also requires a commitment and willingness to share all forms of information among business partners[72] (see figure 2-5). Having been steeped in a bureaucratic and competitive mentality, many businesses have found it difficult to shift from an adversarial approach to a more cooperative one. For example, many manufacturers find it difficult to commit to a specific set of suppliers.[73] And, even after making such a commitment, they are reluctant to share proprietary product data. At the same time, suppliers have been unwilling to let their customers, or other competing suppliers, share their cost data.[74] Failure to share information within firms also inhibits partnering, since effective interorganizational relations require cooperation across all sectors of both firms.[75]

Total quality management (TQM) groups have encountered similar problems. The concept of TQM, which traces its early roots back as far as the 1920s, gained considerable popularity in the late 1970s and early 1980s when American manufacturers learned from their successful Japanese counterparts that it is quality, and not just cost, that drives sales in a post-industrial economy.[76] Fundamental to total quality management is the assumption that, when things go wrong, the problem generally stems from organizational rather than human failures. To solve such organizational problems, TQM calls for employees, working in teams and closely with management, to identify the problems and find ways to overcome them. Work teams also need access to company-wide information to properly analyze issues and solve problems.[77]

Although American businesses have taken many formal steps to adopt team-based, quality-

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69 Ibid., p. 179

'"Ibid., p. 180.

71 AS described by Ring and Van de Ven: "Reliance on trust by organizations can be expected to emerge between business partners only when they have successfully completed transactions in the past and they perceive one another as complying with norms and equity. The more frequently the parties have successfully transacted, the more l ikely they will bring higher levels of trust to subsequent transactions. As the level of trust increases, greater reliance may be placed on the actions of the trusted party. " Ibid., p. 489. See also R.G. Eccles and D. Crane, "Managing Through Networks in Investment Banking," *California Management Review, vol. 30, 1987,* pp. 176-195.

72 Mark Dodgson, "Learning, Trust, and Technological Collaboration," *Human Relations, vol. 46,* No. *1,* January 1993, pp. *77-95.*

73 As noted by Richardson: "Developing long-term, tightly integrated relationships with fewer suppliers, especially with a sole source, conflicts with conventional wisdom and historical U.S. practice. ''James Richardson, "Restructuring Supplier Relationships in U.S. Manufacturing for improved Quality," *Management International Review,* vol. 33, Special Issue, January 1993, p. 55. See also, Martin Everett, "Why Partners Sometimes Part," *Sales and Marketing Management,* April 1993, pp. 69-74.

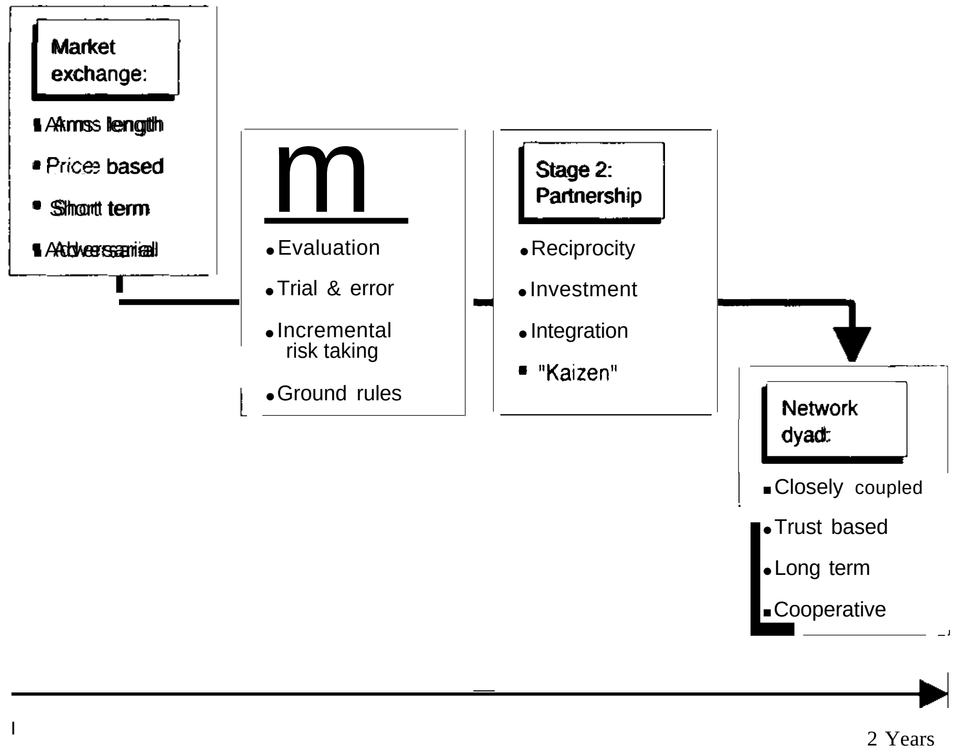
74 See Max Munday, "Buyer-Supplier Partnerships and Cost Data Disclosure," *Management Accounting,* June 1992, pp. 28-36.

75 See Morels M Kleiner and Marvin L. Bouillon, "information" Sharing of Sensitive Business Data With Employ ees," *Industrial Relations,* vol. 30, fall 1991, pp. *480-491.* Motohiro Morishima, "Information Sharing and Firm Performance in Japan," *Industrial Relations, vol. 30, No. 1,* winter 1991, pp. 37-61. See also Motohiro Morishima, "information Sharing and Firm Performance in Japan," *Industrial Relations,* vol. 30, No. *1,* winter *1991.* pp. 37-61.

76 For a discussion of the history and philosophy" of TQM, see Stephen J. Harrison and Ronald Stupak, "Total Quality Management: The Organizational Equivalent of Truth in Public Administration Theory and Practice," *Public Administration Quarterly,* pp. 420-429.

77 1 bid., p. 424.

FIGURE 2-5: Forming the Partnership: A Two-Stage Process



SOURCE Andrea Larson Partner Networks Leveraging External Ties to Improve Entrepreneurial Performance *Journal of Business Venturing* May 1991

oriented approaches, many old behavioral patterns persist.[78] To implement TQM, management must renounce its traditional hierarchical style—based on the specialization of tasks, workplace stability, product iv it y, obedience, and control--in favor of a more trust-oriented approach that calls for leaders who can inspire group motivation, loyalty, commitment, and worker pride.[79] Workers, on the other hand, must not only be willing to learn new skills and adapt to different incentives and reward structures; they must also trust management's intentions. This will be hard to do, given years of adversarial relations. It is even more difficult when TQM groups are established as part of a total business reengineering process. in which case jobs might be at stake .80 Under such circum-

[78] In a study comparing U.S. and Japanese quality management styles, Ebrahimpour and Cullen found, for example, that "A merican managers emphasize concrete results rather than processes. Additionally, they make decisions in a less participate\ e fashion than do Japanese. Individual responsibility and top-down decision making appear to be common features of the Americans} stem. Furthermore, the U.S. management favors a control mechanism based on close supervision and an explicit formal control patter n." Mailing Ebrahimpour and John B. Cullen, "Quality Management In Japanese and American Firms Operating in the United States: A Comparative Study of Styles and Motivational Beliefs," *Management /r] ternational Review*, vol. 33, Special Issue, January 1993, p. 37. See also David Graves, "Forget the Myths and Get on With TQM—Fast," *National Productivity Review*, summer 1993. See also Thomas Bailey, "Organizational Innovations in the Apparel Industry," *Industrial Relations*, vol. 32, No. 1, winter I 992, pp. 30-48.

79}+ arrison and Stupak, op. cit., footnote 76, pp. 4 '6"429

[80] David Fagiano, "The Downsizing and Loyalty Conundrum," , *Management Review*, June 1993. p. 4.

stances, it is not surprising that many quality management programs have yet to show clear-cut positive results.[81]

Technology, although by no means a panacea, offers one way of breaking out of this organizational impasse. As Michael Hammer, a leading proponent of business engineering, has pointed out, "The power of the new technologies is that they allow you to redefine what your problem is."[82] And there are clearly many who agree. According to one estimate, the work flow software market in the United States will grow tenfold by 1996, when it will constitute a $2.5 billion industry.[83]

There is a major problem is viewing technology in this way, however. Like organizational innovations, technology is viewed all too often as a "fix" to be implemented from the top down. Although technology plays a major role in structuring human relations, rarely do businesses, or the people working in them, play a major role in its design. The real choices about technologies are not made when vendors put them up for sale on the market, but when the problem to be solved is first defined. As experience with TQM groups demonstrates, the task of identifying problems is often performed best by those who are doing the work.[84]

NEED FOR A FLEXIBLE WORKFORCE

Over the last several decades, the U.S. workforce has undergone tremendous change as businesses implemented information technology. With new advances in the technology and new organizational forms emerging to use them, workforce changes will likely continue. Furthermore, the overall shift in the structure of the economy from one dominated by mass production to one that is more flexible and centered on services will require a workforce that is similarly flexible and skilled. Experience indicates that information technologies can both upskill and deskill jobs. Recent advances in information technology, however, will likely have more significant impacts because they can increase the levels of both cooperation and control in workplaces. These changes are not understood nearly as well as the role of information technology in affecting skill levels.

The demands for increased flexibility and lower costs are forcing American business to reconsider traditional management techniques. The success of Japanese workplace practices has motivated American businesses to emulate them. Continuous improvement (kaizen), lean production, and just-in-time (kanban) manufacturing are the new standards of performance in production, distribution, and retail. Similarly, the forming of worker teams and quality circles to motivate employees is gaining adherents. This approach to work sees cooperation as a central goal. Employers recognize that encouraging employees to share the firm's goals is not only profitable in the long run, but also necessary for the development of flexible response processes.

Information technology supports these shifts to new ways of managing. EDI, for example, is a critical component in just-in-time distribution because it allows suppliers and customers to coor-

[81] See John Iacovini, "The Human Side of Organizational Change," *Training and Development*, January 1993, pp. 65-68. As the author notes: "Research has shown that few quality-improvement efforts go beyond lip service. Examined more closely, most quality failures result from some fundamental imbalances between the human and business sides of change." Ibid., p. 65. See also Richard S. Belous, "Human Resource Flexibility and Equity: Difficult Questions for Business, Labor and Government," *Journal of Labor Research*, vol. 10, No. 1, winter 1989, pp. 67-72.

[82] Michael Hammer, "Reengineering," *Across the Board*, June 1993, p. 32. See Also Ram Charan, "How Networks Reshape Organizations-for Results," *Harvard Business Review*, September-October 1991, pp. 104-115.

[83] John Gantz, "Surviving the Re-engineering Revolution," *Networking Management*, January 1993, pp. 20-21.

[84] Robert J. Thomas, *What Machines Can't Do: Politics and Technology in the Industrial Enterprise* (Berkeley, CA: University of California Press, in press). See also John Alic, "Who Designs Work? Organizing Production in an Age of High Technology," *Technology and Society*, vol. 12, 1990, pp. 301-317.

dinate the flow of goods. "Concurrent" or "simultaneous" engineering is largely a computerized approach to team-oriented design. Manufacturers find lean production easier to implement with the development of computerized numerically controlled (CNC) machines.

There are other ways to achieve a flexible workforce, but these reduce the quality of work life and can have serious national implications. Layoffs, downsizing, and shifting to contingent workers (such as temporary employees) are also responses to demands for flexibility[85] (see box 2-5). By hiring temporary workers, employers avoid paying fringe benefits and can release workers in economic downturns. Such firms have less incentive to train their employees and upgrade their skills because the chance of recouping their investment is small. Indeed, in this respect, the United States already has a very flexible workforce because of the high rate of labor mobility—the willingness to work for different companies.[86] The experiences of Japan and Germany, however, indicate that achieving flexible workers by improving training and skills also results in higher productivity.[87]

Despite the potential value of the new management techniques, information technology can perpetuate the vestiges of the work-flow-control model typical of the industrial era. Electronically

BOX 2-5: A Flexible or Fragmented Workforce?

The workforce is undergoing a long-term structural change in which workers are more fragmented from the workplace The traditional employee worked for one employer for life with an understood relationship, exchanging loyalty of service for salary, benefits, and career mobility. Today, however, more people work in a variety of settings—home, satellite offices, rented or temporary offices, or the offices of suppliers, partners, or competitors—and through different arrangements with their employers—part-tilme, contractual, temporary, or other individually negotiated arrangements For years, such ad hoc and contingent workers were at the margin of organizations and in the workforce. With the restructuring of organizations and the continued outsourcing, downsizing, and rightsizing that characterizes the current business environment, these workers are Increasingly in the mainstream In the near future, the terms part-time, contract, temporary, and so forth may be replaced by new terms that focus less on working conditions and more on the culture of work and the predominant activities performed by workers and their electronic tools

SOURCE Off Ice of Technology Assessment, 1994

[85] See L. Lynne Pullman, "Temporary Employees: What Are An Employer's EEO Responsibilities?" *Employee Relations Law Journal*, vol. 18, No. 3, winter 1992, pp. 533-538. See also G. Pascal Zachory and Bob Ortega, "Workplace Revolution Boosts Productivity at Cost of Job Security," *Wall Street Journal*, Mar. 19, 1993,

[86] See U.S. Congress, Office Of Technology Assessment, *Technology and Structural Unemployment: Reemploying Displaced Adults*, OTA-ITE-250 (Washington, DC: U.S. Government Printing Office, February 1986), page 144.

[87] In what was one of the most comprehensive studies of its kind, researchers compared the use of CNC equipment in the United Kingdom and Germany. German plants had productivity rates 60 to 130 percent higher than the U. K., and German machinists could reach top-speed production in 2 days on equipment the British machinists took weeks to master. The results were attributed to differences in training. British management practice traditionally is similar to that of the United States. See, for example, A. Serge et al., *Micro-electronics and Manpower in Manufacturing: Applications of Computer Numerical Control in Great Britain and West Germany* (Aldershot, UK: Gower, 1983).

monitoring clerical workers, operators, and others working at computer terminals is an example .[88] New technologies can track areas of work that have traditionally been immune to monitoring. For instance, the location, status, and activity of workers, delivery personnel, and truckers can be more closely monitored. Another example is employer access to employees' electronic mail to monitor workers. The courts are currentl y evaluating employee and employer rights with respect to e-mail monitoring in a case involving the employees of Epson America.[89] Another example is Cypress Semiconductor corporate software. Every 4 hours it scans manufacturing inventory. If a part remains on the shelf beyond a predetermined time, the software shuts down the inventory system, stops manufacturing operations, and notifies the rest of the company through the corporate network. Other departments within the firm face similar performance standards that are tied to corporate goals.[90]

Information technologies support a broad range of employer-employee relationships. The interaction between employee and employer is one balanced by trust, cooperation, and delegation of authority on the one hand, and monitoring and accountability on the other-, Depending on the work environment, information technology can shift the balance in either direction. Workplaces that develop trust and delegate authority tend to implement information technology with a vision of worker participation and cooperation. However, technology is sometimes used to monitor activity, control behavior, and restrict choices.

A strategy that pursues high-wage, high-skill jobs and fosters cooperative, collaborative work environments will improve both the work environment and the standard of living for employees. Policies that work toward that goal recognize the enabling role that information technology can play. Information technology can also be used to deskill jobs and enhance the employer's ability to control and monitor employees. Information technology alone is clearly not a panacea (o improve the quality of work life, It must be linked to enlightened management and a nurturing culture to be successful.

EFFECTS OF TECHNOLOGY CHOICES IN A KNOWLEDGE-BASED SOCIETY

The age-old adage that "knowledge is power" is nowhere more evident than in a knowledge-based society. Regardless of whether referring to work relationships in a firm, competition in the marketplace, or trading relations among nations, having access to information and the ability to package it for a particular use is a key determinant of winners and losers. While this was always the case, the difference today is the extent (o which knowledge is embedded in information and communication technologies. As a result, choices about these technologies—their design, architecture and structure, or the rules and regulations governing their availability and use—will likely have far-reaching social and economic consequences.

Many of these choices will be irreversible, at least in the short and medium terms. Once a decision is made, technology tends to become firmly fixed to a given trajectory. This pattern is especially evident with networked information technologies, which require vast capital and social investment. Thus, periods of rapid technology

[88] See for example, U.S. Congress, Office of Technology Assessment, *The Electronic Supervisor: New Technology, New Tensions*, OTA-CIT-333 (Washington, DC U.S. Government Printing office, September 1987). See also Paul Attewell, "Big Brother and the Sweatshop. Computer Surveillance in the Automated office,'" *Sociological Theory*, vol. 5, 1987, pp. 47-69.

[89] In a case currently in appeal the employees of Epson America Inc. are suing the firm for allegedly copying and reading their e-mail messages. See, for example, David Bjerklie, "E-mail: The Boss is Watching," *Technology Review*, vol. 96, No. 3, April 1993, page 14.

[90] For example if the purchasing department does not reevaluate cases of customers whose credit was revoked within 6 months, the program restores credit. If a shipper is late for delivery without warning or adequate explanation, the shipment is refused. See Stephen Govoni, "License to Ki II ," *Information Week*, Jan. 6, 1992, page 22. See also Thomas Valovic, *Corporate Networks: The Strategic Use (!/ Telecommunications* (Boston, MA Artech House, 1993), pp. 124-125. For similar examples, see Zuboff, op. cit., footnote 32.

advances, such as are occurring today, provide a rare opportunity for reassessing and redirecting both the nature of a particular technology itself, and the economic and social relationships that are structured around it. Given the significance of the moment, and the potential consequences for winners and losers, consideration should be given not only to what technology choices are being made, but also to the process of how, and by whom, these choices are made.[91]

Economic outcomes and performance have always been greatly affected by those who had control over information and the networks that supported and channeled its circulation. Civilizations spanning centuries have recognized the power of information. For example, the city of Venice—at the height of its economic power—sought to control all trade-related information, going so far as to segregate and conduct strict surveillance over all foreign merchants.[92] Similarly, in the bazaar economies of the Middle East, it is the fierce competition for privileged information that drives events. As described by anthropologist Clifford Geertz:

> . . . bazaaris [participantsl are as interested in making search fruitless for others as they are in making it effectual for themselves. The desire to know what is really occurring is matched with the desire to deal with people who don't but imagine they do. The structures establishing search and those casting obstructions in its path are thoroughly intertwined.[93]

New communication and information technologies have led to the redistribution of economic power, and a shift in economic advantage. The history of the printing press is a case in point.[94] Before the development of printing, inventors retained their ideas under their personal control and did not concern themselves with the prospect of others unfairly profiting from their work. They went from town to town selling their intellectual wares, But once their ideas were printed and made public, inventors lost control and, with it. their bargaining power.[95]

The invent ion of the telegraph also served to redistribute economic power. In the early history of the United States, for example, New York City was able to capitalize on its position as a national in fro-mat ion center to become the center of worldwide trade.[96] News continued to flow faster and more fully in and out of New York than any other city, giving it a strong economic advantage. Southern cities, in fact, communicated faster with New York City than within their own region, a fac -

91 As emphasized by Thomas: ". . . it is not enough to claim that technology 'Impacts organizations; it is essential to also ask how and why particular technologies are chosen (or refused) such that they have the impacts [hey do. Second, it is not enough to claim that technology is the simple product of social choice; it is essential to ask how technological alternatives were themselves framed, how the objectives or interests of different organizational actors shape [he range of possibilities considered, and most importantly, how differences in objectives or interests influence the outcomes of change. " Thomas, op. cit., footnote 84. See also Jos Hu igen, "Information and Communication Technologies in the Context of Policy Networks," *Technology In Society*, vol. 15, 1993, pp. 327-338.

92 As described by Braudel "All trade to and from the Terra Firma, all exports from her islands in the Levant or cities in the Adriatic (even goods travelling to Sicily or England) were obliged to pass through the port of Venice. Thus Ven ice had quite deliberately ensnared al I the surrounding subject economies, including the German economy, for her own profit; she drew her l iving from them, preventing them from acting freely and according to their own lights. " Femand Braudel, *The Perspective of the World, Civilization and Capitalism /.$ I/I- /8 I/I Century*, vol. 3 (Berkeley, CA University of California Press, 1992), p. 228.

93 Clifford Geertz, "The Bazaar Economy Information and Search in Peasant Marketing," i n Mark Granovetter and R ichard S wedberg (eds.), *The Sociology of Economic Life* (Boulder, CO: Westview Press, 1992), p. 228.

94 See Elizabeth L. Eisenstein, The *Printing Press as an Agent of Change: Communications and Cultural Transformation In Early Modern Europe*, vols. 1 and 2 (Cambridge, UK Cambridge University Press, 1982).

95 See Bruce W. Bugbee, *Genesis (// American Patent and Copyright Law* (Washington, DC Public Affairs Press, 1967)

96 See Ronald F. Abler, "The Geography of Communications," Michael Eliot Hurst (ed.). *Transportation Geography: Comment and Readin* ~\ (New York, NY McGraw-Hill, 1874).

(or that engendered increasing resentment in the South for cultural as well as economic reasons.[97] With the invention of the telegraph, however, New York central position in the national market began to erode. The opening of the New York-Philadelphia Line, for example, enabled brokers in one city to learn prices in the other, and to place orders before the market had closed. Similarly, prices in other distant markets, such as western grains, also became items of trade through instantaneous communications.[98]

Current technological advances will likely have equally profound effects. Much of the information and knowledge that once was held personally is now embedded in electronic components and networks, where it can be used to support a wide range of economic activities. Information can be programmed in software that performs work routines; stored in databases where it can be updated, processed, and randomly accessed as needed; or even incorporated into information gateways or communication switches to provide network intelligence. To leverage information for economic advantage today, therefore, requires having some control over the access, uses, and design of the technologies in which it is embedded.

Although new technologies have the potential to expand economic opportunities and ease the nation adaptation to a radically changing economic environment, a successful outcome is not assured. Just as the Venetian merchants and Middle Eastern bazaars tried to secure their economic advantage by controlling information access, the powerful economic interests today are likely to attempt to do the same. Thus, a CEO might adopt new computer-based manufacturing technologies for the purpose of gaining greater control over job-related knowledge. Similarly, manufacturers might seek to lock in customers and suppliers by controlling database access through proprietary network standards. Likewise, vendors of information and communication services might try to 1imit competition by restructuring access to the information gateway or intelligent network switch.

How, and to what effect, new communication and information technologies will be employed depends to a large extent on the future role of business. Ironically, precisely at the moment when technological advances provide a unique opportunity for the United States to rethink its technological and socioeconomic choices, the locus of decisionmaking is being transferred from the public to the private sector. With deregulation and the shift of network intelligence and control to the user, many network components that are needed to support electronic commerce now fall outside the government's traditional purview. If new technologies are to generate social and economic changes, therefore, many of these changes must originate within the business community itself.

Finding themselves operating in a highly competitive and rapidly changing knowledge-based, global economy, American businesses are now faced with a number of inducements for change. New ways of conducting business will be required. Cooperation may prove more rewarding than competition, and information-sharing more fruitful than information control. Given the socioeconomic changes taking place, businesses that succeed will be those that are flexible in adapting to take advantage of new situations and events.

New information and communication technologies can help businesses to make the necessary adjustments. However, barring fundamental changes in the way businesses operate, new technologies will more likely be used to bolster

971=+. Robert Albion, *The Rise of New York Port, 1815-1939* (New York, NY: Charles Scribners Sons, 1939); and Al Ian Pred, "Urban Systems Development and the Long Distance Flow of Information Through Preelectronic U.S. Newspapers," *Economic Geography*, vol. *47*, October *1971*, pp. *498-524*.

98 See Kenneth D. Garbade and William L. Silber, "'Technology, Communication, and the Performance of Financial Markets 1840-1975," *Journal q/' Finance*, vol. 33, June 1978, pp. 8 19-983; and Richard DuBoff, "The Telegraph and the Structure of Markets in the United States, 1840-1890," *Research in Economic History*, vol. *8, 1983*.

existing power relationships and perpetuate the status quo.

CRITERIA FOR EVALUATING POLICY OPTIONS

As defined in this report. economic performance entails three essential elements: 1) an increase in the average standard of living; 2) sharing of the benefits of growth among the groups; and 3) sustainable growth. Based on this definition, it is clear that communication and information technologies can contribute to greater economic performance. However, it is also obvious that technology alone is not enough. If the nation economy is to benefit from advanced networking technologies, a number of technological, organizational, and institutional criteria must be met. To the extent that policy measures fail to address al1 of these criteria, the chances for success will be diminished. The outcome" will resemble less a "positive sum game" where all are winners, and more a "zero sum game" in which many tire losers.

Technological Criteria

Versatile and Open Networks and Applications

Versatile networks and applications will be increasingly critical in a global economy characterized by rapid technological and socioeconomic change and a greater variety in preferences, products, and business processes. To perform well, businesses will have to rapidly reconfigure their networks in response to changing circumstances and market demand. Versatile networks will provide the leeway needed to customize applications and networks to support redesigned business processes and flexible working relationships. With the freedom to mix and match a variety of network components, businesses can use technology to add value and develop new products and services.

Interoperability and Seamless Interconnection

To reap the full economic benefits of communication and information technologies, networks and network components will need to be interoperable and open for interconnection. Such networks can reduce transaction costs, whereas closed systems increase the cost of doing business and can create significant barriers to market entry. Interoperable components provide greater network flexibility, are easier to use, and reduce network costs. These capabilities encourage technology diffusion and equity of access. In addition, interoperable systems provide a standard platform for new components and applications.

Ubiquitous and Even Deployment

If the economic benefits of networking are to be broadly shared, technology must be deployed in a time] y and ubiquitous fashion. Business networks can give rise to a significant "first mover" advantage. Networks benefit from considerable economies of scale and scope; therefore, latecomers may be unable to generate the critical mass of users and services to develop a network. Latecomers will also be disadvantaged because business networking not only requires extensive expertise, but also considerable "learning by doing."

Organizational Criteria

Technology Deployment Matched to Business Needs

Technology will not enhance business performance if it does not match business needs. Where technology has been introduced independently of a business plan, efficiency and effectiveness have often declined. Experience suggests that technology and businesses' needs will be most closely matched when: 1) business management takes the initiative in applying technology; 2) technology experts understand and practice business principles and participate in developing the technology plan; and 3) technology users, at all levels, have an opportunity to influence the technology design and deployment strategy.

Versatile Organizational Structures and Role Relationships

In the future, business organizations and processes will need to be more flexible to take advantage of the new opportunities available in a global, knowledge-based economy. Although information and communication technologies can foster and support such organizational change, they cannot substitute for it. Organizations can more easily employ technology to bring about organizational change when roles and routines are broadly defined, resources (especially knowledge and information) are widely shared, and relationships are flexible and loosely coupled.

Supportive and Adaptive Organizational Cultures

Organizational cultures—like organizational structures—need to be adaptable and innovative if technology is to yield positive economic results. Relationships will need to be defined and reinforced less by contractual arrangements and rigid hierarchical rules and regulations, and more by consensual group norms and trust. Interorganizational relations will need to be oriented as much toward cooperation as competition. In addition, businesses will need to develop new and more broad-based criteria for assessing the performance of both individual employees and the enterprise itself.

| Institutional Criteria

Regulation Geared to National Economic and *Social Goals*

Electronic commerce can only occur once the communication and information networks to support it are widely in place. If these networks are to be deployed in a timely fashion, and with an appropriate architecture that will support improved economic performance, regulatory policy will need to be more responsive to, and consistent with, national economic and social goals. To do so, government will need to broaden its perspectives beyond the communication industry, which to date has been the major focus of regulatory policy, and pay greater attention to the economic impacts of technology choices. In addition, as information and communicant ion technologies converge, greater attention must also be paid to the information, or content, aspects of networking technologies.

Need to Reevaluate and Revise the Marketplace Rules

Rapid advances in information and communication technologies, together with business responses to new technological opportunities and constraints, are challenging many of the traditional notions that have governed the marketplace rules and practices of the industrial era. Tensions in the system have already emerged, especially in the areas of antitrust, intellectual property rights, and other laws governing the ownership and use of information. For electronic commerce to flower, and its benefits to be equitably distributed, the rules governing it will need to be brought into line with the fundamental socioeconomic changes taking place. Given a global economy, a consensus regarding these rules will need to be developed on both national and international levels.

Support for Long-Term Resource Maintenance

It will be essential to maintain national capabilities in a global economy where knowledge and information, capital, and labor are not confined to national borders. Support for science, research and development, and an educated workforce will be important. If, for example, care is not taken to develop and maintain a highly educated and skilled workforce, global networks will likely facilitate the substitution of offshore labor for U.S. workers. Similarly, unless efforts are taken to diffuse and commercialize new information technologies more rapidly, their benefits will be realized elsewhere, On the other hand, if communication and other infrastructure are maintained, global networking can attract foreign capital to the United States.