

INFORMATION INDUSTRY STUDY REPORT 1996

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Guangdong P&T
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Guangdong Kelon Electric, PRC
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ABSTRACT

The dynamic track of information technology features nonstop change; competition; convergence; shifting, expanding, opened, and closed markets; and domestic and international alliances. Rarely in history has a single technological development experienced the phenomenal rate of growth that the information technology industry has. Societies around the globe rely increasingly on advanced telecommunications, computer, and other automated information systems in everyday life. Without question, information technology is a force for change--social, political, and economic.

INTRODUCTION

Just as past ages were called bronze or iron after the dominant technology of the times, so should this age be characterized as the information age. For unquestionably the computer and telecommunications information explosions have dominated technology and thereby made irreversible changes in the way people live and work (Lebow, 1995, xiii). The convergence of technologies in computers and telecommunications is changing the world as radically as the industrial revolution did over 200 years ago. The pace of commerce is accelerating exponentially because information technology is transforming the capability of industry and government to conduct business and the means by which they do so.

The information industry, built on a strong base of leading-edge technology, is rapidly expanding, chaotic, and ever-changing; the slightest misstep or delay in bringing a product to market can mean disaster for even the best companies. Ironically, this industry's technology and infrastructure enable all other industries to innovate and expand. Unquestionably, the information industry is a fundamental strategic industry for the United States.

Three pillars will take the information industry into the future: content, infrastructure and services. The content pillar, including voice telephony, video on demand, and multimedia, is the impetus for growth and maturity. With technology advancing rapidly, demands on the industry are limited only by the imagination and expectations of all other industries. The latter

two pillars make up what is referred to as the information industry: a delivery system for content generated elsewhere. Clearly, a modern and improving infrastructure is required to provide industries with a competitive advantage in today's global environment. Likewise, the service sector allows individuals and businesses to choose from numerous combinations of local, cellular, and long-distance telephone service providers.

Access to information and an understanding of how to use new technologies not only are essential for economic success and national security but are basic abilities people need to function in the evolving global society. In short, today's world depends on managing the technology, managing the use of the technology, and managing with technology.

THE INFORMATION INDUSTRY DEFINED

Through the early 1980s, the term *computer* covered just about the entire gamut of information processing. Today, *information technology* is the generally accepted umbrella term for a rapidly expanding range of equipment, applications, services, and basic technologies that fall into three primary categories. The first is computers, which are classified as mainframes, the largest ones; minicomputers, the intermediate size; microcomputers, tagged as the smallest; self-contained portable or personal computers (PCs); and supercomputers, ultra-high-speed processors used primarily for scientific and engineering applications. The second category is telecommunications, or the electronic movement of information via telephone services, video conferencing, voice and video e-mail, and digital cellular communications. Multimedia data, the third category, is a catchall term for the transmission and manipulation of any form of information. It is designed to combine video, animation, still pictures, voice, music, graphics, and text into a single system (Keen, 1995, 165).

Through its global operations, the U.S. computer equipment industry controls more than 75 percent of the world computer market. Computer prices have been continuously declining, but the steadily rising performance and increasingly sophisticated uses of computers have

stimulated domestic sales and exports. As a result of the ever-accelerating tempo of technical change, product research and development costs have increased significantly. The industry's operations have become more global, and companies have formed domestic and foreign alliances to ensure that the lowest cost components and latest technology are available.

Telecommunication services include communication service for local-area, long-distance, international, cellular and mobile radio, satellite, and data communications as well as networking services. Over 2,000 companies, employing approximately 900,000 people and earning revenues estimated at \$200 billion for 1995, provide telecommunication services. The Telecommunications Act of 1996 will make sweeping changes in this sector by encouraging competition and reducing regulations. It will allow long-distance providers, local phone services, cable companies and Internet companies, within certain limits, to enter each other's previously protected markets. Open markets should induce competition, improve service, and reduce costs to the customer.

Multimedia applications are the result of the convergence of audio, video, graphics, and text processing. Unlike traditional computer software, which consists of text, graphics, and high-pitched beeps as the sole audio effects, multimedia applications come with full-motion video, good-quality voices and music, and high-resolution graphics and text. Multimedia is a mass commodity largely because of the development of the compact disc as a medium for storing data. It is becoming a basic component of desktop computers, and the working world is starting to take advantage of digitized audio and video communication across networks or high-speed phone lines. In the workplace multimedia communications take several basic forms: videoconferencing, electronic document sharing, video- and voice-annotated electronic mail, and computer-based training (Baran, 1995, 203). Other areas, such as education, health care, and the sciences, are moving fast to exploit multimedia services.

CURRENT CONDITIONS

The information industry is one of the United States's most dynamic, growth-oriented markets. In general, predictions for information

technology trends tend to favor a swing upward at an exponential rate. Historically, once an innovation reaches a critical mass of users, it grows at a rate of 10-20 percent a year. The best example of this phenomenal growth is Moore's Law. In 1965 Gordon Moore, the cofounder of Intel, predicted that the capacity of a computer chip would double every year based on the price-to-performance ratio. To this day his predictions have held up, and the average rate of increase is a doubling every 18 months (Gates, 1995, 31). Also, in 1995 several telecommunications technologies were in the take-off stage: commodities such as cellular communications and advanced fast packet-switching techniques grew in volume between 40 and 60 percent. Today, multimedia is the area to watch. It may need a longer initiation phase, but once it starts a very fast take-off is expected.

In today's global economy the U.S. information industry has concerns about *subsidies, quotas, trade barriers, and level playing fields*. The controversial questions no longer relate to whether foreign intervention in high-technology industries exists but instead are whether such intervention influences competitive outcomes to the disadvantage of U.S. producers, whether structural differences among nations tilt the playing field, and how much the United States is harmed economically by such practices (Tyson, 1992, 9) Such issues and concerns are being addressed by several international organizations, including the General Agreement on Tariffs and Trade, the North American Free Trade Agreement (NAFTA), and the World Trade Organization (WTO). Multilateral efforts now underway to realize the maximum potential of a global information infrastructure (GII) include negotiations based on worldwide liberalization of basic telecommunications services that fall under the umbrella of the WTO. The United States is also working on other GII-related issues in other multilateral fora, such as the Organization for Economic Cooperation and Development and the World Intellectual Property Organization (LeBel, 1996, 49).

Many foreign governments provide varying levels of support for home-based companies, which creates an uncertain advantage for U.S. companies. The playing field is also tilted by differing concepts of ethical behavior. China and other emerging nations exacerbate this competitive uncertainty through various actions that cause U.S. companies to take up-front losses and assume higher-than-normal risks in order to open up the

market in anticipation of future positive returns. For example, China plays one company off against another by conditioning a contract award on a slim or nonexistent profit or the acceptance of a net loss in order to get a foot in the door of an expanding market. The Chinese recognize that in the long term a foothold in the market could be very lucrative for the winner and maximize the fact that they are negotiating from a position of strength.

Trends in productivity indicate that the U.S. information industry will continue to be among the fastest-growing sectors of the economy. The government and other industries depend on the industry to develop innovative solutions to problems and to continue to increase productivity, efficiency, competitiveness, and employment in the United States. For example, the telecommunications industry's productivity rate is growing because of the insertion of rapidly advancing technology into all segments of the business, on both the software and the hardware sides. Intelligence being installed throughout networks is transforming them from dumb carrier pipes to multimedia communications exchange servers and allows multimedia telephone calls with voice, data, image, and video to be incorporated into office local-area networks (LANs) and wide-area networks.

Clearly, the information technology industry is *competitive in the international arena*. All sectors of the information industry have experienced significant growth. Hardware, semiconductors, software, and services remain some of the healthiest segments of the U.S. economy. Projections are for growth of 10 percent or more for each sector through 2000. New applications such as image processing should spur sales of large computers to manage the growing mass of data on PCs. From the perspective of international competitiveness, the United States stands at the top of the global computer industry. In 1993, all but 2 of the top 10 PC companies worldwide were American. In each sector the United States controlled more than 75 percent of the world market. However, although the United States has remained the top exporter of computers, the U.S. computer industry has lost ground to the Japanese industry since the early 1980s. Over the past 10 years Japanese computer exports have risen 21 percent annually. In any case, while Japanese computer exports are a concern, the United States is the world leader in the provision and export

of information services, and U.S. firms continue to dominate the market, both in terms of number of companies and revenues (Department of Commerce, 1994, 27-1).

Attractive, long-run marketing opportunities in equipment manufacturing and service offerings exist in all regions of the world. Developed nations will get enhanced services; developing nations will see basic network building along with cellular ones. With the connecting of the telephone and the computer, the world telecommunications sector continues to be one of the largest and fastest-growing sectors of the global economy.

There is no question as to the *profitability of the information industry*. The U.S. information industry has always had a positive balance of payments (Department of Commerce, 1994, 27-5). In 1994, the 10 largest telecommunications giants made bigger profits than the 25 largest commercial banks. Additionally, for the past several years 6 of the 10 companies with the largest worldwide software revenues were U.S. companies. Estimates put the global market for telecommunication services alone at \$750 billion and growing fast. However, the profit growth will be tempered over the next few years by heavy capital investment as new and existing companies enter new ventures such as personal communications services, video on demand, and long-distance and local telephone markets.

Today, the *information technology industry affects every other industry*; it enables other industries. Information technology, the combination of computers, telecommunications, and information resources, fundamentally is about business making change an ally rather than a threat (Keen, 1995, ix).

One of the most exciting and enabling aspects of technology is the availability of the Internet, which is causing an explosion in both business and individual use of computers for communications and information transfer. PCs are now gateways to worldwide information repositories. Even though satellite television and radio allow people all over the globe to receive news and entertainment at any time, it is the Internet that allows people to exchange information and ideas in real time.

Notwithstanding the phenomenal rate of change in the industry and the excitement of the Internet, one single action has had the strongest impact on all sectors of the information industry: the passage of the Telecommunications Act of 1996. This law encourages competition and reduces regulations by eliminating regulatory carriers between long-distance providers, local phone services, cable companies, and electric utility providers and allowing firms to enter each other's previously protected markets, although with certain limitations. The end result should provide both business and private customers with one-stop shopping for all their information needs, whether voice, stereo sound, high-speed data processing, or full-screen interactive video on digital television. As well, the open market should induce competition, improve services, and reduce costs to consumers and businesses.

CHALLENGES

The numerous challenges facing the information industry must be resolved as the information age matures in the 21st century. It is imperative that U.S. and international governments understand that they must step up to the formidable task of industrial strategic planning. Critical issues include the industry's ability to respond to rapidly changing information needs and to develop appropriate technology and applications that will deliver services quickly and efficiently. Especially sensitive areas that pose major challenges are *education and training, infrastructure, intellectual property rights (IPR), security and privacy, universal access, standards, evolving technology, and the implementation of the 1996 Telecommunications Act.*

1. Information is a lucrative and desirable industry for the best and brightest people. The challenge is *educating and training* enough people to keep U.S. companies globally competitive. Employees in the information industry must accept change, work on small, integrated teams, and constantly learn new skills and technology. Many information industry companies have formed partnerships with state and local governments and educational institutions to produce future employees and to retrain current ones.

2. The major challenge for public and private sector customers will be to invest in the key *infrastructures*. They must make sure their investment delivers a return that is relevant and effective today and does not become obsolete tomorrow. Capital markets have responded well so far, but they will be challenged as more and more telecommunications stock offerings are brought to market to finance mergers, acquisitions, and foreign privatization. Subsequent to the privatization, large amounts of capital will be needed to finance the required upgrades to the infrastructure.

3. Overcoming the abuse of *IPRs* is another major challenge. One concern is how the United States can strengthen domestic copyright laws and international intellectual property treaties to prevent piracy and to protect the integrity of intellectual property. Vigorous protection of IPR, which apply to patents, copyrights, trademarks, and trade secrets, is critical to trade in the information industry. Although many countries have improved their IPR practices in recent years, it is estimated that piracy deprived the United States of about \$13 billion in worldwide revenues in 1993.

4. Society relies increasingly on advanced telecommunications, computer, and other automated information systems in everyday life. In light of this dependence, a secure and highly efficient national information infrastructure (NII) that can ensure privacy is vital to the continued economic growth and national security of the United States. The most serious threat to the commercial, economic, and political *security and privacy* of the NII will come from information terrorists, from whom there is seemingly no sanctuary. Commercial organizations, especially those in telecommunications, finance, transportation, and power generation, offer choice targets, and unauthorized access to military networks is a major concern. The Department of Defense (DoD) is working on an offensive operation, referred to as *information warfare*, that targets an enemy's information-based systems. Likewise, the industry has developed *information assurance* to defend against intrusion into the content of their information systems. Computer crime is viewed as the fastest-growing component of global organized crime. Unfortunately, the extent of this crime is masked by nondisclosure from businesses that fear the exposure would lead to a loss of customers.

5. All citizens must be assured of *universal access* to telecommunications services. Some analysts fear that new classes of information haves and have-nots will emerge unless the United States extends today's policy to include the new technologies. The Communications Act of 1934 articulated a national goal of service at affordable prices; its replacement, the Telecommunications Act of 1996, falls short of assuring universal coverage by extending this goal to only some competitors. As technology evolves, the nation must reassess what basic service comprises and ensure that it is available at affordable prices.

6. *Standards* are the single most important element in integrating corporate information and communications (Keen, 1995, 251). The standard-setting process can be extraordinarily cumbersome and lengthy, as no single controlling force in the market determines universal standards. For example, nearly 50 committees and organizations are involved in setting standards for international telecommunications, resulting in a great deal of overlap and conflict. Resolving competing points of view and determining industry standards will remain a challenge. If too much time is spent developing the standard, the market moves on; if too little time, the product may have flaws that make it unacceptable or cumbersome to the consumer.

7. Technological advances in the information industry continue to support an increase in processor speed and a reduction in the size of computers. Developments like network computers will reduce the size of computers and the cost of owning them for businesses as well as individual users. The use of global networks, virtual reality, and nanotechnology will make it easier for consumers to communicate complex ideas and shapes globally at a fraction of the cost of conventional means.

8. The Telecommunications Act of 1996 is a notable achievement that improves the competitive situation of combinations of U.S. industry. However, a final challenge will be for the Federal Communications Commission to fulfill its congressional charter as the "honest broker" in developing and enforcing regulations for a comprehensive implementation of this law.

OUTLOOK

The U.S. information industry is able now and in the future to support *national security resource requirements*. Mobilization applies to the telecommunications industry in two basic contexts: the manufacture of equipment and components for use by U.S. military forces and the provision of additional telecommunications capacity and services to support increased demands during crises and emergencies.

The challenge is to look at the mobilization of the telecommunications industry and the needs of industry and government in the light of changes in industry and in ways of thinking about mobilization. In essence, the *impediment to the industry's achieving a full-scale surge and mobilization potential* is the industry's leaders, who are not persuaded to make a commitment to mobilization or to spend money on it. However, this reluctance is not a reason for alarm. Immediate needs for national security can be satisfied by reallocating and adjusting priorities for existing services and capacity. Midterm requirements would exceed the current capability, thereby compelling the reallocation of resources already on hand or in the production pipeline. The long term could be difficult, as it would call for the rapid expansion of the production base under stressed conditions. A mobilization requirement would likely be very expensive, difficult, and time consuming (Garing, 1986, 163).

The *short-term outlook for the U.S. information industry* reflects a highly competitive industry poised to capture the lion's share of the exploding demand for information products and services. Globally, market liberalization is continuing to drive competition. For the remainder of the decade, the world market for telecommunications equipment and services is expected to grow 9.2 percent per year, compared to a 3.1 percent growth in world gross domestic product. Currently, the U.S. computer equipment industry controls more than 75 percent of the world market, and in 1994 the United States captured 46 percent of the world information service revenues.

Market shifts and expansions continually change the scope of the information industry. A major boost to U.S. exports will come from the rapidly expanding markets of Latin America and Asia (particularly India

and China). Many countries are deregulating and privatizing state-owned public telephone companies, which will give U.S. firms access to markets that have been closed or restricted. Advanced U.S. technology and efficiencies generated by years of domestic competition will give the U.S. firms a solid lead in capturing these new markets.

Additionally, new firms taking advantage of the opportunities created by the 1996 Telecommunications Act will enter the market. Currently a wave of mergers and alliances focusing on traditional telecommunications services is taking place in the United States and abroad as companies seek less expensive ways to exploit new technologies and market openings. Cable companies are entering the telephone business by using cable lines to provide access to homes. Under the new law, telephone companies can merge with cable companies and use existing lines in homes and business to deliver voice and data communications as well as entertainment packages. In the next few years a more concentrated industry will offer consumers fully bundled services that will include telephone; Internet; entertainment; home shopping; and financial, social, and governmental services. Dominant players will be supplemented by entrepreneurial companies filling niche markets or providing attractive services that will lead to flattened rates.

The Internet is an admirable example of the technical ingenuity and pioneering spirit of the computer science community. It offers tremendous profit potential and is therefore attracting cable and telephone companies as part of their overall scheme to provide bundled services. Telephone companies are concerned about their market share and competitive position, as it is assumed that the future use of the Internet will include voice and video-voice transmissions. At this point, the quality of voice transmission over the Internet requires substantial improvement; however, intense competition for access will be good for consumers, and rates should drop as the ranges of services increase. This could drive a restructuring of the telephone service pricing system from a charge-per-minute to a flat-rate basis.

Faster and cheaper technologies being produced will allow firms to expand their LAN technology to include intranet lines. A great enhancement to this process is the wireless LAN, and intelligence added to

the systems will enable multimedia telephone calls with voice, data, image, and video to be incorporated into office networks. The expense of having separate office telephone and computer networks will eventually be eliminated. However, neither customers nor providers will allow themselves to be too dependent on a single manufacturer's hardware. Instead, they will rely on the compatibility of network components, plug-and-play technology, or open-system architecture. Uniformity of industry standards, even in the face of intense competition, will be the key to the Internet and intranet.

On the other hand, the *long-term outlook*, perhaps to 2020, favors the development of other technologies, such as virtual reality, holography, nanotechnology, and artificial intelligence, that will enhance the services available through the network of networks. Further development of satellite technology will support high-definition television and video conferencing; however, most satellites will become obsolete after a few years and will need to be replaced continually. Increasingly, major bilateral and multilateral trade disputes may occur as firms battle to obtain licenses to launch new satellite clusters and gain market advantage.

In the long term the public network switching system, which is primarily designed to handle 64-kilobit voice channels, must be upgraded. A new system capable of handling 1.5 to 2 megabits per second will require higher-speed and wider-band video and data communications. Asynchronous transfer mode switching is believed to be the best solution to the problem, although its cost could delay fielding of upgrades for nearly 10 years. Revenues from this segment will increase as the new technology is deployed both domestically and abroad. The demand for wireless services has risen beyond all expectations. In the decade ahead, wireless networks will deliver personalized communications to people on the go and basic service to many who still lack telephones.

The *political and social implications* of the new technologies are substantial. Devices such as pocket-sized automatic translators will have a profound effect on geopolitics and social attitudes. On the mundane side, the improvements in technology will allow federal and state tax systems to move toward full-service automated tax filing. On the esoteric side, the global positioning system is revolutionizing major aspects of social and

commercial activity in sectors such as transportation, law enforcement, and emergency preparedness. The Internet offers the potential for political uses from campaigning to voting by computer. In some cases, the growth of the Internet even raises the question of whether the United States is moving away from a representative democratic society to one that is truly participatory primarily as a result of the advances in information technology.

Several issues outlined above will be the focus of public debate. Attempts to control content (e.g., pornography and violence) on the Internet have economical and societal implications. A delay in developing measures to protect intellectual property could retard the full exploitation of new technologies, while the lack of security on the airwaves leads to concerns that too many people may have access to one's personal information. Also, the potential for information terrorist attacks and computer crime is receiving close scrutiny from the government, the DoD, and private industries. Nevertheless, in the short and long term, the *information industry is postured to respond to the issues and challenges* of the 21st century. In fact, technological and legal measures designed to secure data, protect networks, aid law enforcement efforts, and help an industry ready to deal with the competitive and regulatory consequences of all these issues will steadily proliferate.

GOVERNMENT GOALS AND ROLE

The federal government has a crucial role in sustaining the U.S. lead in information technology, since the continued acceleration of technological change and the global recognition of the strategic value of these technologies mean that any nation can make bold advances if it makes wise investments. At stake is the technology that will determine the nation's ability to sustain economic well-being, to compete successfully in the global marketplace, and to enable affordable national security.

Drawing on more than 40 years of both federal and industrial investments in this technology, the U.S. government needs to build partnerships among business, labor, academia, and the public. Specific government goals should include the following.

Extending the universal service concept to ensure information resources are available to all at affordable prices. Because information means empowerment, the U.S. government must assure universal access to basic telecommunications services for all citizens. As a matter of fundamental fairness, this nation cannot accept a division between information haves and have-nots. Likewise, ensuring the privacy of information and the security of communications and networks is essential. Users must be certain that information transmitted through electronic means will go when and where it is intended to go. The government must work with industry to develop new technologies that protect privacy and must enable law enforcement agencies to continue to use court-authorized wiretaps to fight terrorism and organized crime. The U.S. government must strive to identify threats and vulnerabilities to criminal and terrorist activity. A priority should be to develop encryption hardware and software for this application.

Reversing the perception that the U.S. work force lacks the education and training to be world leaders in developing, manufacturing, and providing information services. The government should formulate a national policy that would consolidate the more than 150 government education and training programs, thereby eliminating redundancy and inefficiency. The money saved should be used to fund innovative approaches to education that fill the gap left at the end of traditional public education. The information industry needs an educationally sophisticated, though not college-educated, work force to remain globally competitive.

Developing standards for voice, video, data, and multi-media services that ensure interoperability and openness. The standards must be compatible with the large installed base of communications technologies, flexible, and adaptable enough to meet users' needs at affordable costs. Equally important is the avoidance of trade barriers raised by incompatible U.S. and foreign standards. The government can be a catalyst in this industry-driven process by participating more actively in domestic and international standards panels and committees with the goals of addressing strategic technical issues of interoperability and eliminating or reducing trade barriers.

Adopting export control policies and international trade rules that are favorable to information industries. U.S. firms must have an opportunity equal to that of international competitors to export telecommunications-related goods and services to potential overseas customers. If restrictions on products do not conflict with national security goals, the United States should remove the restrictions and permit U.S. manufacturers to enter new international markets.

Supporting the development of the NII/GII and protecting IPR. The government must balance the broad public interest in promoting the dissemination of information across the information superhighway with the need to ensure the integrity of IPR, whether the property is text, images, computer programs, databases, or video or multimedia formats. The government should aggressively pursue the strengthening of domestic copyright laws and international intellectual property treaties to prevent piracy and to protect the integrity of intellectual property. An efficient system should be developed to identify, license, and pay royalties for copyrighted products delivered and available over electronic information systems.

Promoting private industry investment in technological innovation and new applications of software. Government regulatory, antitrust, tax, and intellectual property policies all affect the level and timing of new offerings in services and equipment, including the technology base that generates innovations for the marketplace. The government should support research and technology development through partnerships.

Developing surge and mobilization policies to support national security resource requirements. The government must identify force requirements and capabilities in the arenas of information management and assurance. A first step would be to define what mobilization and surge in the information industry means. A starting definition could be "the process of marshaling the information and telecommunications resources needed to make the transition from a normal state to a state of readiness for a national emergency." Clearly the United States faces the prospect of warfare conducted outside the boundaries of traditional militaries. The future national security of the United States may depend on the nation's

ability to adequately plan, develop, and implement information assurance measures.

The U.S. government fashioned a revolutionary approach for acquiring information technology in the acquisition arena by repealing the Brooks Act of 1965 and replacing it with the Cohen Act in the 1996 Authorization Act. The cutting-edge management guidelines established by the Cohen Act directly empower executive agencies; ensure central coordination, which enhances efficiency; simplify competition requirements and commercial purchase processes, which should result in savings and improved product reliability; and decentralize budget and procurement efforts to provide more line responsibility and quicker response time between the need statement and the fielding of the system(s). As a result, the warfighter will have what is needed, when it is needed, and the taxpayer will have value added for each tax dollar.

In conclusion, the U.S. government must stay committed to the high-technology growth industries of the next century. It must continue a policy of aggressively seeking opportunities to minimize competition-stifling regulations and foster free markets at home and abroad. Clearly, NAFTA and the WTO are relevant to the expanding global competitiveness of the U.S. information industry. NAFTA goes a long way toward eliminating entry barriers within North America and requires the adoption of international telecommunications standards. Drawing on trade rules for telecommunications services developed in the Uruguay Round, WTO members are working to forge consensus on many issues critical to open markets. Expanding NAFTA south and opening additional markets through strong leadership in the WTO are appropriate and worthwhile government goals.

The principles and goals outlined in this report provide a blueprint for federal government action relative to the information technology industry. Pursuing these goals will ensure that the government constructively assists U.S. industry, labor, academia, and private citizens as they develop, deploy, and use the various information technologies.

CONCLUSIONS

Information systems permeate the lives of U.S. citizens in the current information age. They will define the 21st century and influence all the nation's activities. As is true of all major changes, the benefits of the information age will carry some costs. Dislocations in some business sectors will increase the need for further education and retraining. The availability of rather inexpensive communications and computing will alter the relationships of nations and of socioeconomic groups within nations. The power and versatility of digital technology will raise new concerns about privacy, commercial confidentiality, and national security. Moreover, equity issues will have to be addressed; the information society should serve all citizens, not just the technically sophisticated or economically privileged (Gates, 1995, 251). The challenge for leaders is to recognize the implications of change in this new environment and identify ways to make sense of its chaotic activity.

The information industry is an essential strategic element of national power. It underlies all other industries and provides the infrastructure that enables their success. The industry's potential benefits for the nation are staggering: full exploitation of information technologies will enable U.S. firms to compete successfully in the global economy, generate good jobs for the American people, and enhance the nation's economic growth. Of equal importance, the explosion in information technology promises to transform the lives of the American people. It can ameliorate the constraints of geography and economic status, and give all Americans a fair opportunity to go as far as their talents and ambitions will take them.

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