SUMMARY

Advances in information technology (IT) are affecting most segments of business, society, and government today in many if not most regions of the world. The changes that IT is bringing about in various aspects of life are often collectively called the "information revolution." RAND has just completed a multiyear effort to explore the nature of these changes throughout the world, painting a picture of the state of the information revolution today and in the near- and mid-term future. (We looked out roughly 5 to 15 years.) This exploration has revealed many common themes that recur throughout the world, as well as many regional variations.

RECURRING THEMES

New Technology Developments Will Continually Drive the Information Revolution

In discussing these developments, we find it useful to distinguish among *technology, products,* and *services.* We view *technology* as the idea or intellectual property based on scientific principles that allows creation of a product that embodies it; wireless communication standards and protocols per se are a technology. A *product* (such as a cellular telephone) may involve hardware and/or software and embodies one or more technologies. *Services* are capabilities offered to users, usually in a form resulting from storage, access, and manipulation of information (by products).

Some *technology* developments can be foreseen, including continued exponential growth in computing power for at least another 10 to 15

years, reaching the foreseeable limits of silicon technology around 2015; continued convergence in voice and data communications and another major leap in available bandwidth during the next two decades; improvements in machine translation so that within 20 years one can have machine translation with any two of three desiderata (high quality, general purpose, fully automatic)—for many purposes and limited domains of discourse, this will be good enough for useful applications; and very strong synergies developing between info-, bio-, nano-, and material technologies.

Product developments will allow information devices to be ubiquitous, wearable, and in continuous contact with one another. We expect to see a multitude of diverse, powerful, inexpensive sensors and other devices capable of (limited-distance) wireless communication; these devices will provide a vastly increased coupling between the physical world and the cyber world, allowing information systems to react much more comprehensively to changes in their environment and vice versa. Computing and information systems will become much more ubiquitous, with convergence of wireless telephones, personal digital assistants (PDAs), radio, voice and email messaging, smart home appliances, etc.; aiding in these developments will be protocols for short-range wireless communication. Display products will undergo dramatic improvement in the coming 15 to 20 years, with "electronic paper" displays that can be rolled or folded and perhaps contain wireless links to personal or other information systems, digital displays that retain their content without requiring power to continually refresh them, and large-screen, flat-panel displays that can be "tiled" to desired sizes.

Services developments will greatly extend access to, and the usefulness of, information systems, with kiosks providing easy access to some information services, entertainment being at the leading edge of novel information services, information services playing an increasing role in health care and telemedicine, online education having increasing but specialized effects, and micropayment schemes emerging to handle small online payments.

It is much easier to predict technology advances than to identify the specific new technology-based products or services that will emerge and be adopted in widespread use. Although technology's progress makes many such products and services possible, markets will

decide which possible products and services become actual and widespread; in this process, the emergence of "killer applications" will greatly affect existing markets and create new markets.

Some tensions arising from these developments will affect the growth and spread of IT-related products and services:

- Optical communications technology and Internet Protocol (IP)–based telephony are likely to be highly disruptive to existing telecommunications industries worldwide.
- Open source versus closed source: propriety standards battles will continue.
- Intellectual property and digital rights issues will create major tensions.

A period of IT consolidation, in response to the "dot-com crash" and the implosion of the telecom industry, is both likely and healthy. This consolidation should lead to a stronger foundation for substantial and sustainable IT growth in the coming decades.

We elaborate on these themes in Chapter Two.

The Information Revolution Is Enabling New Business Models That Are Transforming the Business and Financial Worlds

Many new business models enabled by IT are arising, for the internal organization and functioning of business enterprises and for their external interactions with customers, suppliers, and competitors. Many, if not most, of these new external-interaction business models feature one form or another of electronic commerce, which is rising in importance as a major form of economic activity. These IT-driven changes are furthest along in the financial world.

Much of this leading-edge, IT-enabled business activity is concentrated in geographic "clusters," with North America and Europe furthest along in this process, and parts of the Asia-Pacific region following close behind.

"Creative destruction" is a common feature of these business and financial transformations, with new, more-efficient products and services replacing older and less-efficient ones. This process is often, but not always, accompanied by the economic eclipse of the companies producing the old products and services.

"Information work" and "information workers" are becoming an ever-increasing fraction of economic activity and the overall workforce in many nations, as their business and financial worlds undergo the transformations discussed here. Over time, this will free many businesses in "knowledge industries" to relocate to new areas more suited to information work than to manufacturing work, which in turn will affect where people live. This rise in information work will also affect the education required of people, both initially and over their careers. Over time, this should have a significant impact on educational establishments throughout much of the world.

These IT-enabled changes in the business and financial world have been under way for some time, quickening in the past decade. They are furthest along in North America, closely followed by Europe and parts of the Asia-Pacific region. But even in North America, and even more so in other parts of the world, much more is still to come. For the foreseeable future, an unending series of new IT developments will continually drive this ongoing revolution in the business and financial world, along both current and new paths. These transformations in the business and financial world are, in turn, changing the "playing field" for governments and societies.

We elaborate on these themes in Chapter Three.

The Information Revolution Is Affecting Mechanisms of Governance and Empowering New Political Actors

Some traditional mechanisms of governance (e.g., taxation, regulation and licensing) are becoming increasingly problematic as the information revolution allows action beyond the reach of national governments. In these and other areas, governments that are particularly affected will have to find new mechanisms of governance, or create new, near-universal international control structures.

At the same time that some traditional mechanisms of governance are facing challenge, new governmental mechanisms are being enabled, generally falling under the heading of "e-government." This usually involves the use of IT to improve and eventually transform the manner in which governments interact with and provide public services to their citizens, the management of governments' supply chains, and the conduct of internal governmental processes.

New political actors are being empowered by the information revolution—in the business, social, and political realms, at the subnational, transnational, and supranational levels—which is changing the distribution of political power. At the same time, advances in IT are making new Internet-based modes of interaction possible between citizens and their elected representatives, between candidates and voters, and among citizens themselves (when discussing political issues).

Some scholars suggest that the role of the nation-state could change as a result of these developments. For example, a diffusion of governance activities may occur away from the centrality of the nation-state, with some functions migrating to supranational or intergovernmental organizations, some devolving to local governmental units, and some migrating to private market and nonmarket organizations (at the subnational, national, and supranational levels). Others feel that trends in this regard are by no means clear, pointing out the many essential functions that the nation-state will continue to play. Considering these vastly different visions of the future presented by various "experts," one must conclude that the future role of the nation-state in the information age is unclear.

Different nations will take different approaches to dealing with these changes. Smaller nations may more readily give up some prerogatives of the nation-state. Larger nations may be less willing to give up any prerogatives and may try harder to preserve the traditional roles of the nation-state.

We elaborate on these themes in Chapter Four.

The Information Revolution Both Shapes and Is Shaped by Social and Cultural Values in Significant Ways

The information revolution is being enabled by technology but is driven primarily by nontechnical factors, including social and cultural factors. Social and cultural change will have to take place if individuals, organizations, and nations are to fully exploit the capabilities of IT. Unintended consequences will inevitably be produced in this process. Those that arise when social and technical influences combine may well dominate the intended ones.

Digital divides within and between nations will persist, but their future scope, duration, and significance are subject to debate. Within countries, IT diffusion generally exacerbates disparities and reinforces social cleavages, at least until saturation has been achieved. Moreover, the polarization between the rich and the poor is made more acute because of its visibility in the information society. By and large, the same sorts of growing and visible inequalities as a cause and a consequence of differential access to and use of IT are even sharper at the level of national states. While there is reasonable consensus about the present existence of these digital divides, there is also considerable debate over how their implications should be assessed.

The ability to acquire and use knowledge will be critical for success in the information society, as knowledge work constitutes an increasing proportion of all work in the long-term future. Accordingly, developing human capital appropriately is key. A "quality education for all" will be one of the keys to a nation's success in the information age. This presents different challenges in different parts of the world.

Globalization, boosted by the information revolution, will continue to have multivalenced social and cultural effects. While its economic effects are widely recognized, knowledgeable observers also give considerable weight to its societal implications—both positive and negative. These include further widening of the gap between the political/intellectual/economic elites and others in developing nations, and the globalization of entertainment and, consequently, styles (or at least fads), which leads those in some countries to feel that their own national cultures are being vitiated.

The information revolution will stimulate greater homogeneity in the institutional and legal infrastructures of societies networked across nations while at the same time enhancing the heterogeneity of their constituent cultures.

We elaborate on these themes in Chapter Five.

Many Factors Shape and Characterize a Nation's Approach to the Information Revolution

Some of these factors are causative and can play out in various ways:

- Rich nations are better positioned than poor nations to exploit the information revolution (IR).
- How a society deals with change is a major factor shaping a nation's IR posture.
- Governments and laws can be helpful or unhelpful.
- The structure of capital markets is also important.

Other factors are effects, not causes. The following factors add richness to the description of a nation's posture and serve as ways of tracking its performance:

- The degree and nature of IT penetration into a society and the distribution of its IT activity across the technology, product, and service spectrum are useful descriptors of a nation's IR posture.
- The amount of information work, information workers, and e-commerce in a nation also serves as an important descriptor.
- The presence and number of IT business clusters in a nation are important measures of the vigor of a nation's IR posture.
- The amount of "creative destruction" going on in a nation can be another important measure of the vigor of a nation's IR posture.
- The presence of new political actors and changes in governance are measures of IR-induced change in the political arena.
- The movement of talented, IT-trained people can be a useful indicator of a nation's IR posture.

We elaborate on each of these factors in Chapter Six.

REGIONAL VARIATIONS

North America Will Continue in the Vanguard of the Information Revolution

The North American (i.e., U.S. and Canadian) economies and societies are well positioned to meet the challenges of the information revolution. They have many advantages, including well-developed physical infrastructures and human capital; economies and societies that are generally receptive to change; governments that provide an environment generally hospitable to business developments; legal regimes with good intellectual property protections, well-established contract and bankruptcy laws, and strong protections for freedom of expression; and innovative and efficient capital markets with well-developed venture capital communities. Both are nations of immigrants that attract energetic, talented, IT-trained people from all over the world.

North America will exploit these advantages to continue in the vanguard of the information revolution. The dot-com crash and the telecom implosion may slow the pace of IT-related developments in North America, but only temporarily. Further, North America will, in general, deal well with the stresses generated by the information revolution.

We elaborate on the course of the information revolution in North America in Chapter Seven.

The Information Revolution Is Following a Somewhat Different and More Deliberate Course in Europe

In the technology arena, the European view of the information revolution is similar to the American view but with more emphasis placed on wireless technology.

While the technology underpinnings are largely the same, the social, political, and economic climate in which the information revolution is developing in Europe differs in important ways from that in America. These differences include the following:

- Differing European and American approaches to economic and social change, which comes easier in America than in Europe.
- The greater importance that Europeans attach to economic and social equity.
- The European desire for convergence among the nations of Europe insofar as economic prosperity is concerned.
- Differing trade-offs between market forces and government policies, with the United States giving markets more free rein and Europe relying more on governments to produce socially desirable ends.
- A greater European emphasis on top-down planning by governmental and business elites.

As a result of this different climate, the information revolution is following a somewhat different course in Europe than in America, with the Europeans' greater risk aversion causing the creative destruction process to proceed more slowly, the European economic and social equity emphasis leading to a more subdued approach to new IT-related business opportunities, and the top-down planning mentality reinforcing this slower approach. Consequently, up to now, the information revolution has been proceeding more deliberately in Europe than in America, with the United States in the vanguard in most, but not all, IT-related areas and Europe following somewhat behind. This is likely to continue for at least the next few years, if not longer.

We elaborate on the course of the information revolution in Europe in Chapter Eight.

Many Asia-Pacific Nations Are Poised to Do Well in the Information Revolution, Some Are Not

Asia-Pacific nations vary greatly in their information revolution postures. Several are major IT and Internet users, with Internet penetration in South Korea, Hong Kong, Japan, and Australia exceeding even the U.S. level in 2000, and Singapore, Taiwan, and New Zealand not far behind. In contrast to the situation in the United States, how-

ever, most Internet usage in Asia today is by businesses—not from the home—and this business usage is not terribly sophisticated.

Japan, Singapore, Taiwan, South Korea, Malaysia, Thailand, and the Philippines are all major IT producers on the world stage, with Asia as a whole accounting for 70 to 80 percent of total world output of a wide range of important IT materials, components, and products. Asian IT producers have generally followed the "Japan model" of progressively sophisticated production technology, beginning with labor-intensive, low-value manufacturing and proceeding to higher-value-added stages. South Korean and Taiwanese companies are among the more technologically advanced and diversified after Japan, but they face challenges on their road to becoming global IT innovators. At the other end of the spectrum, most Southeast Asian IT producers appear to be stagnating at lower rungs on the production ladder.

Japan itself has something of a "split personality" regarding the information revolution. There is no question that it is one of the world's leaders in IT today. However, much has been written in recent years regarding the rigidities of the Japanese society, economy, and government. If this condition persists, it could lead Japan gradually to fall behind the nations in the vanguard of the information revolution. On the other hand, some observers have noted a recent emergence of individualism and entrepreneurship in some sectors of the Japanese IT industry. If this nascent trend persists and spreads, it could ensure the future vitality of that industry, in spite of the rigidities in the larger society. In that case, Japan would continue as a world leader in IT, albeit with an ever-increasing fraction of its manufacturing operations moving to Japanese-owned manufacturing facilities in China. It remains to be seen which of these forces—rigidities in the overall society or nascent individualism and entrepreneurship in the Japanese IT industry—proves stronger.

China is of special note as a rapidly emerging IT producer. Clearly defined clusters of IT industry are already developing there, although IT output is far from being a major component of its economy today. The major driving forces in China are the size and potential of its local market and the almost endless availability of cheap labor, both of which attract foreign investment. In recent years, China has become the IT manufacturing base of choice for Asian, North Ameri-

can, and even European companies—a trend that is not only likely to continue but also accelerate now that China has joined the World Trade Organization. As a corollary, China is also beginning to attract a large, increasingly advanced IT knowledge base, some of it from expatriate Chinese returning home after receiving technical training overseas. As a result, China should continue advancing to later stages in IT industry development and, over time, become a major IT player not only in Asia but also in the world, while in the process possibly leapfrogging many nations that today are more advanced but burdened by the inertia created by legacy infrastructures.

South Korea, Taiwan, and the leading IT nations in Southeast Asia achieved their current positions initially by serving as low-cost manufacturing outposts for North American, European, and Japanese electronics and IT companies and gradually working up the IT value-added chain. This process took several decades. The emergence of China as the new low-cost, mass-market manufacturing outpost of choice in Asia changes the IT playing field on which these other Asian nations must now operate. This will not necessarily be a zero-sum game; China's IT gains do not have to be losses for other Asian nations. For these other nations to survive as viable players in the IT world, they must redefine their business models, carving out value-added niches that can withstand the Chinese onslaught. Some of them may succeed by retaining design and high-level engineering capabilities at home while outsourcing manufacturing operations to China, but others, which have not yet advanced to the design and high-level engineering level in their IT operations, may not.

India has three important advantages in the global IT competition: a plentiful supply of talented IT-trained people; copious numbers of educated, low-cost workers proficient in English; and close ties to the many Indian entrepreneurs in Silicon Valley. As a result, IT business clusters have developed there, it is a world leader in back-office services and software outsourcing, and its software production has increased fiftyfold over the past 10 years. The prosperity and growth of the Indian software and back-office service industries should continue, at least over the near- to mid-term. However, going beyond software into IT hardware activities may be difficult, particularly in view of China's growing role in this area. Also, the entire Indian high-tech industry is a thin veneer on top of the Indian economy. Much of the nation is still in the agricultural age, not yet having reached the

industrial age, let alone the information age. These factors may place any broader role in the information revolution beyond India's reach.

Many other Asian nations are lagging well behind today; these include Bhutan, Cambodia, Indonesia, Laos, Mongolia, Myanmar, Nepal, Pakistan, Sri Lanka, Vietnam, and the nations of Central Asia. These nations have low levels of Internet penetration and usage, and little or no IT production activity, and they lack one or more essential elements required to do well in the information revolution. Not only are they lagging behind today, but also little is occurring to improve their future situations insofar as the information revolution is concerned.

We elaborate on the course of the information revolution in the Asia-Pacific region in Chapter Nine.

Latin America Faces Many Obstacles in Responding to the Information Revolution: Some Nations Will Rise to the Challenge, Others May Not

Today, most Latin American nations are "also-rans" in the information revolution, as they are in the global economy. Regarding the information revolution, they can be divided into "leaders," "successful outliers," and the rest.

Argentina, Brazil, Chile, Mexico, and Uruguay have been Latin America's leaders in the information revolution in recent years, leading Latin America in most measures of IT-penetration and usage and in IT-related business and financial developments, and providing IT-related leadership examples to the rest of Latin America. Of these nations, Mexico and Chile continue to do well today, whereas Argentina, Uruguay, and Brazil have recently suffered financial difficulties—in Argentina's case, grave difficulties—that put future economic and IT development in jeopardy.

Several of the small island states in the Caribbean—including the Cayman Islands, the Bahamas, St. Barts, Aruba, the British Virgin Islands, and the U.S. Virgin Islands—are successful outliers regarding the information revolution today. These nations have per capita incomes that are among the highest in Latin America and are much further along in IT penetration and use. They share several precon-

ditions: their governments are founded on trust and transparency; they have a well-established rule of law, high literacy rates, economic cultures in which business can prosper, populations fluent in English, and, perhaps most importantly, political stability. In Central America, Costa Rica is another IT outlier. Intel has based an assembly plant there, which has had a major impact on Costa Rican employment and growth. In attracting Intel, Costa Rica had advantages similar to the Caribbean islands. Even though they are doing well themselves in the information revolution, because they are small and removed geographically from the mainstream of Latin America, Costa Rica and these Caribbean nations do not provide leadership examples to the rest of Latin America; they are information revolution outliers, not leaders.

The rest of the Latin American nations lag behind these leaders and successful outliers, often way behind. The situation is particularly dire for the nations on the Andean ridge (e.g., Bolivia, Ecuador, Peru), those torn by internal guerrilla conflicts (e.g., Colombia), and impoverished island nations of the Caribbean (e.g., Haiti).

Latin America faces many obstacles in exploiting opportunities offered by the information revolution, including a government role in the economy that is often more of an impediment than an advantage in many Latin American nations; privileged positions for large, old-economy firms that often impede the development of markets by new IT-related firms; a financial system in many nations that is not conducive to IT-related startups; shortages of skilled people because of deficiencies in the educational systems and "brain drain" losses, primarily to North America; a pronounced digital divide, even in the leading Latin American nations; and a propensity for frequent financial crises.

All in all, the business and social climate in Latin America is much less hospitable to the information revolution than in North America or Europe, or in many parts of Asia. As a result, the gap between this region and the world's IT leaders is, in the view of experts, not likely to close.

We elaborate on the course of the information revolution in Latin America in Chapter Ten.

Few Middle Eastern and North African Nations Will Fully Experience the Information Revolution, Some May Miss It Altogether

With a few notable exceptions—Bahrain, Israel, Kuwait, Qatar, and the United Arab Emirates (UAE)—IT penetration is below world averages in most Middle Eastern and North African (MENA) nations, sometimes well below. Moreover, irrespective of its magnitude, the pattern of IT diffusion and use in the region is irregular, favoring the wealthy and privileged. This could increase the economic and social disparities between the richest and poorest sectors of MENA societies as time goes on.

The MENA nations can be grouped into three categories regarding the information revolution: "fearful," "driven," and "best of both." The fearful nations include Algeria, Iraq, Libya, and Syria, countries that have limited Internet connectivity or have prohibited it altogether; they would rather forgo the potential benefits in order to ensure that they avoid any negative consequences of joining the networked world. The "best of both" nations are Iran, Saudi Arabia, Tunisia, and the UAE, each of which has tried to develop a tightly controlled domestic Internet network that will enable it to reap benefits in commerce, academia, and government while keeping a close watch and maintaining strict limits on what can and cannot be done and what kinds of information are available.

The rest of the MENA nations can be characterized as "driven." They want what the information revolution offers, and want it badly enough to be willing to risk some disbenefits that may arise from more open and possibly "unacceptable" communications. The wealthiest of these countries, including Bahrain, Kuwait, and Qatar, have well-developed information infrastructures. The poorest country, Yemen, has achieved very little. The middle-tier countries (Egypt, Jordan, Lebanon, Morocco, and Oman) have made interesting but unexceptional progress.

Regarding the future, with the exception of Israel, which we discuss separately below, only a few MENA nations—principally Bahrain, Kuwait, Qatar, and the UAE—are likely to fully exploit opportunities offered by the information revolution. Most of the others will lag behind because of inadequate physical infrastructures and human

capital, governmental policies that hinder development, or cultural impediments, causing this region to fall even further behind the Organisation for Economic Cooperation and Development (OECD) nations.

As with most everything else in the MENA region, Israel is a special case insofar as the information revolution is concerned. During the latter half of the 1990s, Israel developed a venture capital industry, with investment capital flowing into the country from elsewhere in the world, particularly from the United States. As a result, in early 2000 before the current intifada started, the number of Israeli startup firms per capita was the highest anywhere in the world except for Silicon Valley, and the nation ranked third in the world in the number of NASDAQ-listed companies. This led to Israeli strengths in a number of IT areas, including Internet telephony, an industry largely erected upon Israeli innovations. These were among Israel's strengths in 2000. Since then, the intifada has put all this at risk. Clearly, Israel's future as a world player in the information revolution is held at least partially hostage to the outcome of the Arab-Israeli peace process.

We elaborate on the course of the information revolution in the MENA region in Chapter Eleven.

Most Countries of sub-Saharan Africa Will Fall Further Behind in the Information Revolution

There are extreme disparities among African nations; as a result, few statements apply universally. As one example of these disparities, South Africa has roughly half of the continent's IT infrastructure, Nigeria and the North African region each have about one-sixth, and all the rest of Africa accounts for only one-sixth of the infrastructure. Even excluding South Africa, there are also dramatic disparities among the northern, eastern, western, and southern African regions, and within countries of those regions.

With those caveats, there are several measures that help place Africa in context. First, mass media (i.e., radio and television) are now, and will remain for the next decade or so at least, the predominant information dissemination media in Africa. For every telephone in Africa, there are 2,500 televisions and 14,000 radios. Compared with

the rest of the world, Africa is far behind in per capita telephone subscribers. Regarding Internet access, in 1998 Africa had just 4 percent of the world's Internet hosts and 0.22 percent of World Wide Web sites, with more than half of these being in South Africa, even though it has 12 percent of the world's population. One must also remember how poor Africa is in general: The wealthiest 15 individuals in the world, taken together, have a greater net worth than all of sub-Saharan Africa.

Africa's IT problems are not primarily technical; they involve the following factors of culture, competence, capital, and control:

- Cultural factors such as language, nationalism, stratification, legal framework, vertical authority relationships, trust, meritocracy, and concept of information complicate and impede the spread and use of information technology in Africa.
- It takes an educated populace to know how to bring IT to those who most need it. Africa is lacking in this area.
- In many sub-Saharan countries, financial and physical capital (electric power and telecommunications) are lacking.
- The agencies of control in sub-Saharan African countries—governments, militaries, religious organizations, the private sector—often impede IT development.

In spite of these impediments, there are positive indications that the information revolution is moving forward in Africa. However, two additional factors may indirectly impede progress:

- The HIV/AIDS epidemic in Africa, which has become the biggest threat to the continent's development.
- In the post-9/11 era, much of the world's attention and resources will be focused elsewhere.

For all these reasons, it is likely that information technology improvements will continue in Africa, but the region will continue to fall further behind much of the rest of the world during the next several decades.

We elaborate on the course of the information revolution in sub-Saharan Africa in Chapter Twelve.

SOME ADDITIONAL TOPICS (A BRIEF LOOK)

Geopolitical Trends Furthered by the Information Revolution Could Pose Continuing Challenges to the United States

While the U.S. economy and society are well poised to meet the challenges of the information revolution, there are likely to be many losers and laggards elsewhere in the world. Many of these losers or laggards will become disaffected—some seriously.

The information revolution better enables disaffected peoples to combine and organize, thereby rendering them powers that must be dealt with—in many, but not all, cases.

The existence of these disaffected and organized losers or laggards could lead to trends in the world that may challenge vital U.S. interests. For example:

- Extreme losers in the information revolution could become "failed states." Such failed states could become breeding grounds for terrorists, who could threaten vital U.S. interests.
- Responding to the information revolution will stress European economies, societies, and polities, leading to laggards and losers within Europe. This could over time put increasing stress on the North Atlantic Alliance.
- The inability of Japan to change sufficiently to cope with the information revolution—if this turns out to be the case—could lead to the failure of the Japanese economy. The failure of Japan's economy would in turn lead to a vacuum in Asia likely to be filled by China. This would greatly enhance China's position within Asia and make it more likely that China becomes a peer competitor of the United States.

These trends would pose continuing challenges to U.S. interests.

We expand on these thoughts in Chapter Thirteen.

What Future Events Could Change These Projections?

Future "killer applications," unclear at present, will determine the precise nature of IT-driven transformations. They are the wild cards that will determine the fine details of the information revolution.

Many elements can slow down or speed up the pace of IT-driven transformations. Adverse financial events can slow things down; unexpected killer applications can speed things up. Such unpredictable events will occur in the future just as they have in the past.

Future geopolitical events—such as a new "cold war," a global military conflict, or a large-scale regional conflict—could adversely affect how different nations and regions of the world perform. Persistent, widespread, devastating terrorist incidents could have the same effect on a nation or region.

No matter what happens, however, the degree to which IT eventually transforms the world is unlikely to change. We expect these changes ultimately to be profound.

We expand on these thoughts in Chapter Fourteen.

The Information Revolution Is Part of a Broader Technology Revolution with Even Profounder Consequences

The information revolution is not the only technology-driven revolution under way in the world today but merely the most advanced. Advances in biotechnology and nanotechnology, and their synergies with IT, should also change the world greatly over the course of the 21st century.

The consequences of the biorevolution will be especially profound and quite controversial. The ability to alter plant and animal genomes has already led to considerable controversy; the ability to alter the human genome will lead to enormous controversy.

We expand on these thoughts in Chapter Fifteen.