1

INTRODUCING THE BIG PICTURE

> A new social form, the network society, is being constituted around the planet, albeit in a diversity of shapes, and with considerable differences in its consequences for people's lives, depending on history, culture, and institutions.
>
> —MANUEL CASTELLS [1]

Information technologies have become important artifacts—indeed key features—of modern life around the world. This did not happen by the accident of miraculous technologies being continuously served up by engineers and computer scientists selling themselves, so to speak. Managers in companies and in governments made millions of individual decisions to use the technology in support of their work. Additionally, public officials in time came to realize that encouraging use of this class of technology offered an opportunity to improve the quality of life of its citizens, and to make their economies competitive in an increasingly integrated global economy. Aspirations of individuals and institutions changed in the process. Today, corporations and governments interact quite intensively in the grand process of infusing information technologies in all manner of work and activities of a society. Some of the most important and obvious features of that experience are discussed in this book. By its scope, one will see that I

have not discussed the role of individual consumers—the purchasers of iPods and laptops, the users of social networking software and the Internet to find information—because I believe their activities would not be possible without the work of corporations, governments, computer scientists, and engineers that is described in this book. Furthermore, the activities of the consumer are already receiving considerable attention, making the need for the discussion presented in this book all the more urgent to provide balance in our understanding of how nations and their societies are embracing the use of digital technologies.

THE PRESENCE OF INFORMATION TECHNOLOGY

Today, all nations turn to various types of technologies with which to support their current standard of living, to improve their quality of life, and support such daily activities as work, transportation, and entertainment. This applies to both businesses and government agencies. The most obvious collections of technologies used for these purposes have been computers and telecommunications over the past six decades. The most visible current form of this collection of technologies is, of course, the Internet, which went from a narrowly used form of communication in the 1970s and 1980s to the point where today over a third of the world's population uses it, overwhelmingly for e-mail and to find information, but increasingly as well to conduct business transactions. Yet that specific use of information technology (IT)—the Internet—while remarkable, is only one type of computing in use. Every midsized to large business in the advancing and most advanced economies uses computers in support of every major work process. If one could measure the volume of activity going through those systems, we could quite possibly discover more activity than on the Internet. If we look at IT in smaller forms, such as the use of computer chips in various devices, we would discover other vast uses of computing, most notably in cell phones, which are now used by over one-third of the world's population. Interestingly, the fastest deployment of that technology is now occurring in underdeveloped economies, ensuring that in this small form of computing IT is spreading to all countries on earth.

Finally, microcomputing has been embedded in all manner of sophisticated equipment, from rockets and airplanes, to paper making machines, to every automobile made in the past quarter

century in Asia, Western Europe, and North America, in digital music systems over the past two decades, and in today's flat screen television sets. Myriad other consumer electronics have computers embedded in them, such as digital cameras, which essentially destroyed the market for film-based photography in less than a decade; video games, which are now played by over a billion people; and various small consumer and job-related equipment, ranging from microwave ovens to GPS-dependent surveying equipment and mapping. Then there are the hundreds of millions of personal computers, laptops, Blackberries, and iPods, to mention yet other classes of smaller devices used both by workers as part of their on-the-job activities and in the private lives of people from children to senior citizens. So, the first perspective one should keep in mind is that humankind has massively embraced a large variety of computer-based tools and consumer goods.

The second realization—and one that will affect how we look at what comes down the road over the next couple of decades—is how fast these various forms of IT were embraced by humankind. Figure 1.1 illustrates how quickly some technologies have been adopted. Such lists appear often in various forms in histories of computers and consumer products, and the data on rate of speed varies, although not a great deal. It is crucial to see that the rate of adoption of IT increased over time for some of the most important innovations of our age. As the technologies became less expensive, or conversely, one received more functionality for each dollar or Euro of investment, the more demand increased for such

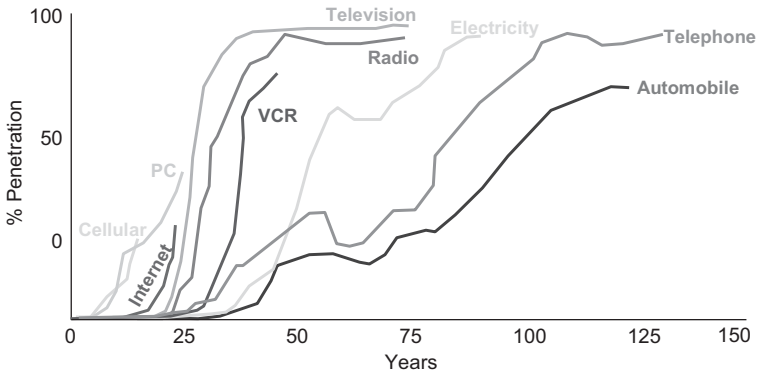

Figure 1.1. Adoptions of new technologies are taking hold at double or triple previous rates.

technologies. Additionally, over time three other technological features influenced in a positive manner the growth in demand: reliability of the technology increased, the number of things one could do with IT did too, and the forms it came in made the combination of functionality (what you could do with it) and cost proportional to potential buyers. What that means is that as the technology became less expensive or came in smaller packages (such as PCs instead of big room-sized computers), smaller organizations could afford to acquire and use them. Beginning in the late 1970s with PCs, the technology began to appear in smaller units, making it possible for individuals to acquire IT as well. By the end of the 1990s, a massive blending of the two classes of technology—big systems for companies and government agencies, and consumer-sized computing—bound together by computerized or computer-based telecommunications, made it possible for institutions and individuals to use IT in ways inconceivable and unaffordable even as late as the early 1970s.

It would be innocent to think that with all that hardware and software in use around the world that society would not be affected. Sociologist Manuel Castells has been looking at this issue for nearly three decades. As early as the 1980s, he began seeing a world networked closely together; that is to say, cities and countries interacted with each other by becoming increasingly dependent on telecommunications and computers. The massive adoption of the Internet by people living around the world, beginning in the late 1990s, reaffirmed his observation, allowing him to go so far as to declare that "the Internet is the fabric of our lives" [2]. While that might be an overstatement today and more true in the future, depending on which country one lives in, there is no denying the fact that its use is pervasive. More to the reality of our current circumstance, Castells concludes that, "If information technology is the present-day equivalent of electricity in the industrial era, in our age the Internet could be likened to both the electrical grid and the electric engine because of its ability to distribute the power of information throughout the entire realm of human activity" [3]. That comment leads to a third observation, that there is so much IT in use that how we work, play, and think of our world is now influenced profoundly by these various technologies. But, back to our first two points, it is more than just the Internet, it is the *combination* of all manner of computing technologies that have collectively begun to affect the way humans function.

There are limits, of course, although always stretched by think-

ing of ever greater possibilities. It has long been fashionable to think of computing as a replacement for the human mind, for instance. As early as 1948, a thoughtful manager in the insurance industry, Edmund C. Berkeley, wrote one of the first books on computers entitled *Giant Brains or, Brains that Think,* and on its cover was the picture of a human head with a transistor attached to it, suggesting it was augmenting people's intellectual capacities [4]. The previous year, MIT mathematician Norbert Wiener published his seminal book on the role of nervous systems, information, and the concept of feedback loops, which he entitled *Cybernetics; or Control and Communications in the Animal and the Machine* [5]. This kind of thinking launched a new field of academic research called artificial intelligence, or as it is more widely known, AI [6]. Over the next half-century, many commentators predicted the transformation of technology into forms so intelligent that either robots were going to take over the world, or humans would become partially mechanically and ever so much smarter [7]. As for us mortals, we are currently content to have spreadsheets that calculate mathematics correctly on our laptops; e-mail, of course; cell phones that are easy to use; video games and iPods to entertain us; and digital imaging in a doctor's office to let the medical profession see what is going on in our bodies.

It is important to account for the limits because there are so many new uses for computing that come along that we are tempted to overestimate what is realistic and practical to expect them to accomplish. For example, robots are used to paint automobiles, even to do all the welding of parts for those vehicles, but they do not look like humans, as in the movie *The Terminator* (1984). They appear more like metal boxes the size of a home refrigerator with an arm or two, and they can only do one or a few things. More sophisticated robots are just now being used to do delicate surgery for which a "steady hand" is intensively required, while Sony Corporation sells small gizmos with computer chips embedded in them that look like dogs and tiny people that are used for entertainment. Programmable vacuum cleaners and lawn mowers are proof that forecasts of future developments do come true. In the world of software, there are now programs that can determine who you really are, thus protecting your identity and your privacy from the user of that software, such as a government agency or a company. That is a wonderful development, since it is now essential to have trusted identification of people and things to prevent terrorism, to fight wars, and to provide the right services to an in-

dividual. We are nowhere near living in the computer-driven world of *Nineteen Eighty-Four* [8]. Nonetheless, we live in a world in which it seems most commentators about computing exaggerate the future to come or the present as it is.

So much is going on that this book cannot describe it all. Because of all this activity, it is at least worth giving a hint of its massiveness with some factoids. To begin with, all of humankind today spends over $3 trillion dollars annually just to acquire hardware, software, and digitally based consumer goods and services. About half of that is spent by organizations, such as companies and government agencies. They, in turn, spend an equal additional amount just using and maintaining what they acquired. It is not uncommon for an advanced national economy to spend between 6 and 16% of its gross domestic product (GDP) on this technology. In developing nations, it is largely spent on telecommunications such as wired telephony and, more often, on wireless phones [9]. In advanced economies we see that anywhere from half to two-thirds of the public uses the Internet or PCs on a regular basis; cell phone usage is now closer to 95%; worldwide, however, the total number of users had surpassed 2.4 billion by the start of 2007. It seems that only babies do not use cell phones in the most advanced economies. Consumers have acquired over 100 million iPods from Apple, and many tens of millions of similar devices from other firms. Today, the cost of the technology continues to decline or is packaged into smaller less expensive units, and we see Nicholas Negroponte at the Massachusetts Institute of Technology (MIT), Intel, and others selling laptops for use by schools that cost between $100 and $200 each. In the mid-1990s, a laptop cost nearly $2000 and there was no guarantee that one could access the Internet with it; the little $100 machines depend on that connection to work.

What are we to make of all this activity? The list of factoids presented above suggests that because there are so many developments underway, we have to be cautious about arriving at glib conclusions. For one thing, notice how many of the developments mentioned so far in this book, and others that will be discussed in succeeding pages, are interdependent on each other. Cell phones only work because of telecommunications and the availability of certain types of computer chips and batteries, the Internet is of value only if its voracious appetite for content is fed, and IT is only affordable if people find ways to pay for it. With so many things continuing to change that are outside the control of any one

group, one has to be cautious about predictions. For example, scientists and engineers can transform technologies if someone can afford to pay their salaries; economic crises do lead to diminutions in research budgets. Also, political priorities in one country can lead to the deployment of much IT as an economic development strategy, whereas in another it may be curtailed due to national censorship policies. Import and export taxes influence the ebb and flow of components around the world, just as other taxes condition the movement of software development from one country to another. A war can spur developments and block routine usages. The list of variables affecting each other is nearly endless.

The one conclusion we can draw is that understanding this historically massive evolution in human society requires humility, caution, and the expectation that results will not always align with expectations. Our views will remain fragmented, not comprehensive. Always, things continue to remain in flux, with no visible end in sight. In short, the more we understand, the less certain we seem about our understanding. Yet it is that confluence of various IT activities underway that require that we form some appreciation of what is happening, since we still need to make decisions about our work and play and the role these technologies should have. That is why we next need to understand some broad patterns at work around the world.

MEGATRENDS AT WORK

There are many trends involving IT. These affect the work of managers, public officials, and their respective customers and citizens. Every student of the process has his or her own list. Mine is simple, short, and based on a considerable body of empirical evidence collected by myself and colleagues at IBM in the 2000s. Yet these are inclusive enough to support the contention that the big picture is in part painted by the various forms of currently used IT. There is no moral judgment involved here. Technology is not good or bad; only its uses apply here, to cure a disease or to make smart bombs, for instance. Some of it works very well, such as an iPod, whereas the operating system on a laptop can be intractable and infuriating. Large government agencies and corporations find that incrementally changing their software over the years leads to improved efficiencies and new services for citizens, but also that large projects implemented in big blocks can result in billions of

dollars in unanticipated cost overruns and failures, particularly in the public sector, which historically always had the largest implementations of IT. The point is that technology is in use and has been long enough that it has affected profoundly the work and play of individuals. Several chapters, in particular, the fourth, explain how technology changes organizations, arguing that incremental changes in how work is done using computers accumulates change in a compound manner over time such that when one looks back a decade or so to contrast how things are done today as compared to that earlier period, one can easily conclude that they caused a revolution when, in fact, they evolved. This is an important insight for understanding how IT is changing our world and how decision makers will embrace future systems.

What are the trends one might keep in mind as one reads this book? On everyone's list in the early 2000s is globalization in its many forms. It seems every commentator has a unique definition of the word but they all have some common elements. The first that almost all observers agree on is the increase in cross-border trade. Wal-Mart in the United States is the world's largest importer of consumer goods made in China, bringing in more products than some nations import in total. The world's seven largest oil companies buy their crude from all over the world: Middle East, Latin America, the North Sea, Vietnam, Canada, and Nigeria. Indian software companies and call centers support retail, software, banking, insurance, and consumer goods firms around the world. The list is long. Globalization has many facets, however, and is not limited just to world trade, although that is an important feature. How important is that feature? One data point suggests the extent involved. In 1990, roughly 40% of all traded goods and services occurred in countries other than where they originated. By the end of 2005, that proportion had reached 60% [10]. The number of companies that operated in the global economy grew from some 35,000 in 1990 to over 70,000 in 2005, while the quantity of firms affiliated with these international companies as business partners increased fourfold [11].

That is merely the tip of the iceberg. At least 200 million people work or live in countries other than their own [12]. That number is expected to grow as workforces become increasingly mobile. Cases exist everywhere: massive migrations of young educated Poles to jobs in Ireland; Irish citizens returning to Ireland in larger numbers than those leaving—a first in the history of the country that occurred in the early 2000s; and millions of Mexican workers and

their families moving legally or illegally into the United States, beginning in the 1980s. Again, the list of examples is long. One variant of this process worth pointing out is that there are internal migrations going on as well in response to the growing availability (or loss) of jobs often driven by international trade. This is occurring with millions of citizens moving from the countryside to fast growing industrializing cities in China, India, Brazil, and across Africa and parts of what used to be the Soviet Union. Internal migration within the enlarged European Union has also increased in the early 2000s. Sometime between when I started writing this book in 2007 and the time it was published, over half the world's population lived in cities—a first in humankind's history. These are now the people Manuel Castells is writing about and that are corporations' largest group of customers.

A subtrend of the globalized movement of people is the migration of talent. Talented, well-educated people with, in many instances, IT skills, are roving the world. New Zealand has become one of the major locations for making of movies that require extensive use of software and video game skills. It is where, for example, the *Lord of the Rings* movies were made. As recently as the early 1990s, many people associated New Zealand's economy more with mutton than with movies. South Korea and India are rapidly becoming the world's largest locales for the production of software, video games, design and manufacture of computer chips, and, in the specific case of South Korea, manufacture of chip-laden consumer electronics, such as digital cameras. As the dependence on IT to do one's work increased in the 1980s and 1990s, it became possible to work and live wherever one wanted. IBM employees around the world used to joke that they could live anywhere so long as they had nearby a fax machine and an airport. Thanks to telecommunications, the Internet, and laptops, they and so many others in thousands of firms no longer need either fax machines or airports to experience productive careers [13].

Another feature of globalization involves the international exchange of ideas and fashions, even culture. It is common today for senior public officials and private sector managers to speak English; scientists and engineers have for decades. In fact, English, Chinese, and Spanish are global languages, with English dominating in the worlds of politics, public administration, defense, academics, economics, business, ideas, media, and fashion. It is also not uncommon for these globe trotters to have attended the same universities or at least to have used the same textbooks in transla-

tion at school. Movies produced in the United States or European productions that win international prizes are seen all over the world; to be sure, it is an old story since Hollywood's productions have been one of the major exports of the United States since the dawn of the twentieth century. Major media companies in all fields of entertainment introduce their products around the world, creating shared experiences among their customers. It seems that we increasingly see the same movies in Europe and North America, read the same novels, and listen to similar, if not exactly the same, music. American-style Rap music is now played all over the world, whereas "fusion" music amalgamates flamenco, Rap, and Central European folk music.

Finally, globalization is extending to a variety of transnational public administrative functions. Before modern globalization, a large portion of governmental international activities largely involved diplomacy, war, law enforcement, and promoting trade. The international role of governments and other public institutions has been increasing since the 1980s. The creation of the World Trade Organization (WTO) in 1995 led to the almost instant establishment of a transnational institution that now describes and enforces rules under which global trade occurs. It did this in less than a decade and yet is still operationally in its childhood, so one can expect its role and power to increase. The World Health Organization (WHO) has increased its international influence due to the spread of various pandemic diseases in the 1990s and beyond, such as avian flu, which required a global response. Environmental groups have scaled up to deal with global warming, green issues, and other environmental concerns as both advocates for transnational responses and through assertion of their desire and effectiveness to lead where individual governments are not willing or able. Most recently, we have all seen a surge in collaboration by banking regulators all over the world in response to the crisis in their industry. It almost seems that the United Nations is being marginalized. But the trend goes further. The European Union (EU) has now taken the global lead in establishing many standards for safety of products that it imposes on the entire world because the rest of the world sells products to the EU. The U.S. Food and Drug Administration (FDA) long acted as the de facto global standards-setting body for drugs and medicines mimicked by many governments, although, even in this area of regulation, the EU is asserting its global influence when it disagrees with an action (or inaction) by the FDA.

IT technical standards boards are promoting open standards for software, about which we will have more to say in future chapters. All of these activities are facilitated by the fast and inexpensive flow of information through e-mail, telecommunications, and the Internet, and can be analyzed and leveraged using other forms of IT.

This increased transnational role of public officials and nonprofit organizations (NPOs) and other nongovernment organizations (NGOs) is such a new development that it is not quite as obvious as it should be because corporations and small firms are not always as prepared as they need to be in dealing with this new wave of globalization. In fact, one of the messages from this book is that the private sector needs to be more engaged in the process than it has been in the past. There are emerging tasks senior management ought to undertake that are introduced in this book. In other words, private–public collaboration and confrontation is an emerging feature of globalization.

To summarize, globalization is a more complicated, nuanced phenomenon than we might have thought as recently as a decade ago [14]. Technology, trade, people, culture, and public administration have all gone global and all the evidence suggests this multifaceted trend is accelerating. A primary engine of that acceleration is the deployment of all manner of IT in communications, transportation, and in exchange of information, goods, and services.

Yet we can be too exuberant in our view that the world has gone or is going global. At the same time that many institutional–managerial infrastructures are globalizing, such as regulatory activities and transnational trade in goods and services, intense localization is also underway, a subject we cannot get into in any detail in this book. But this localization has very important implication for those concerned about technology, namely, that often technologies are embraced and funded differently from one nation to another. No more instructive example exists than cell phones. In the United States, one signs up for two years' worth of service at a fixed or variable cost, but with a contract, and then either buys or receives a telephone from the service provider. In Africa, users prepay for a certain number of minutes. In Europe and parts of Asia, service and the purchase of cell phones are separate transactions. In countries with the highest standards of living, people have their own personal mobile phone; in very poor countries, it could be the village as whole that owns one telephone. Uses also

vary. Teenagers in the United States chat with friends, young Europeans text message a great deal, whereas farmers in India call in to find out the price of crops. The lesson is that although globalization in both how institutions and technologies work is increasing, localization remains vibrant and, one could argue, at a minimum makes possible the increased use of technologies in poor and developing economies. As managers, social commentators, and scientists we cannot ignore these countervailing winds of change.

A second megatrend, related to the first, but nonetheless distinctive in its own right, involves demographics. Managers and public officials should care about this one for two reasons. First, it is unfolding independent of what any individual organization does. Second, technology affects the role, work, and quality of life of people. We have already mentioned the global migration of employees and the massive international and internal migrations stimulating urbanization around the world, but there are other aspects involved in the megatrend of changing demographics that need to be recognized. Specifically, they involve ages of populations. In some countries, work forces and populations are aging rapidly. We are all familiar with accounts about aging populations in Italy, Germany, the United States (Boomers), Japan, and, increasingly, China. As they grow older, their medical needs will influence the development of IT-based medicine and procedures, ranging from more advanced forms of MRI scanners to computer-based development of new medicines, as occurs routinely in the pharmaceutical industry. These developments will, in turn, cause people to live longer, saddling corporate and governmental medical and pension programs with additional costs. Additionally, in the wealthiest economies, services to seniors by both the public and private sectors are increasingly delivered using IT. For example, citizens can apply for government services in many countries using the Internet, rather than going physically to some office and filling out paper forms. Government agencies in Western Europe are increasingly integrating the work of multiple agencies that work directly with citizens so that they have a total view of the needs and services provided to any particular individual. Trusted identity systems are just beginning to appear that will ensure that people get the services they really need and are really the individuals who should get the services they require and are qualified to receive. A similar process is underway in the delivery of goods

and services to seniors: online ordering of medications delivered to one's home, integration of financial services into "one-stop shopping" formats, delivery of media and entertainment over the Internet to a variety of devices, and instruments (platforms) that will increasingly be more user friendly for the sight impaired or those with arthritis. In short, while most commentators focusing on aging populations concentrate on the rising costs of medical coverage and pensions, there is this other demographic trend unfolding involving a growing reliance on IT by aging communities of customers and citizens.

In other countries, the opposite demographic situation exists, in which populations are quite young. This situation that exists in many parts of Asia, Latin America, and across the African continent in some 54 countries. These people are not going away; in fact, many will go be around largely throughout this century and they are the most rapidly expanding cohort in the world's population. They are often poor, live in weak economies that have bad water and inadequate medical facilities, and whose societies invest less in educating their youth than the most advanced nations of the world. Issues and problems with younger populations manifest themselves in different ways, to be sure, but all share the reality that there is churn and change on the way. For example, in Saudi Arabia, a highly literate, well-educated male workforce is experiencing high levels of unemployment; in Brazil not enough children go to school; and the one characteristic shared by all countries with young populations is that children go to school fewer years than anywhere else. But public officials understand the problems and are addressing them. Negreponte sold 150,000 of his inexpensive laptops to Peru in 2007 to facilitate instruction of children in small villages. In Africa, the Internet is being used to transmit educational offerings to rural communities, while it seems that most elementary schools in the United States have formed alliances with elementary schools in other countries with large young populations. We can expect IT to be configured in ways that will help the young to do more than gain access to cell phones—they have these already all over the world—and instead acquire skills that will make it possible for many to thrive in the current century.

Corporations are playing a role as well. Many large corporations are collaborating with local governments in investing in training programs that result in a large pool of properly skilled workforces, especially in countries that have less expensive labor pools. Com-

panies favor investing in those economies where workers already speak English or have higher levels of education than comparable economies. Developing specialized functions in a country is also popular: semiconductor and consumer electronics manufacturing in South Korea and China, software development and support in India and Russia, and extraction of minerals and other resources through the use of advanced technologies in Latin America and Sub-Saharan Africa are a few examples.

Yet another subtrend within demographics not fully appreciated around the world is the gender mismatch just becoming evident in China, but existing elsewhere too. With China's law making it possible for only one child to be born per couple in a nation that favors sons over daughters, there now exists a growing gender imbalance with more males than females. The implications are not well understood. Will men migrate out of China to find wives in other countries? If so, how will that change the culture of other nearby nations? Will that create wars? Will homosexuality increase? What will happen to levels of crime? Will women be "imported" into China? What will be the effects on the role of women? Will they assume more political and managerial leadership positions in China, a process that seems already to be underway? As China's population ages rapidly in the second half of the century with inadequate number of replacements, will the Chinese repeat the experiences the Germans and the Italians face today? All of these issues are slowly unfolding in a nation that has such environmental problems that one can also begin asking if there are some health-related megatrends that need to be accounted for too since China is home to nearly 15% of the world's human population. The follow-on questions these raise for managers with firms in China or dealing with Chinese enterprises, and for public officials in other countries, are complex, often new, and both disturbing (e.g., rising unrest and disruption of business operations) and potentially presenting positive opportunities (e.g., for sale of pollution control equipment).

So far, we have discussed two components of the big picture—accelerating globalization and changing demographics—each of which have been subtexts affected by the use of IT. But there are others to acknowledge.

During the late 1990s and into the next decade, it became increasingly apparent to scientists and public officials that there was something happening with respect to the world's environment.

Was it global warming, as many scientists were arguing? Were other factors at work? As the cost of oil and natural gas rose in the early 2000s and then sharply fluctuated wildly up and down, observers raised the question of carbon-based pollution and, just as serious, the possibility of running out of affordable fuels. Those are concerns of the industrialized economies and of the companies do business in them. Officials, scientists, and commentators all were worried that the consumption of oil was fundamentally damaging the environment. But these kinds of situations can reverse themselves as well. For example, take the situation in which the price of oil drops, generating some interesting implications for IT. In this situation, during the second half of 2008, the price of crude oil dropped from a high of over $100 a barrel to as low as $35–40 per barrel, and clearly remained below the $70 a barrel rate right into the new year. The reason $70 is important is because most oil-rich countries rely on that level of pricing to generate a volume of tax revenues necessary to run a government without having to tax its citizens. This is the case, for instance, in such varied economies as a U.S. state's (Alaska), Trinidad's, Venezuela's, Russia's, and, of course, of oil-producing Arab states. In the case of Trinidad, for instance, when oil dropped below $70, public officials decided to speed up economic development that involved industries outside the oil business, most notably software and other forms of IT. Of course, these strategies take years, if not decades, to implement, as the Irish learned in the 1980s and 1990s. But the point is, an activity in one industry—in this case the falling price of crude oil—can have important effects on the role and use of IT. What is most unnerving, however, is that such consequences of events are not all predictable, although to the credit of Trinidad's government, several years earlier it had already worked out the fundamental strategies necessary to move toward becoming an information society, learning from the experiences of such nations as the United States, Japan, Ireland, and Korea. And, of course, we are still left with the issue of consumption of oil, which remains to be addressed, also in part by the use of IT in protecting the environment.

Then there are the poor communities in India, China, and Africa more concerned with the lack of adequate supplies of clean drinking water, and, additionally in China, clean air. Collectively around the world, thoughtful individuals were again raising the question of how many people and how much human activity could the Earth sustain. Meanwhile, at international conferences

attended by experts, corporate management, and senior public officials, one could hear pronouncements that there was enough water, gas, air, and oil, but in the wrong places, often in politically unstable societies, such as oil in Nigeria, or in underdeveloped economies, such as natural gas in nations bordering Russia to its east, its availability often driven more by political priorities in Moscow and elsewhere than by market demands [15]. Our discussion speaks to the very survival of humankind, to be sure, but also to other issues discussed in this book: economic development, public works, health and medical coverage, quality of life, and, in recent years, "green" issues in politics, social discourse, and business operations, all touched by IT as well.

What is clear is that a tipping point in the conversation occurred sometime in 2006–2008. Governments turned to the environmental issue in a substantive manner. Many corporations finally concluded that green operations could drive down expenses and create new market opportunities. Individual consumers in the most developed countries began to shrink their personal "carbon footprint." The poor in many African communities continued to suffer exposure to mercury and other substances as they dismantled retired personal computers and consumer electronics shipped to them from more advanced societies to recycle valuable components. To be sure, while the issue of environmental concerns exists, it is in a nascent stage of evolution. But already IT is part of the story. Governments are making their buildings greener to lower heating and cooling expenses driven up by the costs of fuel and gas in the early 2000s. Computers frequently manage and measure that effort. City and state governments are mandating less polluting cars, trucks, airplanes, and trains, while myriad digital devices are tracking pollution, sniffing car exhaust, and calculating a company's carbon expenditures. Companies are driving down the costs of heating and cooling their buildings, in using carbon-based fuels such as oil and coal, and in introducing products that are more environmentally "friendly." For many years, researchers working on pollution and global warming depended on data collection and analysis by computers, a use they will increase over time as new tools are developed or old ones simply used more extensively in more countries.

Finally, we should acknowledge what is either another megatrend that makes up part of the big picture, or is a byproduct of the other megatrends. It is becoming clearer that as part of the chang-

ing relationships of people, resources, and technologies that societal interactions are evolving and that some of these changes represent threats to social stability and normal business operations. This comment is far more comprehensive than the threats posed by terrorists in the Middle East, or violent political groupings in such disparate places as Pakistan, Kenya, borderlands next to Israel, and southern Mexico with its local Indian tribes. It is bigger than the narrower discussion about social networks or dating sites that seem to so captivate the press in many countries. In the past several years, we have seen North Africans riot in France, Moslem residents frustrated over their inability to integrate into the national social structures of Scandinavian countries or the Netherlands, people raised in Great Britain by Pakistani parents alienated to such a point that they blew up buses in London, while others of Arab citizenship did the same with a train in Madrid; the list of unrest and disturbance is long, active, dangerous, fundamental, and evident in well over a hundred nations.

This discussion is not intended to scare the reader, merely to point out that too many discussions about IT are too antiseptic, ignoring some fundamental megatrends—realities—that affect the users of computing and who, in turn, use the technology to support their personal priorities. Those evolving societal changes have in common with global economics the feature that in both instances relationships among groups, such as citizens with their governments and customers with their vendors, are changing, as expectations of citizens, consumers, public officials, and business management and employees evolve. Citizens are asking different things of their governments, for instance, for universal health care in the United States, lifetime job security and more generous pensions in Europe, jobs in China, clean water in India, and so forth. Many of these are new demands driven by rising expectations that improving economies stimulate, which IT contributes to by further diffusion of media showing "the good life" in other nations, or are triggered by rising levels of education and access to information. Consumers are better equipped with information about the quality of products and service and their relative worth and, hence, are demanding more and better value from their suppliers. As individuals become more affluent and aware of employment options, or are self-centered, they move around the world quickly to where they think they can fulfill their aspirations.

Although it is difficult to document adequately, and certainly

will not be done in this book, regionalism seems to be on the rise too, along with allegiances to one's cultural heritage. There are several thousand provinces/states in the world functioning within national governments. They seem to be leading in the public administration of economic development, delivery of innovative services to citizens, control over environmental issues, and in local educational reforms. Some of these states are larger than nations, such as all of those in China, India, and even in the United States (California and Texas). Regionalist political aspirations are also high, as in the cases of the Catalans and the Basques in Spain, the Welsh in the United Kingdom, the Flemish, French enclaves in Canada, Palestinians in the Middle East, and myriad African tribes in over four dozen nations not limited to just Sub-Saharan countries. Similarly, ethnic groups are agitating for local control or recognition across large swaths of Asia, even in China (the Tibetans), and by Indian tribes in Brazil and elsewhere in Latin America. In short, unrest and challenges to the prevailing social and economic orders are numerous around the world. One almost has to go back to the experiences of nations in the middle of the nineteenth century to find a period of comparable uncertainty and unrest.

All of this is compounded and facilitated by digital technologies. Television coverage of riots and civil unrest in Paris in 2005 and again in 2007 by North African teenagers spurred others of similar ethnic backgrounds elsewhere in the country to do the same, protesting prejudice in education and lack of jobs. We know that Al-Qaeda operatives use cell phones and laptops as effectively as American and European military personnel, perhaps even more cleverly since they have to do it on the cheap. Arab terrorists leverage electronic press coverage on television and radio, often with better results than a highly paid advertising agency in New York. In short, technology has allowed people to become more aware of their surroundings and what other like-minded people are doing. To be sure, governments of all political stripes are responding by trying to impose controls over material coming from the Internet (China) and monitor telephone conversations (U.S.) [16]. These are all uncomfortable, disquieting features of modern society; though not caused by IT, they are certainly facilitated by use of the technology.

Corporations feel the brunt of these actions. For years eBay has been pressured, then ordered, by the French not to sell Nazi items in France, which has a law forbidding such sales. Yet the transac-

tions can flow from anywhere in the world since eBay is global. How could it comply? Indeed, should it? Google has received similar pressure to report uses of its services to the Chinese government while the same government has been blocking the flow of content from media companies all over the world. How can a corporation function in a global economy with these kinds of issues affecting routine business operations? Many of these issues are new to the management teams of these corporations. eBay and Google, for instance, are essentially still being managed by their first-generation of managers. Even older firms, such as Microsoft, ran into antitrust problems with the European Union (E.U.) after wrestling with U.S. antitrust officials. Interspersed in all of this are the better known issues surrounding the protection, or lack thereof, of patents and copyrights, a problem that manifests itself all over the world in myriad forms and no more so than in anything that has digital features, such as DVDs, CDs, and music and films in digital forms available from computers and over the Internet.

Before exploring some of the implications of these nontechnological trends, because they are also affected by technologies far more today than even in the 1990s, we need to understand more thoroughly how IT is being used.

HOW SOCIETIES USE TECHNOLOGY TO SHAPE THEIR WORLD

The trends described are features of the big picture, the background against which the world's population goes about its business. The rest of this book discusses some of those IT activities which most affect the megatrends described earlier, showing in the process how key technology-related tasks are being carried out. We concentrate largely on the roles of businesses and government agencies, and offer recommendations on these. It is no longer enough to mention such things as "governments encourage the use of IT to further economic development," or that managers "must run globally integrated enterprises." We need a deeper understanding of their issues because so many people now participate in the adoption and use of computing with which to live out the megatrends. As mentioned in the Preface, there are many possible topics for discussion involving computing, but by limiting

the focus to a few that are crucial to the way the world is shaping its immediate destiny managers and public officials can craft effective practices and strategies. However, this approach also means that much is left out but not dismissed as irrelevant. For example, I do not discuss the role of computers in modern warfare as I already did in a prior book [17]. Nor do I describe how computers are used in some 36 industries in the United States as I recently addressed those themes elsewhere too [18]. Rising above those narrower issues are those addressed below. They all share the common characteristic of being global in scope, not limited to the United States, the E.U., parts of India and China, or to interesting cities in Brazil and Eastern Europe.

To be sure, just like the megatrends manifest themselves in unique ways in each country, or even within provinces inside nations, so too what are described in the rest of this book manifest themselves in a unique fashion at four levels:

1. National
2. State/provincial
3. Industry (national and international)
4. Company or agency

That means consumers and individual users are not discussed here. Yet we will reaffirm variations in firms and nations. Every company is really different, so too is each industry, even common industries in different countries. The banking industry in the United States is not the same as that in Spain, for instance; Zara's department stores in Spain operate differently than Harrods of London, or the Sears chain in the United States. Some provinces have a great deal of industry and IT firms, while others are agricultural or low tech. The economies of Estonia, Brazil, China, United States, and Jamaica are quite different. But, in most instances, diffusion of IT is extensive, growing, and influential on the affairs of its users and societies. In short, there is a role for almost everyone in a leadership position or who influences affairs in this world of rising adoption of all manner of information technology.

To begin the discussion, it is helpful to understand how the technology spread so far so fast, which is the subject of the next chapter. In point of fact, there are eight discernable patterns of diffusion of IT. These are useful to describe because they demonstrate how diffusions of a technology are always tailored to the social, legal, economic, and historical proclivities of an individual

nation. In a sense, this chapter reflects a form of the wisdom of crowds because these patterns of adoption are essentially the cumulative behavior of hundreds of thousands, if not a few million, business managers, public officials, IT users and their vendors and advisors around the world over the previous six decades. This discussion provides a proof point that it makes sense for each nation, region, company, or government to define its own path of adoption. The lesson is not limited just to computers and telecommunications, but applies to all manner of technologies which, in and of themselves, are flexible and can be shaped to meet the needs of an industry or society. IT is not the only technology humans will encounter in the twenty-first century, but it is a class of innovations that can be informative about subsequent ones. Next on the horizon is either nanotechnology (about tiny, even microscopic engines, for instance) or biotechnology, which involves programming living cells to cure diseases, provide healthy reengineered foods and medicines, or that can serve as new tools with which to do work (possibly bio-based computers). The chapter ends with some insights on what the various patterns teach us about the megatrends, lessons for managers and policy makers.

Armed with an overview of how IT spread around the world, we next move to the equally expansive question of how governments, also aware of the power of IT, are leveraging these technologies to improve the quality of their performance, the lives of their citizens, and the competitiveness of their economies. Governments at all levels have long been interested in leveraging existing local capabilities and emerging new markets and technologies to improve their economies. Research by many organizations clearly demonstrates that governments have been interested in doing many things with IT, at least since the 1970s [19]. Since the wide adoption of the Internet in the 1990s, and the even earlier manufacture of computer chips and PCs, public officials have been keen to promote the use of IT inside government and corporations, and by citizens at large. They have introduced computing into schools and supported curriculums that trained workers in IT-related skills. Today, the variety of initiatives undertaken by governments is so varied and extensive that one can begin to catalog them by type of economy, much as is done in the next chapter in describing types of deployment. Chapter three is tactical in that it assumes that the reader is a public official. This is done because readers influence what public officials do in many countries and can learn lessons about how best to use IT within their own com-

panies and institutions. Although this chapter concentrates largely on public officials, because policy makers do not operate in isolation, there is much said about the role of private sector management as well. It ends with recommendations on how to proceed for both communities.

What is quite remarkable is how many governments and corporations participate in the economic development process using IT. Even highly underdeveloped or poor economies seek to leverage the technology. Why? In the same countries, corporations also seek to leverage IT for their economic benefit. Why? Because, today economists know that IT can have a positive, indeed dramatic affect on the growth and improvement of a local, state, or national economy. In the 1990s, economists engaged in a major discussion about the "productivity paradox," in which they saw enormous investments being made in IT but could not tie those to any productivity gains of an economy at large. In earlier studies, I offered evidence to the effect that at the firm level benefits were accruing, some dating back to at least the 1960s in the case of the United States [20]. By the end of the 1990s, economists had been able to demonstrate the link between IT investments and national economic productivity across many economies [21]. Their finding was not lost on public officials, whose own economists were reporting results, or on executives whose companies were also deriving benefits from the technology. As a consequence, governments pushed forward various initiatives that relied on IT in the early years of the 2000s. Those strategies are the subject of discussions later in the book.

Armed with information about what is happening on a global scale, we next turn our attention to the mundane, tactical, singular act of a business, technical, or government manager making a decision to do something new using IT. It is the millions and millions of such decisions made in public and private institutions over many decades that, when added up, accounted for the actions described in the first two chapters of this book. By looking at how such decisions are made and justified from an historical perspective, one can see that the manner in which such decisions are made have not changed so much over many decades. Those patterns provide "lessons from history" applicable to decisions managers are making today. These apply to the adoption of large mainframe-based systems as well as to new uses of the Internet. These practices focus on institutional decision-making, not that of consumers, because the lion's share of acquisitions of computing over

the past half-century were made by managers and IT professionals, not consumers buying iPods and laptops.

Having narrowed our view of IT issues as we move from one chapter to another, it then makes sense to step back and debate whether or not we now live in an information age. There are serious reasons to do so. For one thing, naming an age does set a tone and defines priorities; in other words, it helps shape a civilization or simply one's own society. For another, there are nations that have embraced notions of what they want their world to look like. The Japanese government, for instance, has many formal public programs and policies intended to make Japan an "information society." The South Koreans do too, but without giving it a label; they simply made their country the most broadband-intensive culture in the world and watched for consequences as individuals used their imagination, taste, and affordable IT to reshape aspects of their lives. Estonia and Finland have public policies to become some of the most Internet intensive nations on earth as a way to be highly competitive in the global economy. As early as the mid-1990s, President Bill Clinton wanted to give every classroom in America access to the Internet. For all practical purposes, and after investing billions of dollars, he succeeded; that it did not result in some miracle in education is another discussion we cannot address here [22]. The point is, however, that there is much intent and activity under way; hence, the discussion of what might otherwise seem some intellectual fancifulness is important to undertake.

Chapter six examines the historical and emerging role of computer scientists and engineers as the population increases around the world, suggesting a more activist agenda for them. This chapter is almost shamelessly propagandistic for me, but I did that to bring attention to an expanded role I believe the technical community can play, and make suggestions about the leadership role it can take.

The last chapter brings us back to a practical consideration of what we should do in light of any insights presented in this book. It is intended to answer several very blunt questions. The first is, So what? Next, Why do we care? Finally, What should one do next if either a public official or a corporate executive, a government or a company? It turns out that IT is not going away in anyone's lifetime; the technology is continuing to evolve. Most important, many of its effects on how societies and economies will be shaped in the twenty-first century are only just beginning to surface. Despite the enormous amount of hype about the Internet, for exam-

ple, it has barely begun to influence societies to the extent that earlier technologies have but experts on the subject of the Internet are uniformally, absolutely confident it will shape the affairs of individuals, firms, governments, and nations and their economies. In very unprofessional English, the phrase "you ain't seen nothing yet" applies aptly to the Internet.

It also applies to other trends in the evolution and use of IT that are discernable, because there is a secret among technologists already noted earlier in this chapter not often shared widely outside their circle: technologies evolve very slowly, often taking 10 or 15 years to reach a point where they are mature enough to be used in public. Moreover, historical experience also illustrates that from the time someone announces the availability of some new software or hardware tools, to when they are widely used can range from 4 to 20 years. In short, one can begin to paint a picture of some of the uses and effects of IT that will unfold over the next twenty years with enough confidence that individuals can take actions based on such predictions. That is why this chapter alone could be worth the price of this book. By adding recommendations to the discussion based on proven ways and some others proposed initially here, one should expect to leverage trends and align corporate and public policies to the possible.

Each chapter is an independent essay that can be read and studied without reference to any of the others. However, as argued here, nothing operates in isolation; every discussion in this book is related to the others. That makes perspectives, lessons from history, and any forecast difficult to deal with but essential nonetheless. We are moving rapidly into a more highly integrated world, one in which the various points of connection are numerous, complex, and affect each other. Regardless of potential natural disasters, wars, and the inevitable emergence of positive surprises in the evolution of knowledge, science, and technology, IT is a glue that helps bind humankind together. It is, after all, the digital plumbing of modern times.

NOTES AND REFERENCES

1. Manuel Castells, *The Internet Galaxy: Reflections on the Internet, Business, and Society,* Oxford: Oxford University Press, 2001, p. 275.
2. Ibid., p. 1.
3. Ibid.

4. Edmund C. Berkeley, *Giant Brains or Machines that Think,* New York: Wiley, 1949.
5. Norbert Wiener, *Cybernetics: Or Control and Communication in the Animal and the Machine,* Cambridge, MA: MIT Press, 1948.
6. There is an encyclopedic history with a comprehensive bibliography: Margaret A. Boden, *Mind as Machine: A History of Cognitive Science,* 2 vols. Oxford: Clarendon Press, 2006.
7. Thoughtfully explored in a series of essays in Peter J. Denning and Robert M. Metcalfe (Eds.), *Beyond Calculation: The Next Fifty Years of Computing,* New York: Copernicus, 1997; for a more recent, extreme view, see Ray Kurzwell, *The Singularity Is Near: When Humans Transcend Biology,* New York: Viking, 2005.
8. *Nineteen Eighty-Four* is the name of a novel written by George Orwell, published in 1949, about life in a dictatorship.
9. James W. Cortada, Ashish M. Gupta, and Marc Le Noir, *How Nations Thrive in the Information Age,* Somers, NY: IBM Corporation, 2007, pp. 7–8.
10. Susanne Dirks, Mary Keeling, and Ronan Lyons, *Economic Development in a Rubik's Cube World: How To Turn Global Trends into Local Prosperity,* Somers, NY: IBM Corporation, 2008, pp. 3–4.
11. Ibid.
12. In fact, establishing an accurate count has proven difficult to accomplish because many migrants move illegally from one nation to another. The only substantive study of the issue and the role governments play in working with these workers and residents is Brian Lee-Archer, Chris Brailey, Marc Le Noir, and Oliver Ziehm, *For the Good of the Global Economy: Social Protection for the Migrant Worker,* Somers, NY: IBM Corporation, 2007. The United Nations has also published some statistics in *World Migration 2005,* Geneva: United Nations Publications, 2005.
13. This new creative class is described by Richard Florida, *The Flight of the Creative Class: The New Global Competition for Talent,* New York: HarperBusiness, 2005.
14. The first modern observer to make similar points was Robert Gilpin. Of his many books, see *The Challenge of Global Capitalism: The World Economy in the 21st Century,* Princeton, N.J.: Princeton University Press, 2000.
15. An example of the kind of gathering addressing these issues is the annual political risks conference hosted by the Royal Institute for International Affairs, which always draws senior public officials, experts from academia and think tanks, and managers from the private sector.
16. Nicholas Carr, *The Big Switch: Rewiring the World, From Edison to Google,* New York: W.W. Norton, 2008, pp. 179–184, 197–209.
17. James W. Cortada, *The Digital Hand,* vol. 3: *How Computers Changed the Work of American Public Sector Industries,* New York: Oxford University Press, 2008, pp. 49–102.
18. James W. Cortada, *The Digital Hand,* 3 vols., New York: Oxford University Press, 2004–2008.
19. The obvious ones include the European Union, OECD, U.S. General Services

Administration in the public sector, while many in the private sector also exist, such as IBM's Center for the Business of Government, or others run by this firm's competitors.

20. One of the key findings of Cortada, *The Digital Hand,* all 3 volumes.
21. For a very current update, not even published as of 2008, see Stephen D. Oliner, Daniel E. Sichel, and Kevin Stiroh, "Explaining a Productive Decade," Federal Reserve Board, August 2007.
22. Larry Cuban, *Oversold and Underused: Computers in the Classroom,* Cambridge, MA: Harvard University Press, 2001.