IT: Ubiquitous Force

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EXECUTIVE SUMMARY

Information technology and its results touch every aspect of our lives. Statistics reveal that IT will be an ever more vital and multi-dimensional part of our daily lives. While the opportunities are obvious, the challenges are often hidden.

12 TRENDS
changing the world

A five-year research project reveals that the future of commerce worldwide will be greatly influenced by a dozen "global tectonics" that will affect business leaders across all industries:

1. Biotechnology
2. Nanotechnology
3. **Information technology**
4. Population
5. Urbanization
6. Disease and globalization
7. Resource management
8. Environmental degradation
9. Knowledge dissemination
10. Economic integration
11. Conflict
12. Governance

In 1957, the United States, gripped by fear of nuclear attack and deeply involved in the cold war, watched as the Soviet Union launched Sputnik I into space. That moment marked a new age in space exploration, innovation, and competition as the United States and the Soviet Union began the Space Race.

In response to what appeared to be Soviet technological advancement over the United States, President Eisenhower created the Advanced Research Project Agency. (ARPA would later add Defense to its name and be commonly known as DARPA.) It was ARPA, and the academics who led it, that fostered the start of innovation unlike any the world had ever seen. Hailed as the most influential agency in the history of computer development in the United States, ARPA was charged with developing technology to assure that the United States maintained a lead in applying state-of-the-art technology for military capabilities and to prevent technological surprise from adversaries.

With this charge, J.C.R. Licklider of the Massachusetts Institute of Technology became the first head of the computer research program at DARPA in 1962; it was Licklider (or "Lick" as he was known) who envisioned the Internet. He wrote a series of memos before his appointment at DARPA about an "intergalactic network" of computers that could communicate freely with each other. At that time, there were some 10,000 computers in existence, none of them personal computers and all of them slow by today's standards. Lick recognized the need for computers to be more accessible to humans, easier to work with, and connected to each other. He sold his DARPA co-workers on his revolutionary idea. Today, there are more than 800 million computers around the world, with 230 million in the United States alone.

In 1969, several efforts from around the globe came to a head with the development of the first host computer network connecting the University of California, Los Angeles to Stanford University. By the end of that year, four host computers were linked together and the host-to-host protocol was completed. The Internet was born.

Today, the Internet continues to spread to all parts of the world. The share of U.S. households with Internet access increased from 26.2 percent in December 1998 to 41.5 percent in August 2000 and to more than 60 percent by 2004. By 2003, the market was estimated at $6.9 billion in the United States alone. During the same period, the share of Americans using the Internet rose from 32.7 percent to 44.4 percent.

According to Neilson ratings, more than 200 million Americans — 75 percent of the population — have access to the Internet in their own homes. More than 60 million homes in Western Europe are now online. Despite the use of English as the base language of the Internet, expansion of the World Wide Web outside the West has been substantial. An estimated 60 percent of the world's online population resides outside the United States. In Asia alone, the number of Internet users grew to 64 million in 2003 and is expected to reach 370 million by 2006. In 2005, non-English-speaking countries have more people online than English-speaking countries, and their percentage of total use has increased 57 percent.

As the statistics reveal, information technology will be an ever more vital and multidimensional part of our daily lives — supporting our activities at home, work, and school. Although Internet access varies by income, education, race, age, and location, overall access has increased across all of these groups in the United States

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more efficiently. Computer systems help managers determine schedules for employees, shipment orders, product placement, and financial evaluations. As technology expands for business, it expands for personal use as well. Since its introduction in 1996, the Palm personal digital assistant has been sold to more than 20 million consumers worldwide. But as a testament to the speed at which today's hot technology can become yesterday's news, in 2004 the 8-year-old innovation had started to become archaic.

Information technology has more business applications than personal; it is revolutionizing entire industries. Banks, shipping companies, financial services firms, and a wide variety of other areas have been drastically altered as information technology emerged. In 2004 there were more than 380,000 automated teller machines in the United States, up from 187,000 in 1998. At present, ATMs outnumber banks and branch locations almost four to one in the United States.

Not even the fashion industry is free from the influx of technology. At Fashion Week in January 2005, FedEx and Xybernaut (a firm that designs wearable technology) introduced a mobile wearable computer. Both companies expect the new device to assist workers in efficiency and accuracy of shipments.

Most probably the best known aspect of this technological revolution has occurred in the area of communication. Today, anyone anywhere can access the Internet and read about news as it occurs halfway around the world. FedEx can ship anything anywhere in the world in two days, while the document's owner can track its process online through a regularly updated site. Radio-frequency identification allows companies to track the movement of not just boxes but individual items.

Communication capabilities extend

Building TRUST

This spring, the National Science Foundation announced that the University of California, Berkeley will lead an ambitious multi-institution center to protect the nation's computer infrastructure from cyberattacks while improving its reliability.

Collaborators from eight universities will form the new Team for Research in Ubiquitous Secure Technology. The TRUST center is expected to receive nearly $19 million over five years, with the possibility of a five-year, $20 million extension at the end of the initial term.

"The cybersecurity community has long feared that it would take an electronic Pearl Harbor for people to realize the scale of disruptions possible from a concerted attack by terrorists," said S. Shankar Sastry, UC Berkeley professor of electrical engineering and computer sciences and the principal investigator and director of the TRUST center.

The academic partners joining UC Berkeley in this effort are Carnegie Mellon University, Cornell University, Mills College, San Jose State University, Smith College, Stanford University, and Vanderbilt University.

The research will go beyond cybersecurity investigation alone to look at inter-disciplinary collaboration with expertise in economics, public policy, social science, and the human-computer interface. Sastry pointed out that system design to date has not sufficiently accommodated human users and the usability of systems, which are often the weakest link in formation assurance.

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would have immediate feedback from hundreds of students.

In recent decades, information technology has fundamentally changed how people live, work, learn, and interact with one another. This major tectonic force will shape business, education, and economic development well into the future.

Business

For businesses, global IT strategies have resulted in an accompanying economic transformation. Corporations have invested heavily in IT to reduce inefficiencies, accelerate product delivery, and enhance services through automated processes. Information sharing across business units has improved interaction and communication, making it easier for corporations to reposition in existing markets and enter into new markets.

As IT continues to develop as an industry, the resulting technological advancements will make communication, information flow, and business transactions faster, more accurate, and less expensive. Like every successful technology, IT-derived products and technologies will become more efficient, less costly, and maintain worldwide demand.

This presents both challenges and opportunity to the business world. The opportunities are obvious: better and faster communication, more contact with customers, tailored products, and more reliable supply chains. The challenges are often hidden. Technology can help companies in a number of ways, but it can also hurt those who do not take the time to assess which technologies will fit best with their mission. Faster computers don't help a firm that lacks computer-savvy employees. A faster supply chain cannot change the appeal for a product. Better marketing does not change levels of customer satisfaction.

There are fundamental rules of business that cannot be ignored

even further for business. Increased communication means increased access to new markets. Companies can now access markets armed with information about the demographics, culture, tastes, preferences, and disposable income of their potential clients.

Now, through the use of wireless technology, more people, especially those in rural areas, are gaining access to the Internet. These areas now have access to communication and education never before available.

In the near future, the telecom industry will spearhead widespread use of wireless connectivity through handheld devices. The expansion will boost communication to new levels around the globe.

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sibly even countries will be connected through wireless Internet. Announced in February 2005 and expected to be fully functional within two years, Philadelphia plans to turn its entire city into a wireless hot spot. The $10 million project will provide Internet access to 135 square miles of city in an unprecedented undertaking. The money the city expects to save by using the wireless network led officials to believe the project will pay for itself in just four years.

The future of wireless connectivity and its possibilities can only be imagined. At Penn State, the Center for Academic Computing is working with professors to develop interactive classrooms in which the professor can ask the class a question, the students can use their cell phones to text message a response, and the professor (even in a huge lecture hall)

because a new technology comes along. Amazon.com, with its tailored marketing and consumer tracking, has lost some buyers because customer service telephone numbers are difficult if not impossible to find on the site. Employees need to be trained to use a new technology and understand how to employ the vast array of programs available to them.

Ask any professional why IT has helped business and you will hear the same answer: productivity. There is no question that technology has increased productivity by making processes faster, smarter, and easier to manage. What many businesses do not realize is the gains from technology are actually intangible goods. Erik Brynjolfsson from MIT and Lorin Hitt of the Wharton School argue that the underlying effects of implementing technology such as "developing

new software, populating a database, implementing a new business process, acquiring a more highly skilled staff or undergoing a major organizational transformation" are not visible on the financial statements of a company but are intangible assets that increase the value of a firm. Businesses must realize that investment in technology is not to speed up the current way the firm carries out its business; it is the first step in developing a new way to do business.

Brynjolfsson and Hitt also argue that "a combination of investment in technology and changes in organizations and work practices facilitated by these technologies contributes to productivity growth and market value." Technology should be thought of as a tool. The quality and capability of the tool do not matter if it cannot be used in the best way for each

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individual who picks it up. Think of workers on a railroad, each hammering rails into place. When electric machines were developed to hammer nails in faster, was each worker given one and sent back to work? No, of course not. The development of that technology changed the configuration of workers. Technology is a power tool; when it is employed, the structure of the business employing it must also alter.

While IT can affect the internal workings of a business it also has very noticeable applications to external business practices. IT opens up new markets and new opportunities in existing markets. Customization will become the buzzword of industries where it hasn't already taken hold. Through the use of information tracking and online services, business ranging from clothing retailers to

online newspapers and financial services can provide products tailored to their clients' preferences. Companies can use these ties to create a solid consumer base and a strong barrier to entry for those unable to do so. Businesses must overcome this barrier as they attempt to grow market share or develop new products for those outside their customer base.

Education

IT has and will continue to have a major impact on education in terms of how people learn and how educational institutions market themselves. Distance education will create new markets for companies and universities. Advancements in technology and communication speed make education available to anyone with Internet access and provide students with a global network of information to supplement their knowledge and research. MIT was the first major university to offer all of its core courses online, free to any student anywhere in the world with an Internet connection.

Using a system called OpenCourse-Ware, MIT was able to make course materials available for more than 900 of its classes in just two years. The goal is to have 2,000 courses online by 2008, all available for viewing at anytime. The Web site used to access the courses, which requires no entry fee for registration, receives more than 11,000 visitors a day, approximately half of whom are self-learners. MIT is particularly eager to reach educators because of their potential to reach others. More than half of all people using OpenCourseWare are not North Americans, and many hail from rural villages where access to education is limited. In a verification of the program's success, MIT has received requests from other institutions of higher education that are interested in making their courses available as well.

However, there is still a digital divide between those with technology and those who lack access to it. Rural areas of both developed and developing nations are not yet connected to the Internet, a problem that is changing as wireless technology becomes commonplace. The benefit of wireless technology is just that— it is without wires. Set up is faster and less expensive than building a wired network. For example, in South Africa, an initiative has linked five schools together through the Internet, microphones, and virtual whiteboards. Students and teachers can communicate and share information without leaving their own schools. In the United States a similar project links 120 rural communities in Illinois and Iowa.

IT will enlarge the percent of the population with access to education, but it also places pressures on those already traditionally educated. IT requires a degree of education not previously needed for blue-collar manufacturing positions. As IT continues to grow, it will affect the unemployment and wage rates of skilled and unskilled labor. Education-based wage differentials have increased in the past two decades, coinciding with increased workplace computerization. Those differentials will likely become all the more pronounced in the years ahead. Businesses have had to invest in training and retraining their work forces — a trend that recurs every time a major IT innovation is widely adopted. Increasing wages and the relative supply of educated workers supports the belief that IT also improves productivity for skilled workers.

This increase in access to education for rural and developing areas, accompanied by the growing need to re-educate skilled workers, is essentially raising the standard of skill expected from employees in the new millennium.

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Economic development

The results of these changes in business and education have and will continue to influence economic development.

In the United States, IT equipment purchase continues as the largest contributor to industry spending for all types of capital equipment costs. According to the National Science Foundation, industry expenditures on IT hardware and software rose from less than $200 billion in 1993 to more than $600 billion in 2004. While the pace has slowed recently, it is expected to grow again.

IT has without question had an impact on the development of industries and economies around the globe. Economies such as Hong Kong, Singapore, and Taiwan have benefited tremendously from the manufacture and sale of IT products.

By 2015, India will remain in the

forefront of IT development and China will lead the world in IT use. According to *The Economist*, "In 2002, China overtook Japan and Taiwan to become the world's second-largest IT hardware producer after America… China is now the world's biggest IT hardware exporter to America. In 2003, China exported some $130 billion-worth of electronic and IT products, up 41 percent on the previous year. Such products accounted for nearly one-third of total exports. Chinese officials say that output of IT products will triple by 2010."

The impact of IT investment will go well beyond China and India, as important as those countries will be. Latin America's Internet market will grow exponentially as countries deregulate their telecom industries, pursue developing IT markets, and adopt new technologies. Countries such as Argentina, Mexico, and Brazil will present investors with vast opportunities in the telecom industry. The rapid expansion of these information and knowledge flows also has an important social dimension.

The continued spread of IT will enhance cultural and business exchange in a way that will open traditionally closed societies such as China and Saudi Arabia. IT will go further than that too, it will alter intraregional trade patterns affecting the way the world develops relationships and does business.

While the United States maintains its dominant trade position with most of the Middle East, some traditionally closed economies are beginning to open up to each other. Driven by a need for more access to fuel, China has been developing stronger trade relations with the Gulf Cooperation Council. Made up of the United Arab Emirates, Saudi Arabia, Bahrain, Kuwait, Qatar, and Oman, the Council represents six rich Middle Eastern countries, all oil exporters. The volume of trade between China and those six countries rose some 18 percent over the past year, up to $20 billion in 2004.

Furthermore, Chinese companies have been investing in higher risk Arab nations that Western investors still shy away from. In exchange, China has opened up a new market for its exports and its technology.

As governments, investors, and companies expand outside their own countries, cultural exchange will become a part of daily life. Business people must learn how to function in diverse societies with people from around the world, many of whom will
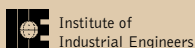
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have very different customs.

Conclusion

Advancements in technology have touched every aspect of our lives, including business, education, and economic development. Governments in the United States and abroad use technology to serve their citizens better and increase their own productivity.

Governments employ management information systems and IT research. According to the NSF, the U.S. Department of the Treasury now collects two-thirds — $1.3 trillion — of its federal revenue electronically. By 1999, the federal government was making 96 percent of salary payments, 81 percent of vendor payments, and 73 percent of benefit payments electronically. This movement from paper to electronic processing of documents and payments has generated cost savings of at least 50 percent. These gains are not limited to the United States, as advanced countries such as Japan and many Western European nations have also scheduled most government administrative services to go online.

As public services adopt IT, they must protect individual privacy and ensure national security. For example, as more countries implement electronic voting, they will need to meet a host of security, privacy, and equity requirements. Internet hacking is now a federal offense in the United States, and it is likely that over time federal regulations and laws will develop to meet new demands imposed by advancements in and the adoption of new information technologies.

Privacy issues are not only important because of Internet hacking but will be the growing focus of attention as an increasing amount of data on individual behavior is collected. Financial services firms know when and where customers spend their money. Many credit card companies even know how their clients spend money, well enough so that they call if an unusual expense is charged to a card. Stores that offer credit lines or frequent shopper cards can track the buying behavior of their clients. Online merchants track not only what their customers buy but what they look at online as well. Nonprofit organizations keep lists of donors, and hospitals record all medical services rendered. Hotels are starting to offer services in which a room will be customized to the desires of its resident, and storing all those preferences in a database. In an effort to increase customer service, information on individual behavior is collected daily. The question then becomes, Who is responsible for this information?

Currently, most American companies regulate themselves. If companies make the choice to stop self-regulation, they will most likely face government-imposed regulation as a concerned and worried public tries to prevent identity and information theft.

As consumers, we must be more

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aware now than ever before about who has our information and how it is being used. Are we prepared to live in a world where, because of the Patriot Act, security cameras, point-of-sale data collection, ATMs, and state-controlled cameras in public places, our movements can literally be tracked hour by hour? As we adopt IT into all aspects of daily life, there are sacrifices to personal privacy that must be made. The choice to make them may still be in the hands of the consumer.

Now and into the future, education, communication, information flows, and business transactions will benefit from advancements in IT. Given the rapid rate of IT uptake by nearly every industry in the world, no company can afford to ignore the trends unfolding in this technological arena. Where IT goes in the future will continue to shape the way society interacts, education reaches people, governments operate, and businesses function. It is now and will continue to be a crucial global tectonic. ❖