The Information Age:
An Anthology on Its Impact and Consequences

Edited by David S. Alberts and Daniel S. Papp

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Preface: Technology and Change in Human Affairs

by Daniel S. Papp and David Alberts

With the fall of communism in Eastern Europe and the dissolution of the Soviet Union, the Cold War ended, and the half-century-old bipolar international system disappeared. These were earthshaking events that rightly received and are receiving extensive study and analysis. They occurred for a host of reasons, many of which were related to the internal political, economic, social, and cultural dynamics of communist states. Several of the more important reasons were the resentment of citizens of communist states toward the institutions and individuals that governed them; a resurgence of nationalism within multinational states; the inability of communist states to transition successfully from centralized political, economic, and administrative structures to more decentralized structures; inadequate economic growth rates and declining standards of living; the inability of communist states to diffuse technical advances throughout productive sectors of society; and over-emphasis on defense spending.1

Even as communist states disintegrated from within, another revolution was accelerating. This quieter revolution, still in its infancy, is a scientific and technological one. It's impact has already been felt, and it promises to change human affairs and the international system as extensively as, perhaps even more extensively than, the collapse of the bipolar international system. The revolution in scientific and technological affairs has many dimensions and has led to a debate about whether scientific-technical advances are changing only the conduct of human affairs and the relationships between present-day international actors, or also the very form and structure of humankind's institutions and international actors themselves.2

Throughout history, advances in information and communication technologies, energy and transportation technologies, biotechnology and life sciences, agriculture and industry, weapons technologies, and other scientific-technical fields have played important roles in driving changes in the ways that men and women conduct their affairs. This has been true in virtually every realm of human endeavor including business and banking, industry and manufacturing, government policy and military affairs, international relations, education and research, social and cultural relations, political affairs, entertainment and news, and elsewhere.3 Given the magnitude of change that the revolution in science and technology has potential to induce, it is vitally important that we understand how this revolution, has changed, is changing and will continue to change our world.

Developing such an understanding is a difficult task. It requires an appreciation and comprehension of the past and present impacts of science and technology on various aspects of the human condition, human endeavors, group and organizational dynamics, and on different types of international actors. It also requires an ability to extrapolate from this foundation with a willingness to engage in informed speculation about the impacts that future advances may have and to develop scenarios of how changes in human activities and international actors may interact to form a new international system.

This book undertakes this task for one major category of scientific and technical advances, information and communication technologies. It is based on historical fact, reasoned speculation about future trends in information and communication technologies, and informed analysis about the impacts that those trends might have on human affairs and the international system as we move into the Information Age. This is the first volume in a two volume set that will lay the foundation for understanding the ways that the Information Age is changing our environment and the institutions upon which we depend for our liberty, health, and happiness.

In this first volume, we will examine some of the broader issues of the Information Age: what the Information Age is; how it affects commerce, business, and service; what it means for the government and the military; and how it affects international actors and the international system. Not everyone will agree with the viewpoints presented here, but that is as it should be; the purpose of this volume—and its successor—is more to generate thoughtful debate and discussion than to provide definitive answers. In the second volume, we will examine in more detailed terms the meaning of the Information Age for the U.S. military. It must be stressed, however, that the two volumes go hand-in-hand; the U.S. military is an imbedded system, imbedded in the environment in which it must operate.

Challenges of the Information Age

Complexity and change are the two defining characteristics of the Information Age. Our successes as individuals, families, organizations, communities, and societies will depend more than ever upon our abilities to adapt, in near real time, to deal with increasingly complex and dynamic situations which will be characteristic of the Information Age.

Each of us, individually and institutionally, has developed mechanisms to either shield us from or deal with complexity and change. Sometimes these mechanisms work too well. That is, they prevent us from sensing how much our worlds are changing, thus robbing us of an opportunity to understand our environment and appropriately modify old responses or develop new responses. The results are often catastrophic; we break rather than bend. History is replete with examples of changed environments that were recognized too late for an institution to successfully adapt. Similarly, history also has many examples of changed environments that were recognized, but by institutions or societies that were themselves unwilling or unable to adapt to new conditions.

The Information Age is and will continue to present us with these kinds of challenges at an alarming rate. The increasing complexity of our environment and the actions necessary to maintain or improve our equilibrium will only serve to make these challenges even more difficult. Successfully responding to these challenges will require three things. First, we will need to recognize that something has changed. Second, we will need to understand the implications of this change. Third, we will need to develop timely and effective responses.

In certain segments of society, most of which are associated with business and commerce, a Darwinian process is at work that rewards the agile and helps ensure that organizations are responsive to their environments. For this process to work well, one needs an active competitive market in which offerings are judged and feedback is supplied continuously. A certain amount of collateral damage is associated with this. If the resulting level of damage is not acceptable, mechanisms are usually put in place to limit marketplace behavior, which in turn reduces rewards and lowers incentives for change.

This Darwinian option is not suitable for changing the behavior of government bureaucracies, especially those entrusted with providing for the common defense. In this case, we have an abiding interest in the survival and continuous functioning and readiness of these organizations. We do not want to adopt a strategy that requires failure to achieve success.

Making our government institutions, and especially those entrusted with providing for our national security, better able to effectively deal with increased complexity and be more responsive to changes in their environment requires, in some cases, immense organizational change. This will not be an easy task, for organizational change will require alterations in the very culture of these institutions. In the final analysis, altering culture means changing behavior, and this demands providing both incentives and tools.

While the rigors of the marketplace provide incentives for business firms, firms that have succeeded have somehow discovered the secret of passing incentives to their employees while providing them with the knowledge and support they need to efficiently turn knowledge into action. Firms whose organizational arrangements and processes distort incentives or fail to empower employees tend to be less successful. Since relatively few organizations endure, some might argue that success is more the result of the right organization with the right product at the right time than the result of an agile organization that has adapted to changing circumstances.

However, the fact is that organizations can adapt if conditions are right. Each of the three necessary ingredients of success—recognizing a changed situation, understanding its implications, and developing a timely and appropriate response— requires an understanding, in the case at hand, of the Information Age and how it is affecting people and organizations. To reiterate, then, the purpose of this volume is to stimulate thinking about how the Information Age is changing our environment so that our national security institutions, in turn, will be able to perform their functions well as the Information Age progresses.

Assessing the Technology/Society Relationship

Assessing the future impacts of a technology or a group of technologies on even a single relatively homogeneous society is a daunting task. Seeking to assess future impacts of these technologies on human interactions and institutions and on international actors and the international system is therefore a task of exponentially greater complexity and difficulty. This is because there are five major types of international actors (states, multinational corporations, international governmental organizations, non-governmental organizations, and individuals) and a large number of sub-national, national, and transnational value systems and cultures, each of which may be profoundly affected in terms of theiir capabilities and constraints.

Before we attempt this complex task, however, it will be useful to discuss the basic relationship that underlies this study, the relationship between technology and society. There are three different primary views of this relationship.

The first asserts that technology causes change in society, with society having a minimal influence on technology. The second reverses the causality of the relationship, maintaining that society and its values drive technology in certain directions and that technology is therefore subservient to society and its values. The third argues that the relationship between technology and society is intricate and complex, and that in given situations and circumstances, either can influence the other to move in a different direction. These three relationships are depicted respectively in Figure 1.

Emmanuel Mesthene and Langdon Winner are leading proponents of the first view. Mesthene calls his perspective "soft determinism" and maintains that technical advances create opportunities to achieve objectives. He asserts that these opportunities force change in social organization so that the new technology can be used to pursue the now-attainable objective. This leads to changed functions of existing social structures, which in turn reduce the ability of old social structures to achieve previous objectives.4

Winner further refines this perspective, adding the concepts of "the technological imperative," which asserts that technical decisions dominate the structure of modern human society, and "reverse adaptation," which argues that the objectives for which technical advances are employed often are relegated to second level priorities, with the primary priority becoming maintaining the functioning of the technology itself.5 In either event, Mesthene and Winner agree, technology drives social change.

Without denying that technology plays an important role in inducing societal change, Lynn White and others reverse the relationship, arguing that society and its values play the dominant role in determining directions that technologies will takes. For example, on a macro-level, White posits that the emergence of a Judeo-Christian belief and value structure in Europe was the dominant factor in permitting and accelerating the emergence of technologically oriented societies there. White maintains that since Judeo-Christian teachings drew a clear distinction between human beings and nature and argued that only human beings have spirits, a mind-set developed in Europe that nature was the tool of humankind. On a micro-level, White also points out that the values and structures of different societies often define what is technologically desirable and sometimes even what is technologically permissible, witness the current debate on genetic engineering. Often, effort and funding follow desire and permission.6 Again, however, the key argument in this second perspective is that society directs technology.

A third perspective is that technology plays a significant role in shaping the political, economic, social, and cultural milieu of human society, and that those milieus in turn play a significant role in shaping technology and how technological advances are employed by society. Max Weber and E.F. Schumacher are leading proponents of this perspective,7 which has been termed "mutual causality" by other observers who argue that this view is "not very comforting" because it "displays the full range of the potential complexity of our technological society."8

These same observers also maintain that the third perspective is "the safest point from which to view the technology-society interaction" because, unlike the first two perspectives, it is not a limiting case "where one or the other type of causal influence is dominant."9 Since the editors of this volume believe that this third perspective is the most accurate reflection of the present-day relationship between technology and society, this study proceeds from this perspective.

What does this mean for the impact of information and communication technologies on humankind's activities and institutions and on international affairs? A brief historical perspective may provide insight.

Twice in the twentieth century, the collapse of an international system has coincided with the coming of age of significant new technologies. Both times, the emerging technologies played a significant role in shaping and molding the new international system. We are witnessing the third time this century that such a phenomenon has unfolded.10

The first time this phenomenon occurred was during World War I, when for the first time the internal combustion engine was widely used in warfare. Trucks, planes, and tanks played major roles in the "War to End All Wars," which both brought to an end the old European balance of power system and moved much of the world into an era of "collective security." Throughout the interwar period, even though the collective security system codified in the League of Nations proved unable to assure the peace, transportation systems powered by the internal combustion engine helped make the world a smaller and more intimate place than it had ever been before.

Similarly, World War II, the most violent and destructive war in human history, ended with the use of the most destructive weapon ever used in warfare, the atomic bomb. Not coincidentally, nuclear weapons and nuclear technologies played a major role in structuring and shaping the post World War II bipolar system and the uneasy equilibrium based upon mutual assured destruction.

In the present time, a new set of advanced information and communication technologies began to emerge even as the old international system weakened. Indeed, some analysts argue that the new technologies contributed directly to the bipolar system's eventual collapse, as will be seen later in this volume. But regardless of the accuracy of these claims, it is evident that new advanced information and communication technologies will have a significant impact in shaping and molding humankind's activities and institutions. They undoubtedly will have an impact on the structure and activities of international actors and the emerging international system as well.

Conceptual Overview of the Volume

What will those impacts be? It is the purpose of this book to help answer that question. It approaches the question in a straightforward manner.

Part One, "The Information and Communication Revolution," sets the stage. It first argues that three modern information and communication revolutions have occurred during the last century and a half, and presents an overview of the historical impacts that the information and communication technologies developed during the first two revolutions have had on humankind's activities and institutions, and on international affairs and on the international system. It next identifies and analyzes several of the more important information and communication technologies that are part of the present information and communication revolution. Then, it provides different views on the debate about whether the changes that are occurring and may be expected to occur are significant enough to be deemed a revolution. It also presents several cautionary notes about issues that are arising out of the Information Age.

Parts Two and Three, "Business, Commerce, and Services," and "Government and the Military," examine the impacts that the technologies of the third modern information and communication revolution are having and are likely to have on specific areas of human interactions. Areas of inquiry include the impact of new information and communication technologies on business, commerce, services, the government, and the military. The objective of Parts Two and Three is to assess the impacts that the technological advances identified in Part One are having and are likely to have on specific areas of human interaction over the next twenty years.

In Part Four, "International Affairs," projections are developed about the ways that the information and communication technologies identified earlier are being and might be assimilated and diffused by different state and non-state actors. Part Four also presents views about the ways in which international actors and the international system are changing and may most likely change as a result of advances in information and communication technologies.

For the convenience of the reader, Parts One through Four are published in four separate volumes, which are not to be confused with the forthcoming Volume II of the overall anthology.

This anthology does not attempt to present an exhaustive analysis of present and potential impacts of the ongoing information and communication revolution. Rather, it seeks to discuss the more prominent impacts, thereby helping readers think beyond the conceptual boxes formed by present-day limitations of information and communication technologies.

Notes

1. For discussions of what led to the collapse of the Soviet Union, see for example Stephen White et al., The Politics of Transition: Shaping a Post-Soviet Future (New

York, NY: Cambridge University Press, 1993); and Walter Laqueur, The Dream That Failed: Reflections on the Soviet Union (New York: Oxford University Press, 1994).

2. See James N. Rosenau, Turbulence in World Politics: A Theory of Change and Continuity (Princeton: Princeton University Press, 1990), which argues that technology is a primary driving force behind a fundamental transformation in the international system that has occurred; Eugene B. Skolnikoff, The Elusive Transformation: Science, Technology, and the Evolution of International Politics (Princeton, NJ: Princeton University Press), which asserts that technology is a driving force behind change, but no fundamental change has occurred in the international system; and Dennis Pirages, Global Technopolitics: The International Politics of Technology and Resources (Pacific Grove, CA: Brooks-Cole, 1989), which posits that the world is entering a third era of technology-driven international change, the first two of which were the agricultural and industrial revolutions. However, Pirages argues the dimensions of the third are not yet clear.

3. See for example Paul Kennedy, The Rise and Fall of the Great Powers: Economic Change and Military Conflict from 1500 to 2000 (New York: Random House, 1987); Lewis Mumford, Technics and Civilization (New York, NY: Harcourt, Brace, 1934); and Eugene B. Skolnikoff, Science, Technology, and American Foreign Policy (Cambridge, MA: MIT Press, 1967), as well as the three books listed in Note 2.

4. Emmanuel G. Mesthene, "How Technology Will Shape the Future," Science (July 12, 1968), pp. 135-143.

5. Langdon Winner, Autonomous Technology (Cambridge, MA: MIT Press, 1977), passim.

6. Lynn White, Jr., Medieval Technology and Social Change (New York, NY: Oxford University Press, 1966), passim. See also Willis Harman, An Incomplete Guide to the Future (San Francisco, CA: San Francisco Book Company, 1976), which argues that the values and beliefs that underlie industrial society are eroding, and that this will have a significant impact on future technological directions.

7. See for example Max Weber; and E.F. Schumacher, Small Is Beautiful: Economics As If People Mattered (New York, NY: Harper Torchbooks, 1973), passim.

8. Alan L. Porter, et. al., A Guidebook for Technology Assessment and Impact Analysis (New York, NY: North Holland, 1980), p. 23.

9. Ibid.

10. In the first two cases, the new technologies did not cause the collapse of the preceding system. In the third case, as will be seen later in this volume, it is possible to argue that the new technologies contributed to the collapse of the preceding international system.

Part One – The Information and Communication Revolution

Introduction

The Information Age. That is what many pundits, writers, and analysts have already labeled these concluding years of the twentieth century and the beginning of the twenty-first century. This characterization of our time is based on the widespread proliferation of emerging information and communication technologies and the capabilities that those technologies provide and will provide humankind to overcome the barriers imposed on communications by time, distance, and location and the limits and constraints inherent in human capacities to process information and make decisions. Advocates of the concept of the Information Age maintain that we have embarked on a journey in which information and communications will become the dominant forces in defining and shaping human actions, interactions, activities, and institutions.

They may be right. But often, promoters of the Information Age give little attention to significant issues and concerns that arise out of their favorite concept. Is the Information Age truly already upon us? Just what is meant by the Information Age? How does the information and communication revolution fit within the broader sweep of human history, or is it indeed such a significant departure for humankind that past history has little relevance? What are the technologies of the information and communication revolution? What do they do and what will they do? Is it really a revolution, and are we really entering an Information Age? Will the capabilities of emerging information and communication technologies lead to greater connectivity and commonality of perception, or will they result in greater isolation and fragmentation? These are some of the major issues explored in Part One of this anthology, designed to set the stage for later discussion and analysis.

In the first article, "Welcome to the Revolution," Thomas A. Stewart begins by stating that the word "revolution" should not be used cheaply. Nevertheless, Stewart asserts, we are in fact already in the midst of a revolution induced by emerging information and communication technologies. Concentrating on the impacts that those technologies are having in the business world, Stewart explains how knowledge technol-ogies are altering the cost/benefit equation for competing organizational arrangements. He concludes that the Information Age is placing a premium on "the ability to adjust and learn" that applies both to individuals and organizations.

Daniel S. Papp, David S. Alberts, and Alissa Tuyahov next place the present information and communication revolution in historical perspective in their article, "Historical Impacts of Information Technologies: An Overview." The authors argue that two information and communication revolutions have already occurred during the last century and a half, and that we are now in the beginning phases of a third. They examine the development of several of the more critical technologies of the first two revolutions, and present an overview of the historical impacts that those technologies have had on humankind's activities and institutions, and on international affairs and on the international system. Although these authors clearly accept the argument that a new information and communication revolution is at hand, they also see the third modern information and communication revolution as part of a continuing process that dates back at least a century and a half.

David S. Alberts, Daniel S. Papp, and W. Thomas Kemp III next identify and analyze several of the more important information and communication technologies that are part of the third modern information and communication revolution in their article, "The Technologies of the Current Information Revolution." The authors maintain that these technologies will have six major types of impacts on information flows and communications: increased speed, greater capacity, enhanced flexibility, greater access, more types of messages, and heightened demand.

But does all of this really mean that a revolution is taking place and that an Information Age is upon us? Without challenging the validity of any of the historical or technological facts previously presented, Frank Webster in "What Information Society?" asks us to be cautious in leaping to conclusions about an information and communication revolution and an Information Age. Observing that there are immense difficulties in measuring what is meant by an Information Age, Webster warns that information by itself means nothing, and that we must take into consideration the meaning and quality of information, not just its quantity. Finally, Webster asks, even with the proliferation of new and emerging information and communication technologies, has society in fact changed profoundly enough to warrant calling the present—or the near term future—an Information Age?

There are also other cautionary notes that must be sounded about the Information Age. Andrew Kupfer explores one of them in "Alone Together: Will Being Wired Set Us Free?" Kupfer agrees that emerging information and communication technologies will inevitably have an immense and even revolutionary impact on the way people live their lives, but points out that along with the advantages of global connectivity come certain disadvantages, even dangers. We may be able to access more information, but will we know the quality of that information? We may be able to know more people, but how deep will friendships be in a wired world? We may be able to let our family and friends know where we are all of the time, but will we be able to restrict knowledge of our activities only to those whom we wish to have it?

Joel Achenbach takes Kupfer's first concern, uncertainty about the quality of information that may be available in the Information Age, and examines it in his article "Reality Check." "There is one nagging problem," Achenbach laments about the Information Age, "Much of the information is not true." He then lays out seven different types of "Bad Information" that he contends we must be concerned about—obvious but wrong information, information censored for your own good, accurate but untrue information, millennial information, diagnostic information, statistical information, and historical information. The chief problem in the Information Age, the author theorizes, will be how to distinguish Good Information from Bad Information. Achenbach is less helpful in telling us how to make such an identification. Borrowing the dictum from "The X-Files," he warns simply that when it comes to information, "Trust No One."

The questions raised and issues posed in these first six articles are portentous ones for the Information Age. Over time—barring a Luddite resurgence—all of us will have to face them. But in a certain sense, we are fortunate. Since we now are only at the dawn of the Information Age, we may have a small window of time during which we can look for answers before the full impact of the Information Age is upon us. The time to begin examining these questions and issues is now. Part One of this anthology hopes to help initiate that process, and to help move our thinking toward responding to these questions and issues.

Chapter 1: Welcome to the Revolution*

by Thomas A. Stewart

Let us not use the word cheaply. Revolution, says Webster's, is "a sudden, radical, or complete change...a basic reorientation." To anyone in the world of business, that sounds about right. We all sense that the changes surrounding us are not mere trends but the workings of large, unruly forces: the globalization of markets; the spread of information technology and computer networks; the dismantling of hierarchy, the structure that has essentially organized work since the mid-nineteenth century. Growing up around these is a new, Information-Age economy, whose fundamental sources of wealth are knowledge and communication rather than natural resources and physical labor.

Each of these transformations is a no-fooling business revolution. Yet all are happening at the same time—and fast. They cause one another and affect one another. As they feed on one another, they nourish a feeling that business and society are in the midst of a revolution comparable in scale and consequence to the Industrial Revolution. Asks George Bennett, chairman of the Symmetrix consulting firm: "If two percent of the population can grow all the food we eat, what if another two percent can manufacture all the refrigerators and other things we need?"

Good question. The parking lot of General Electric's appliance factory in Louisville, Kentucky, was built in 1953 to hold 25,000 cars. Today's workforce is 10,000. In 1985, 406,000 people worked for IBM, which made profits of $6.6 billion. A third of the people, and all of the profits, are gone now. Automaker Volkswagen says it needs just two-thirds of its present workforce. Procter & Gamble, with sales rising, is dismissing 12 percent of its employees. Manufacturing is not alone in downsizing: Cigna Reinsurance, an arm of the Philadelphia giant, has trimmed its workforce 25 percent since 1990.

Change means opportunity as well as danger, in the same way that the Industrial Revolution, while it wrought havoc in the countryside and in the swelling town, brought undreamed of prosperity. No one can say for certain what new ways of working and prospering this revolution will create; in a revolution the only surety is surprise.

The transition may be difficult. As Neal Soss, chief economist for C.S. First Boston, puts it: "Adjustment is the dismal part of the dismal science." And, as Robespierre might have observed on his way to the guillotine, this time it's personal—for the inescapable tumult involves your company and your career. The paragraphs and stories that follow explain the causes and consequences of this era of radical change—and introduce some business leaders who are meeting the challenges it poses.

General Electric Lighting is an ancient business, begun in 1878. It is headquartered in Cleveland on a leafy campus of brick Georgian buildings separated by placid lawns. Like sin into Eden, the world burst through the gates in 1983, when traditional rival Westinghouse sold its lamp operations to Philips Electronics of Holland. To John Opie, GE Lighting's chief, the memory is so vivid that he describes it in the present tense:

"Suddenly we have bigger, stronger competition. They're coming to our market, but we're not in theirs. So we're on the defensive."

Not for long: GE's 1990 acquisition of Hungarian lighting company Tungsram was the first big move by a Western company in Eastern Europe. Now, after buying Thorn EMI in Britain in 1991, GE has 18 percent of Europe's lighting market and is moving into Asia via a joint venture with Hitachi. As recently as 1988, GE Lighting got less than 20 percent of its sales from outside the U.S. This year, Opie says, more than 40 percent of sales will come from abroad; by 1996, more than half will. In a few short years, Opie's world changed utterly.

What happened at GE Lighting illustrates the surprises and paradoxes of globalization. Surprise: Globalization isn't old hat. Global competition has accelerated sharply in just the past few years. The market value of U.S. direct investment abroad rose 35 percent, to $776 billion, from 1987 to 1992, while the value of foreign direct investment in America more than doubled, to $692 billion.

You ain't seen nothin' yet. The extraordinary rise in overseas telephone traffic may best gauge how much more often people in different nations feel they have something urgent to say to one another—a good deal of it coordinating business activity. First Boston's Neal Soss points out that in the past five years or so the commercial world has been swelled by the former Soviet empire, China, India, Indonesia, and much of Latin America—billions of people stepping out from behind political and economic walls. This is the most dramatic change in the geography of capitalism in history.

Paradox: Though it's hard to imagine a more macroeconomic subject, globalization is intensely parochial. Globalization's strongest effects are on companies. Says Anant Sundaram, professor at Dartmouth's Tuck School of business: "Statistics at the macro level grossly underestimate globalization's presence and impact." For example, Chrysler got just 7 percent of sales from outside the U.S. and Canada in 1992, but in the 1980s global competition nearly killed it.

Investment numbers also reveal too little, for they do not count minority ownership or alliances—or the impact of competition originating abroad. Notes Frederick Kovac, vice president for planning at Goodyear, whose products can be found on all seven continents and the moon: "The major strategic decisions of our biggest competitors are made in France and Japan." Sales by overseas subsidiaries of American corporations are about three times greater than the value of all U.S. exports. Thus a lot of commerce that looks domestic to an economist—such as the Stouffer's frozen dinner you bought last week—looks international to a chief financial officer, in this case Nestle's.

This makes for a profound change, Mr. CFO, in your job. Some observers argue that it is time you forget about the business cycle, or at least pay a lot less mind to it. Says Gail Fosler, chief economist of the Conference Board: "It's every industry on its own. When I talk to companies, it's very difficult to describe a business environment that's true for everybody." For example, she argues, as Fortune's economists also hold, that capital spending "is no longer driven by business cycle considerations but by global competition." If the world is your oyster, an oyster is your whole world.

Horace "Woody" Brock, president of Strategic Economic Decisions, an advisory firm in California, agrees. He says a nation's economy should be viewed as a portfolio of businesses whose fates are less and less linked: "What happens in the U.S. copper industry may be caused by shocks in Africa, and will have no effect on Silicon Valley. Silicon Valley may drive events in Japan's electronics industry, but these in turn will be uncorrelated with the auto industry in either Japan or Detroit." Look at Seattle, Brock says, where two great technology companies, Boeing and Microsoft, operate side-by-side, one sagging, one booming—"utterly out of sync."

For a nation, the net effect should be more stability, with long odds against all sectors booming or busting together. For individual businesses, however, it's a different story. Says Brock: "If your competitor in Germany does something, you react immediately—you don't wait for interest rates or recovery or anything else."

Fortunately, the revolution in information technology is creating tools that permit just such agility.

Robert Immerman is the founder of InterDesign, a private company in Solon, Ohio, with annual sales above $10 million. InterDesign sells plastic clocks, refrigerator magnets, soap dishes, and the like. Wal-Mart, Kmart, and Target are customers, as are hundreds of houseware stores.

There's not a high-tech item among its products, but computers have changed the business. In the past twelve years, InterDesign's employment has tripled, total space has quintupled, and sales have octupled, but its megabytes of computer memory have gone up thirty-fold. Seven years ago Immerman dug deep and found $10,000 to buy a used disk drive that had 288 megabytes of storage—capacity that costs about $350 today. Says Immerman: "In the 1970s we went to the Post Office to pick up our orders. In the early 1980s we put in an 800 number. Late 1980s, we got a fax machine. In 1991, pressured first by Target, we added electronic data interchange."

Now, just two years later, more than half of InterDesign's orders arrive via modem straight into company computers. Errors in order entry and shipping have all but disappeared. Immerman says: "We had fifty weeks perfect with a big chain. Then one week we missed part of the order for one item on a long list—and they're on the phone wondering what's wrong." Staffers who used to man phones taking orders now track sales by product, color, customer, region—valuable information that Immerman once couldn't afford to collect.

InterDesign's story is typical. In Alcoa's Davenport, Iowa, factory, which rolls aluminum foil, sheet, and plate, a computer stands at every work post to control machinery or communicate data about schedules and production. Practically every package deliverer, bank teller, retail clerk, telephone operator, and bill collector in America works with a computer. Microchips have invaded automobiles and clothes dryers. Three out of ten American homes have a PC.

The revolution begins when these computers hook up to one another. Already two out of five computers in the U.S. are part of a network —mostly intracompany nets, but more and more are crossing company lines, just as InterDesign's electronic data interchange does. Data traffic over phone wires is growing 30 percent a year, says Danielle Danese, a telecommunications analyst at Salomon Brothers. Traffic on the global Internet doubles every year.

The potential for information sharing is almost unimaginable. On the wall of every classroom, dorm room, and office at Case Western Reserve University is a box containing a phone jack, coaxial cable, and four fiber-optic lines. Through that box students could suck down the entire contents of the Library of Congress in less than a minute, if the library were on-line and they had room to store it.

For years CEOs and economists lamented that billions invested in information technology had returned little to productivity. That dirge is done. Says William Wheeler, a consultant at Coopers & Lybrand: "For the first time the computer is an enabler of productivity improvement rather than a cause of lack of productivity." Instantaneous, cross-functional communication about orders and scheduling enabled M.A. Hanna, the $1.3-billion-in-annual-sales polymer maker, to speed production, reduce inventory, and cut waste so much that the company needs a third less working capital to get a dollar of sales than it did four years ago. CEO Martin D. Walker notes that this gain came entirely within the four walls of the company; he estimates that an equal gain in working capital turnover is waiting to be found by networking with suppliers and customers.

Efficiency is a first-order effect of new technology: That's how you justify the capital expenditure. The second-order effects are more interesting, because they are unpredicted. One disorienting result of the spread of computer nets has been the transformation of sales, marketing, and distribution. To see the change, says Fred Wiersema, a consultant at CSC Index in Cambridge, Massachusetts, dig a ten-year-old marketing plan out of the file and compare it with a new one: "The distribution channel is a mess. Customers have much more power. There's fragmentation in media and advertising. The activities of the sales force are completely different."

The next trend, says William Bluestein, director of computing strategy research for Forrester Research, a Massachusetts firm: "Companies that empower their customers." Soon, pursuing cost savings, suppliers and customers will be able to rummage around in each other's computers, entering orders directly, checking stock and shipping status. One vehicle manufacturer can already go into Goodyear's system. Says strategist Kovac: "There will be a day in the not-distant future when customers will get data on the tests of a new tire as soon as our engineers do. They'll see everything—warts and all."

From there it's a short step before customers start comparing notes—maybe on your network. Says Bluestein: "If I were Ralph Nader, I'd set up a consumer chat line so someone who was thinking of buying a Saturn could ask people who have one how they like it. If GM were smart, they'd do it themselves."

Like globalization, information technology vastly extends a company's reach—but has the paradoxical effect of rewarding intimacy. Computers enormously increase the amount of information a company can have about its market—but deliver premium returns less to careful planning than to quick responses to changing circumstances. Both phenomena have powerful implications for the way work is organized.

In 1958 Harvard Business Review published an article called "Management in the 1980s" by Harold J. Leavitt and Thomas L. Whisler, professors at the Carnegie Institute of Technology and the University of Chicago. It predicted that the computer would do to middle management what the Black Death did to 14th-century Europeans. So it has: If you're middle management and still have a job, don't enter your boss's office alone. Says GE Lighting's John Opie: "There are just two people between me and a salesman—information technology replaced the rest."

Leavitt and Whisler, knowing only mainframes, foresaw an Orwellian workplace in which the surviving middle managers were tightly controlled from on high, little different from the proles they bossed. In a world of expensive, centralized computing, it might have happened that way. But distributed computing redistributes power. Says Goodyear's Kovac: "It used to be, if you wanted information, you had to go up, over, and down through the organization. Now you just tap in. Everybody can know as much about the company as the chairman of the board. That's what broke down the hierarchy. It's not why we bought computers, but it's what they did."

The management revolution has many fathers, some more venerable than the computer; self-managed teams and total quality management have intellectual roots reaching back half a century. Why, then, does it seem as if the mores and structures of management are undergoing discontinuous change? Is this really new? Or are we deluding ourselves, the way each generation of teenagers thinks it discovered sex?

The evidence suggests a basic shift in the organization of work. Look first at the ubiquity of change. No longer is the management revolution confined to the same dozen trendsetting companies, the GEs, Motorolas, and Xeroxes. Says Stephen Gage, president of the Cleveland Advanced Manufacturing Program, a federally subsidized organization that helps small business apply new technology: "I doubt if there's a company around here that isn't experimenting with something having to do with dismantling Taylorism."

Equally striking, leading companies now envision an endlessly changing organizational design. Kovac says: "The key term is 'reconfigurable.' We want an organization that's reconfigurable on an annual, monthly, weekly, daily, even hourly basis. Immutable systems are dinosaurs." To make this sort of agility possible, leaders are honing such techniques as rapid product development, flexible production systems, and team-based incentives.

At bottom, the management revolution triumphs because the underlying economics of communication and control have changed, and those changes favor small, flexible organizations, not big ones. The argument, developed by microeconomists influenced by Berkeley's Oliver Williamson (and here oversimplified), goes like this:

A transaction can be accomplished in one of two basic ways: You can go out and buy something from someone else, or you can produce it yourself. (Yes, there are hybrid forms, but remember that we're oversimplifying.) Call the first system a market and the second a hierarchy. Vertically integrated businesses, in which transactions take place between divisions, each with its own organizational ziggurat, are hierarchies. Each system has its advantages. Markets generally deliver the lowest price, because of competition. But hierarchies usually have lower coordinating costs—such as for salesmen, advertising, or debt collection. Depending on how those costs and benefits line up, a given industry will tend to be more or less vertically integrated, feature larger or smaller companies, and display a bureaucratic or entrepreneurial management style.

Now buy a computer. The costs change. In particular, hierarchies begin to lose their comparative advantage in coordinating costs. Invoicing is automated, decimating armies of clerks. Electronic order-entry cuts selling costs. Says Thomas W. Malone, professor at the Sloan School of Management at MIT: "Coordinating activities are information-intensive, and computers make coordinating better and cheaper." The result, Malone argues, is to increase the range of transactions in which markets are more desirable. Result: More companies decide to buy what they once produced in-house.

The nice thing about this argument is that it checks out. Big companies are breaking up; outsourcing is on the rise. According to Roy Smith, vice president of Microelectronics & Computer Technology Corp., three out of ten large U.S. industrial companies outsource more than half their manufacturing.

Businesses are more tightly focused: Conference Board figures show that between 1979 and 1991 the number of three-digit standard industrial classifications (SIC codes) in which an average U.S. manufacturer does business dropped from 4.35 to 2.12. Companies are also smaller: Census data show that the number of employees at the average U.S. workplace is 8 percent lower than it was in 1980. Combining those figures with data on spending for information technology, MIT's Malone and several colleagues found the shrinkage is greatest in industries where IT spending is highest. Smaller payrolls are not simply the result of automation, for gross shipments and value-added also decline. The strong implication: In an Information-Age business, small is beautiful.

Of the four horsemen of revolutionary change, the hardest to grasp is the invention of an Information-Age economy. How can a whole economy be based on intangible knowledge and communication? Yet intellectual capital—knowledge that can be captured and deployed to create advantage over competitors—is as vital a business concern as capital of the familiar monetary sort. Intellectual labor, too, is where the action is, a fact demonstrated by the widening gap between the pay of college-educated workers and those less schooled.

Though knowledge assets and outputs are intangible, they are no less real for being so. It is possible to track the "intellectual content" of the economy. In 1991, business investment in computers and telecommunications equipment —tools of the new economy that create, sort, store, and ship knowledge—for the first time exceeded capital spending for industrial, construction, and other "old economy" equipment. The figures, while impressive, understate investment in knowledge machines because they do not show the growing intellectual ability of industrial gear. For example, more than half of machine-tool spending in the U.S. is for equipment with built-in computer numerical controls that, often, can be connected to networks. Says Jodie Glore, vice president of the automation group at industrial-controls powerhouse Allen-Bradley: "The electromechanical boxes we used to sell had a macho feel. You could tell that they cost a lot. Now it's, 'You see this disk...?'"

The new economy will transform the old and reduce its relative importance, but will not kill it. The Industrial Revolution did not end agriculture, because we still have to eat, and the Information Revolution will not end industry, because we still need cans to hold beer. Microsoft Chairman Bill Gates, up to now the preeminent capitalist of the knowledge age, spends his money on a big house and fancy cars, tangible stuff indeed.

The first effect of intellectual capital and knowledge work is to alter the economics of familiar goods and services—a process well under way. For example, in the now misnamed "industrialized" world, the amount of energy needed to produce a given amount of GDP has fallen 2 percent a year, compounded, for more than 20 years. Factory labor is less physically demanding: Gone the heroic workman, a WPA mural in living flesh, ruddy in the glow of the blast furnace; now she's likely to be a middle-aged mom, sitting in front of a screen, who attends night school to study statistical process control. Many auto repairs will soon be made not by a grease monkey with a wrench but by a technician who fixes an engine knock by reprogramming a microchip.

As the usefulness of information, information technology, and information work grows, businesses find more ways to substitute them for expensive investments in physical assets, such as factories, warehouses, and inventories. By using high-speed data communications networks to track production, stock, and orders, GE Lighting has closed 26 of 34 U.S. warehouses since 1987 and replaced 25 customer service centers with one new, high-tech center. In effect, those buildings and stockpiles—physical assets—have been replaced by networks and databases—intellectual assets. Similarly, the cost of establishing a retail bank branch has shrunk: You can find one inside the door of the supermarket, next to the Coke machine. Especially in the Christmas shopping season, each day's mail brings you a stack of department stores. For the right products, catalogue retailers will migrate to computer or television networks. Rent in cyberspace is even cheaper than catalogue space, and much lower than rent at the mall.

The shift to the information economy, like globalization, computerization, and the management revolution, appears first as a way of doing old jobs more cheaply. For those on efficiency's receiving end, it is a threat. But the drive for efficiency has also paid to string 12 million miles of optical fiber in the U.S., and, long before any couch potato has ordered up video-on-demand, efficiency will pay for a lot more construction of the electronic superhighway, the infrastructure of the information economy.

That endeavor, says Paul Saffo, an analyst at the Institute for the Future in Menlo Park, California, "is a full-employment act for entrepreneurs." Compared with trade in traditional goods and services, commerce in knowledge is startup heaven. Entry barriers are low. Distribution and marketing of information need little capital; they don't even require access to a printing press anymore. Many products and services can be distributed electronically.

The second-order effect of change, opportunity, is the unpredictable one. Gottlieb Daimler, Ransom Olds, and their pals thought they had invented an improvement on the horse. They did not know that the automobile would fill the countryside with suburbs—which, in turn, created thousands of jobs building houses, making lawnmowers, and delivering pizza. The knowledge economy is still so young that we have few hints of its second-order effects, in the view of Richard Collin, who studies the subject as director of Neurope Lab, a think tank in Archamps, France, near Geneva. Says Collin: "Today we are thinking in terms of using knowledge to improve productivity in our old businesses—how to do the same with less. Tomorrow we will think of competition—how to do more in new businesses."

It makes sense that the core business of the knowledge economy will be...knowledge. Information, like electricity, does nothing unless it is harnessed in useful devices, like appliances. All kinds of appliance makers—writers of software, creators of databases—are beginning to fill the Information-Age business directory.

The most valuable devices will be those that help business and people cope with change. Says consultant Fred Wiersema: "Management today has to think like a fighter pilot. When things move so fast you can't always make the right decision—so you have to learn to adjust, to correct more quickly." The same imperative holds for individuals. Says Kovac: "Today the job is You Inc. When I came to Goodyear in 1958, my chances of promotion were one in eight. For a young person today, they are one in 30, and it's going to one in 50. But I think my children and grandchildren will have more opportunities than I did. They'll just be different."

For Dustin Hoffman, as "The Graduate" in 1967, the future was plastics. Today you might say it's plasticity: the ability to adjust and learn.

Chapter 2: Historical Impacts of Information Technologies: An Overview

by Daniel S. Papp, David S. Alberts, and Alissa Tuyahov

Throughout recorded history, human beings have needed to communicate and to exchange information. The reasons behind this need have been and remain diverse—to sound alarms, to provide for common needs, to establish a sense of community and human empathy, to deliver information and news, and so on. In many respects, civilization is based on humankind's need—and ability—to communicate and to exchange information.

However, these abilities have always been complicated by distance, time, or location.1 People could signal or talk directly to each other, but not over great distances. An individual could reduce the distance between himself and the person with whom he or she wished to communicate, but reducing distance took time, and sometimes time was not available. On occasion, the location of either the individual who wished to communicate or the person to whom a message was to be sent made it difficult or impossible for communication to occur. In addition, from the very earliest times, getting the message through was only one of the concerns. The desire for privacy, security, authenticity, timeliness, and proof of receipt influenced how communications were used and often drove communications "technology."

To reduce the impact of distance, time, and location, men and women throughout history employed various forms of information and communication technology. Drums, torches, signal fires, flags, pictographs on papyrus, and writing on clay and stone tablets were among the earliest technologies humankind used in its efforts to reduce the impact of distance, time, and location on communications. Codes, cyphers, trusted agents, seals, and signatures have always accompanied communications and have grown in sophistication along with communications methods. Sometimes people even turned to the animal world to enhance their ability to communicate; King Solomon used messenger pigeons to deliver messages as early as about 1000 BC.2

These primitive and traditional methods and technologies, many of which remain in use today, have improved humankind's ability to communicate, but they were and continue to be limited in what they could and can do. Some approaches require favorable environmental conditions: low wind, line of sight visibility, or good weather. Pictographs and other forms of written communications take time to construct. If privacy or security is desired, extra time is required to translate the message into a coded form. Regardless of how long it takes to compose messages, messages take time to deliver and, if necessary, to decode. Nor could it be assumed that the receiver could necessarily decipher, read, and understand what was written. And, as a function of the means of communications, messages are subject to various forms of distortion. For centuries, then, distance, time, and location continued to significantly inhibit humankind's ability to communicate, and advances in information and communication technologies progressed, albeit slowly.

In the mid-nineteenth century, this began to change as several technologies matured that enhanced humankind's ability to communicate more quickly and extensively (except for the development of the ability to speak and the development of the printing press) than ever before. In the short century and a half since then, the impact of distance, time, and location on communications has been reduced to a greater extent than in all previous years of recorded history combined. At the same time, humankind's ability to enrich messages with images and figures has vastly improved, as has its ability to ensure the privacy, authenticity, and receipt of messages.

This 150-year period may be viewed either as a single ongoing information revolution with three distinct phases, or as three distinct historical periods, each with enough significance to be labelled a revolution. In this volume, for reasons that will become clear, the editors have opted for the view that each period warrants being labeled a revolution. But not all analysts, again as will become clear in subsequent chapters, agree with this perspective.

The first modern information revolution began in the mid-nineteenth century and extended for approximately 100 years. This first revolution primarily enhanced communications. During this period, technologies such as the telegraph, telephone, and radio came of age.3 These technologies transformed not only humankind's ability to communicate, but also people's lives. Especially in industrial societies, they changed the ways that people related to one another and altered the ways that business, government, and military and foreign policy establishments conducted their affairs. Given the dimensions of their impacts, these technologies also helped modify the structure of the international system.

The second modern information revolution extended from the mid-twentieth century until perhaps the 1980s. During this period, technologies such as television, early generation computers, and satellites linked the world together in ways that it had never before been linked. These technologies, like the telegraph, telephone, and radio before them, again transformed humankind's ability to communicate; changed the ways that people related to one another; altered the conduct of the affairs of business and government; and modified the structure of the international system.

Since the 1980s, still more information technologies have been developed and have begun to be employed, technologies with capabilities that dwarf those of the information technologies already in use. We are thus on the verge of a third modern information revolution, one that perhaps should be labelled a "knowledge revolution" since it encompasses advances in information technologies that significantly alter the politics, economics, sociology, and culture of knowledge creation and distribution.

How the technologies of the first two eras evolved and helped shape human activities and institutions is an important story, for it provides an understanding of how and why things are as they are. It provides an understanding of how and why international actors and the international system have evolved. Most importantly, it may provide clues about how emerging information technologies might influence the future shape, relationships, and conduct of human institutions, human activities, international actors, and the international system. Given the magnitude of the capabilities that emerging information technologies promise to provide, these are clues that are well worth having.

The Impacts of the First Modern Information Revolution

Between the mid-nineteenth and mid-twentieth centuries, many new information technologies aided and abetted humankind's efforts to overcome distance, time, and location, but three stand out: the telegraph, telephone, and radio. Together, these technologies can arguably be described as the technologies of the first modern information revolution.

How did this first modern information revolution affect human activities and institutions, international actors, and the international system? There are many answers to this simple question, and we will approach them by exploring one technology at a time.

The Telegraph. First operationalized in a practical sense in 1845, the telegraph sparked a wave of communications development throughout the world. One analyst, writing of the development of the telegraph and the dramatic effects that it had on society during the second half of the nineteenth century, asserted that the telegraph "initiated the first truly electronic communications revolution and gave rise to the age of instant global communications."[4]

The first experiments that attempted to transmit messages electronically over wires actually occurred in the eighteenth century. However, Samuel Morse, an American inventor, is generally credited with having developed the first operational model of the telegraph. Although a British team invented and tested a basic telegraph in 1837, Morse developed a prototype system that employed an electromagnetic relay and regenerated signals over long distances. These signals were recorded as dot-and-dash messages directly on paper. Morse patented the technology in 1840. Then, with a $30,000 grant from the U.S. Congress, Morse built a telegraph line between Washington, D.C. and Baltimore to demonstrate his invention. On January 1, 1845, Morse sent the message, "What hath God wrought?" over his telegraph wires. A new era had begun.[5]

Morse's invention spread rapidly and had immense impact across a wide range of human activities. Within a year of Morse's first message, the United States had almost 1,500 kilometers of telegraph lines in place. By 1851, fifty companies were in the telegraph business in the U.S.[6] but by 1861, Western Union had emerged as a monopoly in the telegraph business.

In the United States, the use of the telegraph chronologically and geographically closely paralleled the expansion of the railroad system. Each fueled the success of the other. The telegraph helped railroads communicate and function more efficiently, and railroads in turn expanded the American telegraph network, making it even more effective than it had been. Before the end of the century, communication in the U.S., according to one source, no longer relied solely on a physical infrastructure that "depended on the speed of horses, ships, runners, and railroads."[7] Even though the telegraph was at first vulnerable to disruption and loss of signal, it soon rivaled the national postal service in volume of service.

The telegraph quickly entered widespread use outside the United States. As early as 1851, the telegraph expanded the internationalization of financial markets as it connected the London and Paris stock exchanges.8 By the end of the century, business interests and government offices throughout Europe were linked by telegraph. Indeed, the telegraph transformed the conduct of virtually every business transaction and government action since messages were now sent rapidly and accurately over long and short distances.

This was an immense boon to businesses, government, and almost very other form of human interaction as well. With the telegraph, person to person messages could be rapidly transmitted across physical boundaries such as mountains and rivers, thereby creating more opportunities for business expansion and coordination. Much to the consternation of more conservative rulers of the day, the telegraph could also transcend national boundaries, thereby challenging the sovereignty of the nation-state and its ruler. The economic and political ramifications of such capabilities were immense.

The introduction of the telegraph also had an extensive impact on military affairs. For example, during the American Civil War, the military used the telegraph to direct troops, provide logistical support, enhance military efficiency and organization, and relay strategic and tactical intelligence about enemy movements and actions.9 For example, one of the first uses of the telegraph during the Civil War occurred on April 15, 1861, when President Abraham Lincoln sent a telegraph message calling for 75,000 troops to defend Washington. Lincoln received an immediate response via telegraph that 90,000 troops were ready.

The telegraph played a major public policy role in the war efforts of the North and the South. It helped the news media of the day keep citizens informed in near real time about the war and the course of battles, and it provided the northern and southern governments with a new medium through which they could try to mold public opinion. The telegraph also had a significant impact on the way governments related to the rest of society. For example, in the U.S., organizational foundations for expanded military use of the telegraph were laid throughout the Civil War as the American Telegraph Company extended its facilities to the War Department. Recognizing the importance of the telegraph to the war effort, Congress in 1862 passed legislation that enabled President Lincoln to take control of all telegraph lines in the United States.

This led directly to the development of the civilian U.S. Military Telegraph Corps, which soon employed 1,000 operators and hundreds of other workers. Serving the administrative, logistic, strategic, and tactical needs of the War Department and northern armies in the field, the Military Telegraph Corps between May 1, 1861, and June 30, 1866, constructed 15,389 miles of telegraph lines.10

In addition to the Military Telegraph Corps, a Signal Corps was formed as a branch of the military under the direction of the War Department. The Signal Corps often competed with the Military Telegraph Corps even though both served the same war effort. By the end of fiscal year 1865, the Military Telegraph Corps had sent about 6,500,000 messages at a direct cost to the Government of $2,655,500. By comparison, the direct cost of Signal Corps messages for the same period was $1,595,257.[11]

The newness of the telegraph combined with the sudden onset of the war were primarily responsible for the development of these two overlapping organizations with similar responsibilities. At the end of the war, the Military Telegraph Corps was dissolved and the Signal Corps remained. But there was absolutely no doubt that the telegraph and the railroad were the most significant logistical and communication innovations of the Civil War. Both had an immense impact on virtually all future major wars.

The telegraph also had a sizable impact on late nineteenth century and early twentieth century foreign policy and diplomacy. With the telegraph's capacity to send messages in near real time over long distances, many capitals of Europe before the end of the century were linked together by telegraph. With embassies connected by telegraph to their home foreign ministries and sometimes to their home chief executive, ambassadors, long used to operating on their own, increasingly received instructions about pressing issues from their home office. Not surprisingly, the volume of diplomatic traffic increased as embassy-home ministry links improved and as the difficulty and cost of sending messages decreased. Diplomatically, then, Europe became a much smaller place because of the telegraph. Although it is too much to argue that the European balance of power system of the late nineteenth and early twentieth century remained stable for as long as it did because of the telegraph, the rapid flow of messages between capitals that the telegraph made possible significantly increased the amount of information that European decision makers had at their disposal and certainly facilitated the coordination of policy positions and actions.

The telegraph also soon increased the speed and timeliness of information flows between continents. Efforts to link Europe and the U.S. by telegraph in the form of submarine cables proceeded apace during the 1850s and 1860s. The first effort, headed by the American Cyrus W. Field in 1857, failed when the submarine cable snapped. Field's second attempt also failed, but in 1858, a third try succeeded. Over 700 messages were sent via submarine cable before it failed later in the year. Despite the potential benefits of a cable link between Europe and the U.S., Field could not raise sufficient funding for the next attempt until 1866. This attempt succeeded, and Europe and the U.S. have been linked ever since. Instantaneous communication was thus possible between continents.

At the level of the international system, the implications of submarine cables for foreign policy and diplomacy were staggering. As long as submarine cables and telegraph lines linked their location of service with the home capital, foreign ministries, executive offices, and military commanders had potential to communicate with their direct reports regardless of where those reports were anywhere in the world. Diplomatic and military command and control were therefore significantly enhanced. One indication of the potential impact of this came in 1903 when U.S. President Theodore Roosevelt sent a message around the world in only nine minutes.

By the end of the nineteenth century and beginning of the twentieth century, then, the telegraph had made the world a smaller place. The telegraph had lessened the constraints imposed on communication by distance, time, and location to a greater extent than all previous improvements combined.

But this did not mean that time and distance no longer posed problems for human communication. Obviously, they still did. At the same time, however, other forms of communication were being developed that further abetted humankind's ability to communicate faster and more effectively.

The Telephone. The telephone, building upon the success and technology of the telegraph, is one of the most influential developments in communications history. The first telephonic device that could transmit sound electronically was built in 1861 by the German scientist Johann Philip Reis. Even so, the invention of the telephone is generally credited to Alexander Graham Bell in 1876.

Bell, a Scotsman who emigrated to the United States, worked for the Western Union Telegraph Company. Bell and his assistant, Thomas Watson, discovered a method to transmit sound and the human voice by electric current. Even though others argued that they had invented the telephone earlier, Bell received the patent for the device and in 1877 founded the Bell Telephone Company. Twenty two years later, the Bell Telephone Company was renamed the American Telephone and Telegraph Company (AT&T), a name that it has to the present day.

Like the telegraph before it, the telephone had a profound impact on business, government, the military, foreign policy, and almost every other arena of human activity. Less than 25 years after its invention, the telephone was in widespread use in Europe and the United States. In the United States, one of the primary reasons that this occurred—beyond the obvious reasons of ease of use and improved communications—was the principle of universal service.

Because of universal service, extensive long distance and local lines were built during the 1870s and 1880s. These lines created a vast communication network for direct person to person contact. By 1900, the United States had one million telephones in use, with local systems linked into a national telephone network.[12] In 1910, the federal government moved to exert its influence over this network when Congress passed the Mann-Elkins Act, which established the Interstate Commerce Commission (ICC). The ICC had jurisdiction over all telephone service and other interstate business.

Meanwhile, outside the U.S., other industrialized countries created their own telephone networks, many with government oversight and sometimes control. Telephone use was widespread in Europe, but until low cost long distance service was later developed, most telephone use was restricted to local or inter-urban calls. Indeed, recognizing the potential economic and security implications of unfettered international telephone use, many states guarded their control of trans-border telephone (and telegraph) communications.

In the United States, the Bell System grew as it acquired smaller companies during the first three decades of the twentieth century. By the 1930s, the Bell System had acquired monopoly status, which it retained into the 1970s. The Communications Act of 1934 was an important factor in AT&T's growth, defining the company as a common carrier that could transport telecommunication traffic over facilities that were available on an equal basis to all paying customers, but which could not have a financial interest in the creation of the content carried.13 AT&T's monopoly status led to increased power and influence for the company, which in turn led to increased government regulation of AT&T.

Most astounding, however, was the growth of the use of the telephone. Founded upon the premise of universal service delivered by a universal phone system that supplied superior service at low rates, the Bell System delivered as promised, both in local communications and long distance communications; by 1939, the number of telephone calls in the U.S. exceeded the number of letters mailed.14

In addition, AT&T formed Bell Telephone Laboratories, also known as Bell Labs, which provided the company and the country with cutting edge technologies. Indeed, scientists from Bell Labs received more Nobel Prizes than any other organization in the world by discovering or developing technologies such as microwave radio, mobile radio, cellular radio telephony, coaxial cables, semiconductor technology including the transistor, optical fibers, and electronic switching.15

As the twentieth century progressed, the telephone became ubiquitous, especially in the United States and to a lesser degree in other industrial societies. In business, the telephone speeded transactions and enhanced communications and coordination even more than the telegraph. In government, its impacts were much the same. In military affairs and foreign policy, the telephone, like the telegraph before it, provided opportunities for enhanced coordination and greater efficiencies through rapid person-to-person communication at a distance. In military affairs specifically, one analyst noted that the telegraph and telephone together "quickened the pace of warfare by shortening response times and increasing flexibility."16 The same analyst further observed that "coupling this speed of information communication with the effect of the railroad on speed of movement, the nature of land warfare was changed in scale by two primarily civil inventions."

By the early twentieth century, then, the telegraph and telephone had transformed human communications. Distance, time, and location still presented difficulties for communications, but the difficulties were by no means as significant as they had been only 25 years earlier. Nevertheless, communications were still constrained by location since both the telegraph and telephone required lines over which signals could be sent. Obviously, this meant that senders and receivers were fixed to locations at which sending and receiving equipment was available. As the first modern information revolution progressed, however, this soon changed.

Radio, the "Wireless Telegraph." In 1894, Guglielmo Marconi, an Italian citizen, sent the world's first radio signal over a three kilometer distance. When the Italian government turned down Marconi's offer to provide it with his new invention, he traveled to Great

Britain, where he secured a patent for his radio. When he demonstrated his radio's ability to send messages from shore to ship and between ships that were beyond each other's line of sight, the British and U.S. navies moved to adopt this new technology to enhance communications at sea. Even more impressively, Marconi in December 1901 sent a message 3,540 kilometers across the Atlantic Ocean from Cornwall, England, to St. John's, Newfoundland. Eight years later, Marconi received the Nobel Peace prize in physics for his accomplishments.17

At first, radio use was relatively limited because only Morse code could be sent. Even so, increased numbers of commercial and naval vessels were equipped with radio, and the use of radio on land also expanded. However, when Reginald Fessenden discovered in 1906 how to send voice and music via radio, the slowly expanding non-maritime use of radio became an avalanche. By the 1920s, over 600 radio stations broadcast in the United States alone, many of which were owned by nationwide radio networks.18 Other American businesses realized that the new technology afforded significant advantages, and radio was quickly employed to advertise and publicize as well as to entertain and educate.

Because of the growing importance of radio to American business and society, Congress in 1927 passed the Radio Act and created the Federal Radio Commission to regulate the industry.19 Perhaps the single greatest indication of the growing importance of radio in the United States was the trend in advertising revenue; in 1943, money spent on radio ads for the first time surpassed the amount of money spent on newspaper ads.20

Throughout this period, the U.S. Government and the U.S. military played a major role in the development and use of radio. During World War I, the government and military used radio extensively for communications, command and control, and related purposes. In addition, the Navy pressured inventors such as Marconi, Fessenden, DeForest, and Armstrong to put an end to their disputes over patents, thereby helping standardize radio technology.21 And in April 1917, at the onset of U.S. entry into World War I, President Woodrow Wilson commandeered all wireless radio stations in the United States and its possessions. Throughout World War I, Marconi and others in the radio industry fully cooperated with the war effort and with the Government as it extended its control over radio.22

Military use of radio expanded even more during World War II. Every major international actor in the war used radio extensively in all branches of their armed services. The radio gave commanders more flexibility with troops, allowed greater mobility, and enhanced overall command and control. Indeed, without the radio, Germany's "Blitzkrieg" warfare could not have been implemented. Meanwhile, governments used radio to inform—and sometimes misinform—their citizens about the progress of the war, to promote nationalism, and to spread propaganda. Some analysts even argued that radio was the "paramount information medium of the war, both domestically and internationally."23

Radio also contributed to the Allies' war effort in its application to radar, an acronym for "radio detection and ranging." Although Hertz demonstrated in 1887 that radio waves could be reflected from solid objects, the technology was not put to use until 1935 when Watson-Watt in Great Britain created a successful aircraft detection system.24 This provided Great Britain with a decided advantage in the early years of the war.

Indeed, radar was used so successfully in the war that Germany blamed the defeat of the Luftwaffe during the Battle of Britain on Britain's radar and fighter control network.25 Other experts argued that "the whole evolution of sea warfare in World War II revolved around radar" since radar aided planes taking off from carriers to find the enemy and aided them in their return.26 British and American scientists improved the capability of radar throughout the war, while Germany and Japan lagged in the development and utilization of this key new technology.

The Impacts of the First Modern Information Revolution

By the end of World War II, the technologies of the first modern information revolution had had a massive impact on the way people lived and worked; on the way that businesses and governments conducted their affairs; and on the way that wars were fought and peace was pursued. With their efforts to communicate less hampered by distance, time, and location than ever before, people knew more about what was happening nearby and far away than they had in the past, factored this knowledge into decisions that they made, and changed their perspectives on local, national, and international affairs.

Despite the magnitude of change that this revolution brought to humankind's ability to communicate, the technologies of the first information revolution did little to alter the structures of the major international actors or the international system. These technologies came of age during an era in which international affairs was dominated by European states. Europeans had divided most of the rest of the world outside Europe into colonies, and there was little on the horizon to indicate that this would change. Meanwhile, in Europe itself, a balance of power system held sway, with Great Britain acting as the principal balancing agent.

In this international system, states were the primary types of international actors, and throughout this era, they remained the primary actors. Indeed, if anything, European states used the new technologies to enhance their preeminent positions in the global power structure to improve their ability to communicate with their far-flung empires and to command and control political and military forces.

As for other types of international actors, even though business use of these technologies proliferated dramatically, the volume of international trade and the impact of international business on world affairs remained small during the late nineteenth and early twentieth centuries. Despite improved information and communication capabilities, businesses that operated internationally remained structured primarily as "mother-daughter" arrangements in which the central office granted autonomy of operations to overseas subsidiaries. Other types of international actors such as intergovernmental and nongovernmental organizations remained inconsequential on the international scene.

All told, then, even though the technologies of the first modern information revolution had an immense impact on how people lived and conducted their lives, on the way businesses and governments ran their affairs, and on the way diplomacy and war were conducted, the first information revolution had little impact on the structure or function of international actors or on the international system.

The Impacts of the Second Modern Information Revolution

As World War II drew to a close, most people recognized that information and communication technologies had made the world a much smaller, if not necessarily better, place. However, with World War II in the Pacific Theater having been brought to a close by the most awesome weapon ever invented, few people recognized that even more significant technological breakthroughs in information and communication technologies were just over the horizon.

Centered on television, early generation computers, and satellites, the second modern information revolution reduced the impact of distance, time, and location on human communications as much if not more than the technologies of the first information revolution. They also significantly enriched the communications experience. The second modern information revolution had sizable impacts on the workplace and economic affairs, on culture and society, and on military affairs and international relations.

The impact on the workplace and economic affairs was easy to discern. In the decade following World War II, as the rest of the world rebuilt from the devastation caused by the war, the United States' economy changed steadily from an industrially based economy to one based on services. During this time, the number of workers in service industries in the United States grew rapidly, eventually rising in the 1960s to outnumber blue collar workers. Information became a commodity in its own right, and its management and distribution became a major factor in the American economy. New industries developed based on technologies that satisfied these needs. This phenomenon began in the United States, but it soon assumed global proportions as information and its collection, management, and distribution became the hallmarks of advanced industrial societies around the world.

New information and communication technologies also found prominent places in American homes and soon thereafter in homes around the world as the television and eventually the computer entered global society's mainstream. As the new technologies spread throughout society, their influence began to change cultural relationships and values. In many homes, the television became a central focus of family life, altering the way people interacted with one another and the way that they spent their time. Often, it introduced new values that competed with traditional ways of viewing the world and conducting activities. It also provided more sources of information, sometimes with a sense of greater immediacy, than had previously been available.

These new technologies were not restricted to the workplace and the home. Military affairs and international relations also were strongly affected by these new technologies, with the military and foreign policy priorities of the United States and its allies as well as the U.S.S.R. and its allies helping drive complementary and sometimes converging research in telecommunications, computers, and satellites. Indeed, the combination of these technologies increased military capabilities, provided diplomatic affairs in remote areas of the world an urgency that they previously had lacked, and arguably helped lead to the collapse of the bipolar international system.

This, then, was the second modern information revolution, centered on television, early generation computers, and satellites. Television was a qualitative improvement over radio, allowing much greater bandwidth to be transmitted in a form more immediately accessible and powerful. Computers provided individuals and organizations with a much greater capability to collect, analyze, and utilize information. And satellites greatly extended the global communications infrastructure. As with our discussion of the first modern information revolution, we will discuss each technology separately.

Television. Although it was invented before World War II, television had no real impact on human institutions and activities, international actors, or the international system until after the war. However, when TV took hold, its impact was immense, first within the United States, then within other industrialized states, and eventually throughout the world.

As a technology, television developed gradually. In the 1920s, Philo Farnsworth, Vladimir Zworykin, and Allen Dumont contributed significantly to its development. In 1922, Farnsworth invented the process of scanning an image in a series of lines. In 1928, he announced the development of an all electric television system. Meanwhile, Zworykin in 1923 developed the iconoscope tube and the kinescope television tube in 1926. At the same time, Allen Dumont developed the basic technology for a receiver picture tube.27

During the 1930s, several major American corporations, most notably the Radio Corporation of America, General Electric, and AT&T, recognized the commercial potential of television and invested millions of dollars in its development.28 Businesses and governments outside the United States, especially in Germany, also pursued the nascent technology. By 1936, German television had advanced to the point that experimental broadcasts of the Berlin Olympics were distributed to selected sites in the German capital.29 In the United States, the first American television broadcast was of the 1939 Harvard-Yale baseball game.30

During World War II, television was little more than a technical curiosity. After the war, this changed rapidly. As TV quality improved and programming became more widely available, Americans led the way in buying televisions. As the only industrial state left unravaged by war, the United States was the only major country whose citizens had enough wealth and leisure time to pursue such a diversion. Indeed, the rapidity of television's penetration of the American market was astonishing; in 1945, only a fraction of one percent of all American families had televisions, while 10 years later, the figure had leaped to 72 percent.31

In the U.S., RCA led in the manufacture of television sets for commercial sale. It was soon joined by other firms that sought a share of the growing television sales market.

Three privately owned television networks also emerged in the American market in the post-war years: ABC, CBS, and NBC, and they monopolized American television programming. At first, television programming closely paralleled that of radio broadcasting.

By the 1960s, television had become one of the most influential and pervasive technical developments in history, not only in the United States, but also in other industrialized states. TV's presence and influence also spread into many of the least developed countries of the world. Even residents of impoverished urban tenements and isolated rural villages found television's lure irresistible.

Wherever it was introduced, TV had a dramatic effect on society and public opinion. Because of television, men and women saw people and places and heard ideas and viewpoints that earlier, they might never have seen or heard in their lifetime. Recognizing this, many countries developed state-owned or state-controlled television stations, networks, and programming capacity. Other countries, like the U.S., emphasized privately owned stations, networks, and programming capabilities. Still others moved toward a mix of state-owned and privately owned stations. Regardless of whether TV was publicly controlled or privately owned, everywhere it was a medium for educating, informing, entertaining, and propagandizing.

In the eyes of many, television by the 1960s had also led to the expansion of U.S. cultural, economic, and political influence around the world. With the United States leading the way in the production of television programming, programs made in the United States dominated television broadcast time in many countries. This led many countries in the developing world to accuse the U.S. of "electronic imperialism." Even in developed countries like France, the dominance of U.S.-made programs became a source of considerable concern and has resulted in regulations aimed at limiting the amount of U.S.-produced programming.32

Television also had an extensive impact on business. In the United States, business advertising became one of the chief ways to finance privately owned television stations and networks. TV's ability to reach diverse people thus transformed the way businesses approached marketing efforts.33 At the same time, with the dominance of U.S. programs in many countries, familiarity with U.S. products as well as lifestyles increased around the world.

Television's political role also grew immensely. By 1960, TV had become so powerful a medium within the United States that many analysts believed that the televised 1960 presidential debate between John Kennedy and Richard Nixon won the election for Kennedy. Later in the decade, with the Vietnam War being projected directly into American living rooms, TV was widely believed to have accelerated the growth of opposition to the conflict.34

Many people also believed that TV was a powerful tool for projecting social morals and norms. Given this belief, many argued, the content of TV programming must be screened and if need be censored. At the national government level, some governments insisted that TV programming include values that they wanted their citizens to emulate. Other governments censored program content to ensure that it coincided with government preferences. Recognizing the potential of television to influence outlooks and attitudes, many governments around the world used television as a tool through which their "official" interpretation of world events, public policy, and national programs could be promulgated. Communist governments in the Soviet Union and Eastern Europe were especially notorious for this approach, although they were by no means the only ones that used television this way. Such efforts have not always been successful. For example, there is substantial evidence that the growth in acceptance of Western lifestyles, consumerism, and pro-democracy sentiment that helped bring about the collapse of communism in Eastern Europe was sped by trans-border television broadcasts from Western Europe.35

Television, then, had and has a ubiquitous impact. By the 1960s, it had carved out a place for itself in virtually every country, and it penetrated virtually every realm of human endeavor. What is more, its influence continued to grow, especially after it was married with satellite technology during the late 1960s and 1970s. Television's ability to provide graphic visual images was enhanced by the immediacy provided by global satellite networking. With the marriage of satellite technology and television, people around the world were able to see not only what had happened, but also what was happening as it happened. The implications of this for international affairs were immense. Ironically, when television was in its infancy, few people expected its influence to be so pervasive. The same is not true for the next technology of the second information and communication revolution that we will explore: early generation computers. From the time that they were invented, many people expected the impact of computers to be immense.

Early Generation Computers. The impetus behind much of the development of early generation computers was provided by military needs. According to one noted analyst, "the military, particularly in America, has been involved with computers almost from the beginning, not only as users but also as active consumers who... frequently laid down specifications and provided funds for development."36

The first electronic computer was invented by John Vincent Atanasoff, who produced working models of data processing units and computer memory at the University of Iowa in 1939. The British mathematician Alan Turing followed close on the heels of Atanasoff, developing "Colossus," the first working digital computer, during World War II to crack Nazi war codes and gain access to Adolf Hitler's military plans.37 "Colossus" was in many ways as strategically important to the Allied war effort as radar.

World War II also demonstrated the need for high-speed complex mathematical computations to help aim artillery and rocket fire. Efforts were undertaken throughout the war to develop this capability, eventually leading in 1946 to the creation of the Electronic Numerical Integrator And Calculator (ENIAC) at the University of Pennsylvania. Invented by J. Presper Eckert and John Mauchly, ENIAC contained 17,000 vacuum tubes, weighed thirty tons, and occupied 15,000 feet of floor space. John von Neuman also made significant contributions to the development of the modern computer with a 1945 paper that outlined the design for a high-speed digital computer with memory.

ENIAC and other first generation computers used vacuum tubes to perform their calculations. Although first generation computers were a significant step forward, the vacuum tubes upon which they were based generated considerable heat, could not be miniaturized, and often burned out. Thus, it was a major breakthrough in 1947 when William Shockley, Walter Brattain, and John Bardeen invented the transistor. The transistor became the basis for a second generation of computers that emerged in the 1950s and 1960s. Second generation computers were smaller, faster, and more reliable than their first generation counterparts.

A third generation of computers based on integrated circuits emerged as computer technology continued its rapid advance.38 Much of the ongoing research was funded by the U.S. Department of Defense. The unique relationship that developed between the government, the military, and industry helped create an innovative environment for the invention of information and communications technologies. The military used computers not only for fire control and related purposes, but also for more elementary purposes such as establishing constant centralized control "over the exact whereabouts, status, and condition of the last nut and bolt intended for the last tank of the last battalion."39

Early generation computers also had a large impact in business and non-military sectors of government in areas as diverse as information and data storage, management, and manipulation; inventory monitoring and control; and communications. In the context of communications, one area that requires special mention is the development of computerized switching networks. Computerized switching networks made it possible to create a global switching network utilizing cables, microwaves, and satellites so that users of most of the world's estimated 700 million telephones could talk to each other via standard voice communications or via facsimile machines. Computerized switches also made automatic dialing and call-back dialing an operational reality. With the use of modems and other devices, computers attached to phone lines could also talk to other computers regardless of location. Thus, computer advances permit information and data to be transferred globally on virtually a moment's notice. This led to the beginning of the globalization of banking and reservation services, the enhancement of global databases, and the development of global electronic mail.40

As rudimentary as they were, early generation computers enabled people to store, track, and manipulate more data faster than had ever before been possible. They also linked far-flung locations of the world together more closely than they had ever before been linked. With their capacity to store, track, manipulate, and distribute data rapidly, early generation computers, especially in industrial societies, changed the ways that people related one to another; altered the ways that the affairs of business, government, and the military and foreign policy establishments were conducted; and laid the groundwork for changing the structures of and relationships among international actors.

Satellites. Satellites were also an important component of the second modern information and communication revolution. Because of their location, satellites could relay telephone and television signals over vast areas of the earth. More than any other single technology, satellites provided the capability for real-time global communications. What is more, satellites, when married with television, provided people with the ability not only to hear what was happening virtually anywhere in the world as it actually happened, but also to see events "live." The development of reliable satellites thus had dramatic economic, industrial, cultural, military, and political implications for human interactions and outlooks, and for the international system.41

As with computers, the military led the way in developing satellites. The first U.S. military communications satellite, SCORE (Signal Communications by Orbiting Relay Equipment) was launched on December 18, 1958, one year after the Soviet Union launched Sputnik I. Since then, military communication satellites have acquired multiple uses including routine communication, command and control of forces in the field, reconnaissance and surveillance, meteorology, and navigation.42

Beyond their military utility, satellites have extensive civilian use, having played a major role in civilian global communications since the mid-1960s. The introduction of satellite communications to the civilian sector began in July 1958, when the U.S. Congress passed the National Aeronautics and Space Act, which created NASA as a civilian agency to pursue space activities. Four years later, the U.S. Congress created the Communications Satellite Corporation to develop national communications satellites and also passed the 1962 Federal Communications Act, which allowed the FCC to regulate the operation of all communications satellites.43

The first true civilian telecommunications satellite, Syncom III, was launched into orbit in 1964. The world’s first commercial communication satellite, "Early Bird," was launched the following year. It carried only 240 voice channels or one television channel, but it was the beginning of a massive civilian global communication revolution. Although at first only the U.S. and the U.S.S.R. had satellites, the technology proliferated when seven countries formed the International Telecommunications Satellite Organization (INTELSAT) to create a global commercial satellite system. One of INTELSAT’s more notable accomplishments was its global broadcast on July 20, 1969, of live television coverage of the Apollo 11 moon landing.44

Since then, communication satellites have led to the formation of a true global communication network. Theoretically, a global satellite communication network could employ as few as three satellites, but in fact many satellites make up the present-day satellite communication network. Most low and middle latitude countries use satellites in geosynchronous orbit 23,000 miles above the equator, but countries in higher latitudes often use satellites in elliptical orbits because they have difficulty receiving signals from satellites over the equator.

Satellite communications improved tremendously over the first three decades of use. During the early years of satellite communications only a few hundred channels existed, but thousands are now available for telephone, television, and data transmission. Direct broadcast satellites allow companies and countries to beam broadcasts into any location that has a receiver. Store-and-forward satellites, once the domain of government intelligence and military communities, are now commercially available as well, thereby allowing private users to send data and information to a satellite, and have the satellite broadcast the data and information at a later time to a single-site user.

Increased access to satellite communications has already tied the world more closely together as virtually every form of communication can now be transmitted globally on a moment's notice. Global telephone and television satellite transmissions are common. Companies use communication satellites to transmit even the most sensitive data and information throughout the world. Two-way global teleconferencing is increasingly available.

Satellites, then, when married with other technologies of the first and second modern information and communication revolutions, provided the world with a virtually instantaneous global communication capability. Some say that this capability is leading to the development of a sense of global community. Whether or not this observation proves factual, it is beyond dispute that satellites have helped make many people more aware of communities and events in far away places and provided them with a window on societies radically different from their own.

The Impacts of the Second Modern Information Revolution. How, then, has the second modern information revolution impacted the shape, relationships, and conduct of human institutions and human activities, and the structures and dynamics of international actors and the international system? The answer to this question is exceedingly complex, in part because the second modern information revolution is so recent that its technologies have yet to be fully absorbed, diffused, and operationalized.

Indeed, different international actors have absorbed, diffused, and operationalized television, computers, and satellite technology in different ways and at different rates of speed. This differentiated pattern and rate of absorption, diffusion, and operationalization has led to different types and rates of change in different actors on the international scene.

The multinational corporation is arguably the type of international actor that has been most affected by the second modern information revolution. Businesses transmit tremendous amounts of information and data throughout the world. In some cases, geography has little or no impact on business decisions about where to locate. For example, several U.S. airlines and other reservation services have facilities outside the United States because of lower labor costs there. Similarly, in international banking and finance, the ability to transfer funds electronically throughout the world has already had an immense impact. Some observers believe that the world has already become a single banking and financial market.45

Advanced information and communication technologies have also influenced the way some multinational corporations structure themselves. Although forces in addition to improved information and communication technologies led MNCs to move toward the adoption of global product divisional structures as opposed to the pre-World War II mother-daughter organizational structure arrangement, there is no doubt that the enhanced abilities of MNCs to communicate with their overseas subsidiaries strengthened this trend. Further advances in information and communication technologies in turn have influenced MNCs to begin developing a distributed network organizational structure.46

The technologies of the second modern information revolution have also accelerated the trends toward regionalization and globalization of business as more companies in the 1970s and 1980s gained access to less costly global communications capabilities. On a regional basis, this phenomenon was one of the factors that strengthened pressures in Europe for movement toward political and economic unity. In short, advanced information and communication technologies have allowed many firms to become multinational on either a regional or global basis.

The expanded role of MNCs has raised questions about the ability of individual states to provide for the economic well-being of their population since significant amounts of economic activity are being conducted on a transnational or global basis. The recent growth in global trade, much of it made possible by the technologies of the second modern information revolution, has been nothing short of phenomenal. As we have already seen, international finance and banking has been transformed by the ability to transfer funds electronically throughout the world at a moment's notice, and many other service industries are becoming more and more internationalized.

This does not imply that states are in imminent danger of disappearing because of advanced information and communication technologies. In fact, in some cases, as in Argentina's decision to outlaw call-back technology and Egypt's decision to delay the implementation of debit card telephone and telegraph charging, states have actively sought to maintain their sovereignty by attempting to control information and communication flows. In other cases such as the European Union (EU), NAFTA, and MERCOSUR, states are positioning themselves to take advantage of such technologies to increase economic activity and position themselves for future prosperity. In some instances, for example in the EU's case, this response opens the possibility of a movement toward a post-state international era in which a grouping of states cede a significant part of their decision-making capabilities to a transnational actor.

The technologies of the second information revolution have also had an impact on the role that non-governmental organizations (NGOs) play in international affairs. Many of these actors have widely scattered memberships and have become more active, better coordinated, and more influential as advanced information and communication technologies have become more widely available. And the technologies of the second information revolution have already led to the formation of networks among certain NGOs. For example, the Association for Progressive Communication links 20,000 NGOs and individual members in 95 countries via electronic mail and facsimiles. Its membership includes some of the world's most prominent NGOs and related organizations such as Amnesty International, Greenpeace, Oxfam, the Sierra Club, many labor unions, and a host of peace organizations.47

Individuals are also part of this growing global cyber-mainstreet, having ready access to telephones, electronic mail, and facsimiles whose links transcend national boundaries. Much of the personal use of these technologies is for social, educational, and business purposes. However, on several occasions, including most notably the 1989 Tiananmen Square massacre and during the 1991 Soviet coup, electronic mail and facsimiles provided an important link to the outside world for individuals in China and the former Soviet Union.

At the same time, the ability of the international media to provide foreign perspectives and outlooks on a real-time basis to virtually every major media outlet in the world has created a sense of global connectivity, if not community, that has never before existed. It is too much to argue that this has led to changed views on the parts of individuals about their role and the role of their countries in the world, but it is not too much to say that to many individuals, the international media is altering the way that they view themselves and the world.

At the regional level, the second modern information revolution has also had a demonstrable impact. As discussed above, advanced information and communication technologies have increased the flow of information and data transmission across national boundaries, thereby strengthening the impetus toward greater European integration and the transformation of the European Community into the European Union. To a certain extent, it may also be argued that a similar series of events led to the creation of the Asia-Pacific Economic Cooperation zone and the Free Trade Area of the Americas, although neither is anywhere near as developed an organization as the EU.

At the system level, the industrialized West's ability to take advantage of the technologies of the second modern information and communication revolution helped the West during the 1970s and 1980s create an uneven economic playing field between the West on the one hand and the Soviet Union and its allies on the other. For example, in 1978, the Soviet Union had roughly 25,000 computers in operation, while the United States had over 250,000. By 1988, the Soviet Union had about 150,000 personal computers, whereas, the U.S. had over 40 million.48 The Soviet situation was further worsened since the U.S.S.R. was unable and unwilling to incorporate widespread computer networking into its decision-making processes because of its centralized political and economic systems.

Throughout the late 1970s and 1980s, then, the Soviet economy fell further behind the more advanced and technologically sophisticated industrialized democracies of the West and Far East, due in no small part to the U.S.S.R.'s inability and unwillingness to participate fully in the second information revolution. In simplest terms, the Soviet Union could not compete against knowledge-based technologies integrated into market driven economies.

Mikhail Gorbachev recognized this, and therefore instituted a set of reforms in the U.S.S.R. to address these and other problems.49 Gorbachev's reforms, however, had unintended consequences. Intended to decentralize economic decision making and lead to improved production, they instead increased confusion and economic uncertainty in the U.S.S.R., and Soviet production declined. Designed to encourage popular support for communism by bringing more people into the political decision-making process, they instead led more Soviet citizens to question the system and eventually reject it. Intended to give more Soviet citizens a stake in the system, they instead led to the growth of nationalism and the eventual dissolution of the U.S.S.R.

In the final analysis, U.S. and Western development of advanced information and communications technologies coupled with the closed nature of Russian society and the centralized organizational structure of the Soviet economy played a major role in ending the Cold War as the Soviet economy proved unable to widely adapt emerging information and communication technologies. The forces at work that led to the collapse of the U.S.S.R. were much more extensive than those associated with the second modern information revolution, but there is no doubt that this revolution helped accelerate the collapse of the U.S.S.R. and the accompanying end of the bipolar international system.

Conclusions

The preceding overview has shown that during the last century and a half, the first and second information revolutions had a significant influence on the capabilities and actions of human beings, states, and other international actors. As technical capabilities increased, men and women and the institutions that they created found themselves increasingly able to overcome barriers to communications imposed by distance, time, and location and to enhance their abilities to exchange information effectively.

However, despite the impact that the first and second modern information revolutions have had on human activity, the structure and importance of international actors, multinational corporations excepted, has not yet been significantly altered. States remain structured much as they were in earlier centuries, and they remain the dominant class of international actor. International governmental organizations (IGOs) remain creatures of states, addressing issues that states permit them to address. Advances in information and communication technologies have allowed IGOs to expand their activities and therefore, to a certain extent, to increase their their importance, but again only when states acquiesce. And even though NGOs have taken advantage of information and communication technologies to better enhance their capabilities, they remain relatively weak as a class of international actor.

As a class of international actors, only multinational corporations have significantly altered their actions and their structure as a result of information and communication technologies. With many MNCs employing advanced information and communication technologies to degrees unequalled by other international actors outside the military, decision makers at many MNCs now think and act as a matter of course on a global basis. Technology has impacted not only the way that MNCs operate, but also the way that they are structured. Most MNCs have discarded old-style mother-daughter organizational structure, replacing them with global product division structures, and some MNCs are now progressing toward a distributed network organizational structure, aided and abetted by information and communication technologies.

As for the impact that information and communication technologies have had on the international system, they played only a limited role in the demise of the pre-World War I balance of power system, the formation of the inter-war collective security system, and the collapse of that system. An arguable case can be made that they played a large role in the half century long survival of the post-World War II bipolar system. A substantial case can be made that they played a significant role in the collapse of that system and in the incipient creation of large regional economic trading blocs in the years since then.

What do these historical observations mean for the future? It is too early in our study to answer this question. However, given the capabilities that emerging information and communication technologies have and will have, it is a foregone conclusion that they will play even larger roles in influencing the actions of today's and tomorrow's international actors, on affecting the evolving structure of those actors, and on influencing the way the international system is shaped.

What will those roles be? How will tomorrow's international actors and the international system that they create be influenced by emerging information and communication technologies? Are trends discernible today that might give us clues about answers to these and related questions? What issues will confront the international community as a result of the changes that are sure to come? To begin to answer these questions, we will turn first to some of the more prominent technologies that comprise today's information revolution.

Notes

1. This is not to say that other factors have not complicated communications. For example, language differences and cost have also made communications more difficult.

2. For a good discussion of humanity's early communication technologies, see Eric A. Havelock and Jackson P. Hershbell, Communication Arts in the Ancient World (New York, NY: Hastings House, 1978).

3. For one view of the impact of these technologies on international affairs, see Daniel R. Headrick, The Invisible Weapon: Telecommunications and International Politics 1851-1945 (New York, NY: Oxford University Press, 1991). For histories of the development of these technologies, see George G. Blake, History of Radio Telegraphy and Telephony (New York, NY: Arno Press, 1974); Gerald J. Holzmann and Bjorn Pehrson, The Early History of Data Networks (Los Alamitos, CA: IEEE Computer Society Press, 1995), and Fred Shunaman (ed.), From Spark to Satellite: A History of Radio Communication (New York, NY: Scribner, 1979).

4. Maurice Estabrooks, Electronic Technology, Corporate Strategy, and World Transformation (Westport, CT: Quorum Books, 1995), p. 20.

5. Ibid, pp. 20-21.

6. Ibid, p. 21.

7. Joseph Straubhaar and Robert LaRose, Communications Media in the Information Society (New York, NY: Wadsworth Publishing Company, 1996), p. 57.

8. Estabrooks, p. 22.

9. For several discussions of the role of the telegraph during the Civil War, see John O. Pastore, The Story of Communications: From Beacon Light to Telstar (New York, NY: Macfadden Books, 1964); Timothy Garden, The Technology Trap: Science and the Military (McLean, VA: Brassey's Defense Publishers, 1989); and William Plum, The Military Telegraph During the Civil War, Volumes I and II (New York, NY: Arno Press, 1974). The following portrayal of the role of the telegraph during the Civil War is derived from these sources.

10. Plum, p. 9.

11. Ibid, p. 9.

12. Estabrooks, p. 23.

13. Straubhaar and LaRose, p. 262.

14. Ithiel de Sola Pool, Technologies Without Boundaries: On Telecommunications in a Global Age (Cambridge, MA: Harvard University Press, 1990), p. 9.

15. Estabrooks, p. 26.

16. Garden, pp. 21-22.

17. For details on the early development of radio, see Hugh G.T. Aitkin, Syntony and Spark: The Origins of Radio (New York, NY: Wiley, 1976) and W.P. Folly, Marconi (New York, NY: Stein and Day, 1972).

18. Straubhaar and LaRose, p. 180.

19. Estabrooks, p. 30.

20. Straubhaar and LaRose, p. 179.

21. Ibid, p. 175.

22. Thomas E. Will, Telecommunication Structure and Management in the Executive Branch of Government, 1900-1970 (Boulder, CO: Westview Press, 1978).

23. Straubhaar and LaRose, p. 179.

24. Garden, p. 35.

25. Estabrooks, p. 32.

26. Vannevar Bush, Modern Arms and Free Men (New York, NY: Simon and Schuster, 1949), p. 38.

27. Straubhaar and LaRose, p. 206.

28. Estabrooks, p. 33.

29. See Richard D. Mandell, The Nazi Olympics (New York, NY: Macmillan, 1971).

30. Straubhaar and LaRose, p. 206.

31. Estabrooks, p. 33.

32. For discussions of "electronic imperialism," see for example Thomas L. McPhail, Electronic Colonialism: The Future of International Broadcasting and Communication (London: Sage Publications, 1981); and several chapters in Edward A. Comor, The Global Political Economy of Communication: Hegemony, Telecommunication, and the Information Economy (New York, NY: St. Martin's Press, 1994).

33. See Les Brown, Television: the Business Behind the Box (New York, NY: Harcourt Brace Jovanovich, 1971) for a discussion of television's impact on business and marketing in the 1950s and 1960s.

34. For discussions of the 1960 presidential debate, see Sidney Krauss, The Great Debates: Background, Perspective, Effects (Glouchester, MA: P. Smith, 1968). For discussions of the impact of television on U.S. foreign policy and the Vietnam War, see J. Fred MacDonald, Television and the Red Menace: The Video Road to Vietnam (New York, NY: Praeger, 1985). For discussions of both issues, see Robert Donovan and Ray Scherer, Unsilent Revolution: Television News and American Public Life (New York, NY: Cambridge University Press, 1992).

35. For an analysis of the role of trans-border television broadcasts in the collapse of Eastern European communism, see Ben Fowkes, The Rise and Fall of Communism in Eastern Europe (New York, NY: St. Martin's Press, 1993); and David S. Mason, Revolution in East-Central Europe: The Rise and Fall of Communism and the Cold War (Boulder, CO: Westview Press, 1992).

36. Martin Van Crevald, Technology and War: From 2000 B.C. to the Present (New York, NY: The Free Press, 1991), p. 239.

37. Estabrooks, p. 42.

38. Straubhaar and La Rose, pp. 295-297.

39. Van Crevald, p. 240.

40. For discussions of the early phases of these trends, see Elaine B. Kerr and Starr Roxanne Hiltz, Computer-Mediated Communication Systems: Status and Evaluation (New York, NY: Academic Press, 1982); Jacques Vallee, Computer Message Systems (New York, NY: Data Communications, 1984); and Murray Laver, Computers, Communications and Society (New York, NY: Oxford University Press, 1975).

41. For several studies of the impacts of satellites on global communications, see Heather E. Hudson, Communication Satellites: Their Development and Impact (New York, NY: Free Press, 1990); David W.E. Rees, Satellite Communications: The First Quarter Century of Service (New York, NY: Wiley, 1990); Joseph N. Pelton, Global Communications Satellite Policy: INTELSAT, Politics, and Functionalism (Mt. Airy, MD: Lomond Books, 1974); and John Robinson Pierce, The Beginning of Satellite Communications (San Francisco, CA: San Francisco Press, 1968).

42. For discussions of the military uses of satellites, see Paul B. Stares, The Militarization of Space: U.S. Policy 1945-1984 (Ithaca, NY: Cornell University Press, 1984); A. Nejat Ince (ed.), Digital Satellite Communications Systems and Technologies: Military and Civilian Applications (Boston, MA: Kluwer Academic Press, 1992); and the IEEE Military Communications Conference, Conference Record/MILCOM 95 (New York, NY: Institute of Electrical and Electronics Engineers, 1995).

43. Estabrooks, p. 73.

44. Ibid., p. 73.

45. See for example Bruno Lanvin (ed.), Trading in a New World Order: The Impact of Telecommunications and Data Services on International Trade in Services (Boulder, CO: Westview Press, 1993).

46. For discussions of different types of organizational structures of multinational corporations, see Robert Howard (ed.), The Learning Imperative: Managing People for Continuous Innovation (Boston, MA: Harvard Business School Press, 1993); Michael Raymond and Alan Rinzler (eds.), The New Paradigm in Business: Emerging Strategies for Leadership and Organizational Change (New York, NY: J.P. Tarcher/Perigee, 1993); and Daniel S. Papp, Contemporary International Relations: Frameworks for Understanding (Fifth Edition) (Boston, MA: Allwyn and Bacon, 1996), Chapter 4.

47. For a discussion of the Association for Progressive Communication, see Howard H. Frederick, Global Communication and International Relations (Belmont, CA: Wadsworth Publishing Company, 1993), p. 97.

48. James Robinson, "Technology, Change, and the Emerging International Order," SAIS Review (Winter-Spring 1995), p. 156.

49. For Gorbachev's rationale for reform, see Mikhail Gorbachev, Perestroika (New York, NY: Harper & Row, 1987).

Chapter 3: The Technologies of the Information Revolution

by David S. Alberts, Daniel S. Papp, and W. Thomas Kemp III

Spurred on by the Cold War, the United States during the 1950s and 1960s made massive investments in its scientific and technological infrastructures, particularly those segments related to national defense. Many of these investments, as discussed in Chapter 1, were a driving force behind the enablers of the Information Age: semiconductors, computers, and satellites, some of the primary technologies of the second modern information revolution.

By the late 1980s, the dawn of yet another information revolution had emerged, this time spurred by further advances in and wider dissemination of semiconductors, computers, fiber optics, networking, and other information and communication technologies. While defense spending played a significant role in bringing about this new revolution, private companies and individual entrepreneurs were also a driving force behind many of the emerging new technologies. Many analysts predicted that the effects of this new revolution would dwarf those that had come before. Indeed, it was at this point in history when many analysts began to describe the rapidly approaching 21st century as "the Information Age."[1]

Subsequent chapters in this book will explore various dimensions of the Information Age. In this chapter, our task is different. Here, we provide a non-technical overview of some of the technologies that have the greatest potential to further expand humankind's ability to create knowledge and to communicate, and ponder what effects they might have.

The Technologies of the Information Revolution

Many technologies are part of the contemporary information revolution, but eight stand out: (1) advanced semiconductors; (2) advanced computers; (3) fiber optics; (4) cellular technology; (5) satellite technology; (6) advanced networking; (7) improved human-computer interaction; and (8) digital transmission and digital compression. Each will be discussed separately, although in practice the capabilities of several are often combined.

Advanced Semiconductors. Semiconductors are arguably the technology that has contributed the most to our current ability to store, process, and communicate information. Indeed, without the advances in semiconductor technology that have taken place over the past 30 years,[2] information and communication technologies may have required hundreds of years to advance to their present levels rather than hundreds of weeks. As Chapter 2 showed, advances in communications and information storage and processing capabilities were slow in evolving for most of recorded history. However, with the invention of the semiconductor, the rate of advance in a host of computing capabilities (including expanded memory, faster speed, improved reliability, and overall performance) increased dramatically, often approaching exponential growth.

Semiconductors are made by implanting electronic switches onto silicon wafers. First, a large circular silicon wafer is made. This wafer is then divided into as many squares as possible; the larger the circular wafer and the more squares that can be cut from the wafer, the better. Small electronic switches are then assembled on the cut square wafers. The final product is a semiconductor.

Semiconductor technology has improved dramatically since the mid-1970s. In 1978, a computer memory chip held approximately 10,000 bits of information; by 1993, each chip could hold roughly 10 million bits of information. Throughout this decade and a half, the amount of computational memory per computer chip increased by a factor of 4 every 3 years.3 This is the equivalent of investing one dollar and having it grow to over 500 dollars in 15 years. These advances were achieved by learning how to more densely populate each silicon wafer and by improving the switches.

Manufacturers also learned how to increase the size of each wafer, allowing still more switches to be placed on each. For example, in 1980, an advanced microprocessor contained perhaps 10,000 transistors; by 1994, this number grew to approximately 100 million transistors, a 10 thousand fold increase. Between 1966 and 1989, semiconductors dramatically increased in size, from 30 mm to 200 mm, increasing the amount of information that could be stored from 3,200 bits to one billion bits. Between 1989 and 1996, the productivity of semiconductors increased over 300,000 times. In the future, 300 mm wafers could contain as many as fifty billion bits, a productivity increase of 16 million.4

Simultaneously, the costs of manufacturing semiconductors declined. In 1970, one bit of information cost roughly one cent to store; by 1990, it cost only one thousandth of a cent to store. This dramatic reduction in storage cost reduced the cost of manufacturing semiconductors, and is projected to continue.5

There is, however, a cloud on the horizon for semiconductors. Advances in semiconductor technology have required finding ways to put additional and/or better designed switches on silicon wafers and to increase the size of the wafer. Recently, however, some manufacturers have concluded that the semiconductor is nearing the physical limits of size and design. Many believe that to continue to improve semiconductor technology, a new manufacturing process must be developed.6

There may be ways to do this. Presently, the creation of the silicon wafer uses two materials. A new manufacturing technology for semiconductors might craft wafers from one material instead of two, thus decreasing the thickness of semiconductors and allowing them to be used more flexibly. Manufacturers are also experimenting with new electronic switches for semiconductors as well as bio-switches and other forms of switches that would increase a semiconductor's performance without requiring additional wafer space.

If semiconductor technology is to continue to improve, new advances in electronic switching and new technologies for semiconductor manufacturing will be needed. Most experts believe that this will occur.7 If they are right, advanced semiconductors will continue to be a driving force behind the third modern information revolution.

Advanced Computers. Computers are central to all facets of automated information creation, dissemination, and utilization. Since the creation of the world's first computer, computer capabilities have improved immensely. Enabled by improved microchips, today's computers are much faster, have much larger capacities, and are much more reliable than those that were used as recently as 2 years ago. Within the information technology community, there is unanimity that computing capabilities will continue to expand. Many experts believe that early in the twenty-first century, high- volume microprocessors will have cracked the so-called "bips barrier" and will be able to execute over one billion operations per second.8 Beyond this, the U.S. Government's High Performance Computing and Communicating Program expects to create supercomputers with the ability to compute one trillion mathematical operations per second.9

Computers and related technologies are the backbone of the third modern information revolution. Beginning in the early 1970s, the perfection of very large-scale integrated circuits permitted hundreds of thousands of components to be placed on one chip. This led to the development of fourth generation computers,10 which were followed in the late 1970s and 1980s by fifth generation computers such as the Cray super-computer which used multiple processing units to process data simultaneously in a parallel manner. We are fast approaching the time when desktop work stations exceed the computational power of early fifth generation computers. And sixth generation computers that are based on artificial intelligence are on the horizon.

As computer performance improved during the 1980s and 1990s, computer technology doubled its price performance ratio roughly every 18 months. This meant that every year and a half, computers doubled their performance capabilities without increasing their price. There is every expectation that such price performance improvement will continue into at least the near-term future. This raises the possibility that as computer performance improves and costs decline, "ubiquitous computing" will become a reality, that is, computers will recede into the background of consciousness much the way electric motors did because they will be everywhere. Nevertheless, computers will still be there.

The transformation of the communications industry occurred when older switching technologies were replaced by digital switches. Hence, computers are now responsible for the global transmission and receipt of voice, video, and digital data; thus, given the volume of global information and communications flows, it is only computerized switching that allows coordination of the world's information and communications flows in a practical and time-effective manner. Computerized switching has contributed to the creation of a global switching network utilizing cables, microwaves, and satellites so that users of most of the world's estimated 700 million telephones can talk to each other via standard voice communication or via facsimile machines. Nearly all of the world's telephone services are now controlled using computerized switching. Computers also allow consumers cost-effective optional features such as touch-tone dialing, call waiting, call forwarding, digital voice mail, and conference calling. As important, computers attached to phone lines with modems and other devices can communicate directly and automatically with other computers regardless of location.

What does the future hold for computer technology? Most analysts believe the future will in many ways be like the past, with continued increases in computational power, greater reliability, continued miniaturization, and even lower costs arriving in rapid fire order. Increasingly, portable computers and other personal digital assistants are being used by business and residential consumers as prices decline, ease of use improves, and features become increasingly enhanced. Hardware advances may soon bring us "wearable" computers and "truly personal" computers that will allow more mobility and freedom of movement for users without sacrificing computing ability.[11]

Thus, computer advances have helped permit messages, data, and information to be transferred globally on virtually a moment's notice. As computers continue to become smaller and lighter, as computer power requirements are reduced, as power sources become more portable, and as costs over time decline, computers will become truly ubiquitous. If the information technology community is correct in its predictions of continued rapid advances, the implications for humankind's ability to communicate and relate to one another, the conduct of the business and government affairs, and the structure of the international system are immense.

Fiber Optics. Historically, telegraph, telephone, and cable television services were carried over copper wires and coaxial cables. These are being phased out by a superior technology, fiber optics. Fiber optics, extremely thin glass fibers, carry light pulses similar to Morse code from a sending source to a receiving destination. Fiber optic cables experience lower attenuation and leakage than copper wire, and can carry much more information and data than either copper wire or coaxial cables. For example, copper wire can carry 64,000 bits of information per second, whereas fiber optics can carry over a billion bits of information per second.[12]

Similarly, coaxial cable can transmit only 2 to 4 audio channels and 60 video channels. This transmission capacity is adequate for basic telephone and cable television services, but not for connecting to the "information superhighway." By comparison, a cable television company using fiber optics can transmit over 500 channels and allow customers to custom design their own cable television packages.

We have witnessed only the beginning of the expansion of bandwidth offered by fiber optics. Some experts predict that eventually the capacity of advanced fiber optic cables will exceed one trillion bits of information per second.[13] If this prediction is accurate, humankind's capacity to transmit information will expand tremendously as fiber optic technology evolves and is adopted more widely.

Cellular Technology. Until recently, most commercially available two-way capable electromagnetic transmitters and receivers that could cover extended distances required sizable equipment, wire or cable, or some combination of the two. In any case, the locations from which one could transmit and receive messages were tied to technology that could be transported only with difficulty.

The advent of modern cellular and related technologies is changing this. The combination of miniaturization, local radio nets, advanced networks, and improved transceivers that make up cellular and related technologies is rapidly cutting through the knot that tied telephones to wires or cable and that limited the flexibility of telephonic and related communications.

In the United States and other developed countries, cellular and related technologies entered widespread use in the late 1970s and early 1980s. Since then, the growth in cellular technologies use has been phenomenal. For example, in the United States, commercial cellular systems began operating in 1983; by 1991, approximately 7.5 million Americans subscribed to cellular service; and by 1995, the number had grown to 25 million, with cellular coverage available in half the country. Meanwhile, in Japan, fewer than 250,000 people used cellular phones in 1989; by 1994, the number had grown to 2.1 million people; and by 1996, to approximately 11 million people.14

In essence, cellular telephones are mobile radio transmitters and receivers that look and act like traditional telephones, using radio waves to send and receive messages from remote non-wired locations. Users operate cellular telephones in much the same way that traditional telephones are operated. Unlike land-wired telephones, however, cellular telephones rely on cellular radio towers to transmit messages to and from the cellular user. Users of cellular systems are therefore not tied to sending and receiving locations that are connected by wires.

Although commercial cellular systems have been in use only since the late 1970s and early 1980s, cellular telephone technology is not new. Indeed, it has been used since early in the twentieth century. For example, during World War I, Motorola produced mobile telephones for the Allied armies. These mobile telephones for all practical purposes were the first cellular telephones. Radiophones were similarly used in World War II, the Korean War, and the Vietnam War.15

Although the technology used for communications in these conflicts remained basically the same, the size of the radiophone decreased considerably. Whereas a soldier in World War I required a full backpack to send and receive radio communications, a Vietnam-era soldier needed only a large radio telephone. Today, most cellular telephones are smaller than standard line-wired telephones, and many fit into a shirt pocket. All are powerful enough to send and receive messages several miles. Enhanced miniaturization, advances in networking, and improved transmitter performance will inevitably expand the adoption of cellular technology.

Increasingly, cellular telephone users can also send and receive data as more and more computer users employ cellular telephones in conjunction with computer modems. The combination of cellular technology and portable computers allows people to exchange information to and from virtually anywhere in the world in near real time.

Outside the industrialized world, cellular technology is having a notable impact in many developing states. Newly industrialized countries such as South Korea and Taiwan are using cellular technology to augment existing line-wired telecommunications networks, thereby improving their telecommunications infrastructures without expending resources on land-based telephone lines. Developing countries such as India and some Caribbean states are building new national telecommunications networks using cellular technology instead of traditional land-based line technology.16 For many of these countries, cellular technologies provide better services than land-lines and have lower installation and maintenance costs. Cellular technology has thus helped some developing states construct advanced national telecommunications infrastructures, thereby accelerating economic development.

The most notable recent advance in cellular technology is the personal communication system (PCS). Using cellular technology and employing extremely small cellular radio repeaters to transmit and receive messages, a PCS has several advantages over a traditional cellular system. First, since a PCS cellular repeater is much smaller than traditional cellular radio towers and can fit inside an office or room, it is more flexible than a traditional cellular repeater.17 Second, a PCS also costs less to install and maintain than a traditional cellular system. However, a PCS also has a disadvantage in that it has a more limited range than a traditional cellular system and hence requires many more repeaters to achieve the same coverage.

As cellular systems proliferate, capabilities increase, and costs decline, more and more people will use cellular technology, and use it not for "emergencies" but as their normal means of communications. There is no doubt, then, that cellular technologies are having a sizable impact on the way people interact by eliminating the need to be "connected" by a tether to a house or an office. Cellular technologies have therefore become a central feature of the contemporary information revolution.

Satellite Technology. Satellites have played a major role in global communications since the first true telecommunications satellite, Syncom III, was launched in 1964. The following year, "Early Bird," the world's first commercial communication satellite, was launched. Although it could carry only 240 voice channels or one television channel, "Early Bird" was the beginning of a massive global communication revolution.18

Since then, the entire world has been linked together via communication satellites. Theoretically, a global satellite communication network could employ as few as three satellites, but in fact many satellites, most in geosynchronous orbit 23,000 miles above the equator, make up the present-day global satellite communication network. Most low- and middle-latitude countries use these geosynchronous orbits, but countries in higher latitudes such as Russia often use satellites in elliptical orbits because they have difficulty receiving signals from satellites over the equator.

Satellite communication has improved immensely during the first several decades of its existence. Whereas "Early Bird" and its immediate successors carried only a few hundred voice channels, today's satellites carry thousands of channels for telephone, television, and data transmission. Direct broadcast satellites and store-and-forward satellites are the two main types of communication satellites. A direct broadcast satellite acts as a repeater for information, allowing a broadcast site to send information to a satellite and have that information redirected elsewhere in the world. Store-and-forward satellites allow information to be sent to a satellite, have that information stored until a later time, and transmit that information exclusively to authorized recipients. Direct broadcast satellites are often employed by broadcast and cable television companies, while governments and private business with sensitive data to protect from unauthorized recipients use store-and-forward satellites.

Satellite technology, in conjunction with computers, telephones, digital compression, and other information and communication technologies, has helped build an international communication infrastructure accessible by governments, business, education, and private consumers. Satellite technology provides information—particularly defense-related and weather-related information—previously unavailable to any but major powers and some international corporations. Satellites have made international telephone calls, global electronic mail, intercontinental teleconferencing, and worldwide broadcasts of television events commonplace. Satellite telephone calls, which directly use communication satellites to send and receive messages, have become the norm rather than the exception.

Increased access to instantaneous satellite communications has tied the world more closely together than ever before. As computer advances, digital technologies and digital compression, and cellular technology are increasingly married with satellite communication, the global network of communication satellites will evolve into a seamless information infrastructure that will significantly enhance the value of the connectivity provided.[19]

Indeed, in March 1994, William H. Gates, Chairman of Microsoft, and Craig O. McCaw, Chairman of McCaw Cellular Communications, formed Teledesic Corporation, whose purpose was to create by 2001 a $9 billion global system of 840 low-orbit satellites.[20] Although Teledesic has little likelihood of achieving its goal by 2001, if it or other firms or government are able to create such a system, instantaneous satellite-based communications will be available at virtually every spot on earth.

Advanced Networking. Discussed briefly under computing advances, networking has become a science unto itself. Throughout the world, scientists and engineers are investigating a host of specific methods and concepts to enhance "connectivity," that is, the ability of various forms of communication technologies to talk to each other, and to enhance the speed at which these communications take place.

The largest and best known network is the Internet, used widely in the United States and around the world by governments, universities, businesses, and individuals. Established as the ARPANET in the 1980s by the U.S. Government for use by government and university researchers and analysts to rapidly exchange their research results and ideas, the ARPANET evolved into the Internet and has since expanded throughout the world. Information and information-related services of infinite variety can now be found on the Internet, ranging from stock and commodity prices, instant news and weather updates, census data, homepages for all manner of organizations, religious tracts, items for sale, pen pals, and even specialized forms of pornography.

As Figure 3-1 and Table 3-1 show, the growth of the Internet has been explosive both in quantitative and geographic terms. In 1988, the Internet had barely 100 networks connected to it. By 1991, approximately 4,000 networks were attached. By 1995, approximately 40,000 networks were connected, about two-thirds in the United States. Globally, a new network joined the Internet in 1995 approximately every half hour from countries as widely scattered as Algeria, Brazil, Ghana, Kazakhstan, and Vietnam.

Figure 3-1. The Growth of the Internet

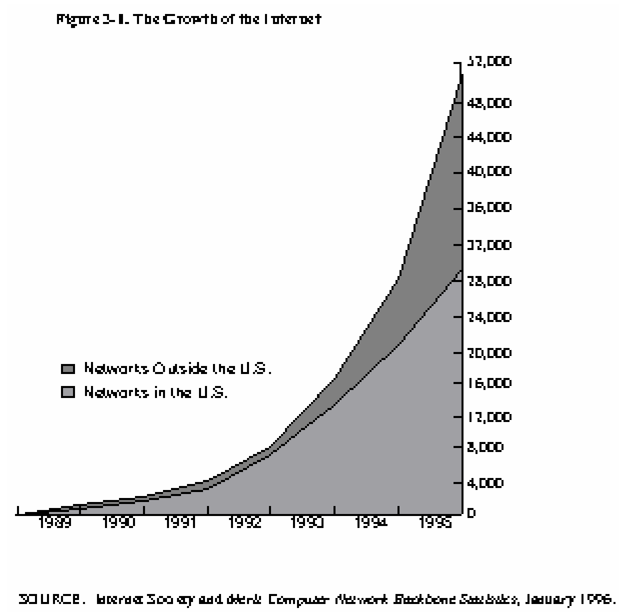

Table 3-1.

Table 3-1. A Country-by-Country Sampling of Computer Networks on the Internet, 1995

Country	Initial Internet Connection	Number of Networks on the Internet, 1995
Algeria	4/94	3
Argentina	10/90	27
Australia	5/89	1,875
Belarus	2/95	1
Belgium	5/90	138
Brazil	6/90	165
Burkina Faso	10/94	2
Canada	7/88	4,795
Chile	4/90	102
China	4/94	8
Denmark	11/88	48
Ecuador	7/92	85
Egypt	11/93	7
France	7/88	2,003
Germany	9/89	1,750
Ghana	5/93	1
Hungary	11/91	164
India	11/90	13
Indonesia	7/93	46
Japan	8/89	1,847
Kazakhstan	11/93	2
Kenya	11/93	1
Mexico	2/89	126
Morocco	10/94	1
Mozambique	3/95	6
Norway	11/88	214
Poland	11/91	131
Russia	6/93	405
Singapore	5/91	107
South Africa	12/91	419
Thailand	7/92	107
Turkey	1/93	97
United Kingdom	4/89	1,436
United States	7/88	28,470
Uruguay	4/94	1
Vietnam	4/95	1

SOURCE: Merit Computer Network Backbone Statistics, January 1996

Even more networking advances are on the horizon. For example, the U.S. Government is pursuing advanced networking under the auspices of the High Performance Computing and Communication (HPCC) program, which has as one of its objectives the development of computer networks capable of transmitting a billion bits (i.e., one gigabit) of data per second. The specific purpose of the HPCC program is to upgrade the U.S. National Research and Education Network (NREN). It is expected that there will be significant commercial spin-offs in areas as diverse as credit card validation, banking, airline and hotel reservations, and outsourcing services. HPCC networking advances will also play a significant role in creating the "information superhighway," which will link many different services from a variety of different electronic mediums into one communication pathway and network.21

The United States leads the world in networking technologies, but even in the United States, the creation of a completely integrated, high-speed, high capacity network remains years away. The creation of such a network that extends beyond the United States linking different states and regions is even farther in the future. Even so, over time, advanced networking application and uses will proliferate. Global electronic mail via the Internet is already a reality, and software systems such as "web browsers" are making it increasingly easy to navigate. Aside from providing access to the Internet, commercial online services such as America Online provide a host of value-added services. Advanced networking is thus a critical technology in the information revolution, with impacts that are only beginning to be realized.

Improved Human-Computer Interaction. In their 50 years of existence, computers have terrified many people because of the complexity of their "man-machine interface." Recently, however, the widespread availability of easily understandable and usable operating systems and software such as Macintosh and Windows has reduced the level of fear. Indeed, more and more people have found and are finding that working with computers is not necessarily all that difficult.

Much of the greater ease of computer use is the result of the greater processing capacity that today's computers have. As computer capacities increase, a greater percentage of capacity can be devoted to simplifying the user interface as opposed to delivering functionality.

Even easier interface systems that utilize voice recognition and handwriting identification are in their infancy, with their maturation and proliferation on the horizon. These and other improved interface technologies promise to open the world of computing to millions of people who currently avoid computers because of real and imagined barriers associated with the user interface. This, in turn, implies that more and more people will exchange messages, data, and information, and find themselves managing, manipulating, and using data in electronic form.22

Digital Transmission and Digital Compression. Until recently, almost all telecommunication mediums used analog transmissions, that is, transmissions in which electrical signals were used to represent the voice, data, graphic, or picture that was being sent. This is changing as digital technology replaces analog technology. Digital transmissions use binary digits—ones and zeros— carried as electrical pulses to represent data and information.

Digital signals have numerous advantages over analog signals. They are completely accurate and less subject to attenuation. They are the language of computers, and they are fast. In addition, digital technology allows users to employ a type of shorthand mathematical approach, digital compression, in which immense data files can be dramatically reduced in size. Digital compression identifies what part of a picture or data set is new and what is old, and sends only the new information. This increases the amount of information that can be sent over a "line" of given capacity.

In basic terms, there are two primary types of compression, "lossless compression" and "lossy compression." Lossless compression is used when the receiving party must replicate exactly the data that was transmitted. For example, if text is being transmitted, every word or entry sent must be received as sent. However, if pictures are being transmitted, a certain loss of clarity, focus, or color may be acceptable. Lossless compression allows less compression. As a result, lossless compression permits a compression ratio of perhaps only 4 or 5, that is, a transmission length of 20 to 25 percent of the uncompressed message.

Lossy compression is another matter. Presently, lossy compression ratios in the 20 to 30 range are typical (requiring only three to five percent of the "full" message, and some experts estimate that lossy compression will allow as much as 100 times the amount of information to be sent over a given channel. Clearly, if this prediction proves accurate, both the speed and the capacity of international communication will expand significantly as digital compression technologies are adopted widely.23

Furthermore, the addition of ISDN services, a digital telecommunications technology that offers users voice mail, quick and clear video-conferencing, and increased speed for data transmission, has greatly expanded the role of the telephone for business and residential use. For example, although facsimile (FAX) technology is not new, only with the advent of widespread digital telecommunications has the FAX pervaded business, government, academic, and residential markets. As business and other users in the 1980s found that new technologies enabled the FAX to quickly transmit even long documents, the use of FAX machines expanded tremendously. By the 1990s, many business and residential users had integrated computing and FAX capabilities.

Digital transmission and digital compression are thus critical technologies of the third modern information revolution. They have already had a significant impact on human interaction and hold promise to further increase humankind’s ability to overcome constraints on communication imposed by time, location, and distance.

Types of Impacts

Individually, each technology discussed above will significantly enhance humankind’s ability to communicate, to utilize information, and to overcome obstacles presented to communication of distance, time, and location. Taken together, however, the impact that these technologies may be expected to have will be significantly magnified. Potential impacts may be grouped into six major areas.

Increased Speed. The speed with which information can be transmitted will increase significantly, and once received, the speed at which it can be managed, manipulated, and interpreted will also increase. The speed at which information flows within organizations and among organizations and international actors will increase, although at differing rates depending upon on a host of factors. Increased speed will matter more for some uses than for others. Not surprisingly, some international actors will benefit more from more rapid information flows than others. But in general, the increased speed of information flow will serve to increase the tempo of interactions.

Greater Capacity. The capacity to transmit information will also increase significantly as these technologies are improved. Once again, increased capacity will become available at different rates to different types of organizations. As with increased speed, greater information and communication capacity will benefit some organizations and international actors more than others. Here, however, the point to be stressed is that for many organizations and actors, the ability to transmit and interpret vastly greater amounts of information will mean that decision makers will have a greatly enhanced picture of the world, themselves, and others upon which to base their decisions.

Enhanced Flexibility. The seven technologies discussed will also enhance the flexibility of information flows. Those needing information will be able to reach out and get it from a greatly increased number of potential sources. Those needing to communicate with someone will find it easier to do so quickly and directly. Put differently, these technologies will decrease the location dependence of information and communication transactions.Once again, enhanced flexibility will be available to some more quickly than others and will matter more for some than for others.

Greater Access. In addition to increased speed, greater capacity, and enhanced flexibility, the seven technologies discussed above will provide greater access to people, organizations, and information to more and more individuals.

Some observers have argued that improved access will lead to the "democratization" of information and communication flows throughout the world, that is, a decreased ability of a few (e.g., governments, businesses, and the "haves") to dominate information and communication channels. This may be true. However, improved access will not occur throughout the world at the same rate of speed. It will also undoubtedly be organized in different ways depending on the organization or actor under discussion. And as we have already discussed, all will not benefit equally. Thus, whether this optimistic scenario of the democratizing impact of information and communication technologies is accurate remains to be seen.

More Types of Message. Little more than a century ago, electronic communications was confined to sending electrical pulses that represented letters of the alphabet a few hundred miles along wire cables. But today, it is possible to send voice, data, and picture messages from one side of the world to the other.

To the extent that more complex messages such as pictures more accurately represent reality and are more quickly absorbed and understood than text messages, the expansion of message types from text to voice, data, and picture is an important factor in enhancing the utility of "global connectivity."

Heightened Demand. The impacts of the technologies discussed above are a direct function of involved technologies. Heightened demand is different as it is not a direct but a secondary impact, that is, a function of how individuals and other international actors will react to the capabilities provided by advanced information and communication technologies. Heightened demand will result from factors such as increased availability, greater utility, heightened interest, ease of use, and of course, lower costs.

Like the direct impacts considered, heightened demand for communications and information will occur unevenly throughout organizations, societies, and international actors. Heightened demand will act much like a chemical catalyst intensifying the impacts of technology and hurrying progress.

Conclusions

There is little doubt that these technologies and other advances in related information and communication technologies will expand humankind's ability to overcome previous limitations on the ability to communicate.

But what will be the effects of these immensely expanded abilities to communicate and to utilize information? Will the effects of these technologies be so significant that the much-heralded "Information Age" becomes a reality? And what exactly will this Information Age be like? How will humankind's established ways of conducting affairs, of undertaking interactions, and of structuring and organizing society be affected? What effects, in turn, will our expanded abilities to communicate have on international actors, their behavior, their structures, their roles in the world, and the international system that they together create?

These are difficult questions to answer. But it is important to try to find answers to them since those who best answer them will be better able not only to operate in the Information Age, but will also be better able to influence how the world will operate and how it it will be shaped. The rest of this book is devoted to an examination of these and other questions and issues about the Information Age.

Notes

1. See for example, Gerald Brock, Telecommunications Policy for the Information Age: From Monopoly to Competition (Cambridge, MA: Harvard University Press, 1994).

2. For a detailed discussion of the development of semiconductors, see Peter R. Morris, A History of the World Semiconductor Industry (London: P. Peregrinus on behalf of the Institute of Electrical Engineers, 1990).

3. Forest Baskett and John L. Hennessy, "Microprocessors: From Desktops to Supercomputers" (Science, Volume 261: August 13, 1993), p. 864.

4. Ibid., and H.S. Lehman, Electronics Technology Perspective (Paper presented for the research seminar, "The Information Revolution: Its Current and Future Consequences" (Atlanta, GA: Packaging Research Center, Georgia Institute of Technology, 1995), pp. 4-5.

5. Raymond A. Fillion, "A Forecast on the Future of Hybrid Wafer Scale Integration Technology" (IEEE Transactions on Components, Hybrids, and Manufacturing Technology, v16: November 1993), p. 615.

6. Ibid., pp. 615-624.

7. Ibid., pp. 615-624.

8. Baskett and Hennessy, p. 864.

9. For a discussion of the HPCC program, see Dana A. Browne et al. (eds.), High Performance Computing and Its Applications in the Physical Sciences: Proceedings of the Mardi Gras ‘93 Conference, February 18-20, 1993, Louisiana State University (River Edge, NJ: World Scientific, 1994).

10. For a discussion of the first three generations of computers, see Chapter 1.

11. For a discussion of "wearable" and "truly personal computers," see S. Finger, et al., "Rapid Design and Manufacture of Wearable Computers," Communications of the ACM (February 1996) and Galen Gruman, "Truly Personal Computers," MacWorld (August 1996).

12. For discussions of fiber optics, see Lynne D. Greene, Fiber Optic Communications (Boca Raton, FL: CRC Press, 1993); Gail J. Brown, Technologies for Optical Fiber Communications (Bellingham, WA: USA SPIE, 1994); Joseph W. Goodman, "Levels of Light," Byte (October 1989); and Paul Merenbloom, "Considering Copper? Think Fiber to the Desktop," InfoWorld (November 27, 1995).

13. "Modeling Reality," IEEE Spectrum, (September 1992), p. 56.

14. "Enter, Son of Walkman," Economist (June 22, 1996), pp. 64-67; The New York Times, March 18, 1992; and "Remote Phones Made Simple," Mother Earth News (April 1996), pp. 18-22.

15. For a discussion of the development of wireless telephony, see George G. Blake, History of Radio Telegraphy and Telephony (New York, NY: Arno Press, 1974).

16. The New York Times, July 6, 1992; and Michael Vatikiotis and Jonathan Karp, "Upwardly Mobile," Far Eastern Economic Review, (May 18, 1995), pp. 82-86.

17. Sara Curtis, "Beyond Cellular," MacLean’s (January 23, 1995), pp. 46-47; and Economist (June 22, 1996), pp. 64-67.

18. For discussions of communications satellites, see Gary D. Morgan and Walter L. Morgan, Principles of Communication Satellites (New York, NY: Wiley, 1993); James Wood, Satellite Communications Pocket Book (Boston, MA: Newnes, 1994); and G. Marall and M. Bousquet, Satellite Communications Systems: Systems, Techniques, and Technology (New York, NY: Wiley, 1993).

19. "Infrastructure in the Sky," Economist (March 26, 1994), pp. 101-102; and Gary Stix, "Cyberspace Cadets," Scientific American (June 1994), pp. 98-101.

20. Atlanta Journal Constitution (March 21, 1994).

21. Dana A. Browne, et al. (eds.), High Performance Computing and Its Applications in the Physical Sciences: Proceedings of the Mardi Gras '93 Conference, February 18-20, 1993, Louisiana State University (River Edge, NJ: World Scientific, 1994); and Raymond A. Fillion, "A Forecast on the Future of Hybrid Wafer Scale Integration Technology" (IEEE Transactions on Components, Hybrids, and Manufacturing Technology, November 1993), p. 615.

22. For discussions of human-computer interaction, see Alan Dix, Human-Computer Interaction (New York, NY: Prentice Hall, 1993); Mark W. Lansdale and Thomas C. Ormerod, Understanding Interface: A Handbook of Human-Computer Dialogue (San Diego, CA: Academic Press, 1994); and Brad J. Blumenthal, Human-Computer Interaction (New York, NY: Springer Verlag, 1994).

23. For discussions of digital transmission and compression, see Richard E. Matick, Transmission Lines for Digital and Communication Networks (New York, NY: Institute of Electrical and Electronics Engineers, 1995); Arun N. Netravali, Digital Pictures: Representation, Compression, and Standards (New York, NY: Plenum Press, 1995); and R.J. Clarke, Digital Compression of Still Images and Photos (New York, NY: Academic Press, 1995).

Chapter 4: What Information Society?*

by Frank Webster

Commentators increasingly talk about information as a defining feature of the modern world. Much attention is now devoted to the informatization of social life: we are told that we are entering an Information Age, that a new mode of information predominates, that we have moved into a global information economy. Many writers even identify as information societies the United States, Britain, Japan, Germany, and other nations with a similar way of life. Indeed, it appears that information has "become so important today as to merit treatment as a symbol for the very age in which we live."1

Just what sense to make of this symbol has been the source of a great deal of controversy. To some, it constitutes the beginning of a truly professionalized and caring society, while to others, it represents a tightening of control over the citizenry; to some, it heralds the emergence of a highly educated public that has ready access to knowledge, while to others, it means a deluge of trivia, sensationalism, and misleading propaganda; to some, it was the development of the nation state that promoted the role of information, while to others, it was changes in corporate organization that led information to become more critical.

However, a major division of opinion that cuts across interpretations is the separation between thinkers who, on the one hand, subscribe to the notion that in recent times we have seen emerge information societies that are marked by their differences from hitherto existing societies. Not all of these are altogether happy with the term "information society," but insofar as they argue that the present era is special and different, marking a turning point in social development, then I think they can be described as its endorsers. On the other hand, there are scholars who, while happy to concede that information has taken on a special significance in the modern era, insist that the central feature of the present is its continuity with the past.

We may separate those who endorse the idea of an information society and those who regard informatization as the continuation of pre-established relations. Toward one wing we may position those who proclaim a new sort of society that has emerged from the old. Drawn to this side are theorists of

- postindustrialism2
- postmodernism3
- flexible specialization4
- the control revolution5
- the informational mode of development6

On the other side are writers who place emphasis on continuities. I would include here theorists of

- neo-Marxism[7]
- regulation theory[8]
- flexible accumulation[9]
- nation state and violence[10]
- the public sphere[11]

None of the latter group denies that information is key to the modern world, but unlike the former group, they argue that the form and function of information is subordinate to long-established principles and practices.

In what follows, I pay particular attention to definitions that underpin information society theorists. The insistence of these thinkers that our time is one of novelty cries out for analysis, more urgently than those scenarios that contend that the status quo remains. Of course, it is also unavoidable that in examining information society theorists, I shall consider aspects of the latter group, since a good deal of this critique requires expression of their misgivings.

Definitions of the Information Society

In reading the voluminous literature on the information society, many writers operate with undeveloped definitions of their subject. They write copiously about particular features of the information society but are curiously vague about their operational criteria. Eager to make sense of changes in information, they rush to interpret these changes in terms of different forms of economic production, new forms of social interaction, or innovative processes of production. However, they very often fail to set out clearly in what ways and why information is becoming more central today, so critical indeed that it is ushering in a new type of society. Just what is it about information that makes so many think that it is at the core of the modern age?

It is possible to distinguish analytically five definitions of an information society, each of which presents criteria for identifying the new. These are technological, economic, occupational, spatial, and cultural.

Technological. The most common definition of the information society emphasizes spectacular technological innovation. The key idea is that breakthroughs in information processing, storage, and transmission have led to the application of information technologies (IT) in virtually all corners of society. The major concern is the astonishing reductions in the costs of computers, their prodigious increases in power, and their consequent application anywhere and everywhere.

Because it is now economical and feasible to put computers in typewriters, cars, cookers, watches, factory machines, televisions, and toys, it follows that we are certain to experience social upheaval of such magnitude that we shall enter a new era. Many books, magazine articles, and TV presentations have encouraged the development of a distinct genre that offers this viewpoint: the mighty micro will usher in an entirely new silicon civilization.

Somewhat more sophisticated versions of this technological route to the information society attend to the convergence and imbrication of telecommunications and computing. They argue that cheap information processing and storage technologies (computers) lead to extensive distribution. One of the major areas thus impacted is telecommunications, notably switching centers, which, in being computerized, in effect merge with the general development of computing and impel still more dramatic improvement of information management and distribution. This unification is especially fortuitous because the widespread dissemination of computers means that, for optimum use, they require connection. In short, the computerization of telecommunications means that, increasingly, computer can be linked to computer, hence the prospect of links between terminals within and between offices, banks, homes, shops, factories, schools, the globe itself.

It is tempting to dismiss technological approaches to the information society. Awed by the pace and magnitude of technological change, writers naively tell us that "the computer revolution...will have an overwhelming and comprehensive impact, affecting every human being on Earth in every aspect of his or her life."12 This tone is characteristically full of dire wake-up warnings, shallow analyses of the substantive realm, and the self-assurance that only the author has understood what most others have yet to comprehend. It presents but a poor case for the validity of technological measures.13

Nevertheless, if the likes of Alvin Toffler, Christopher Evans, and James Martin impel one toward ready rejection of technological criteria, it has to be acknowledged that many more serious scholars adopt what is at base a similar approach. For instance, Williams, a leading American communications professor, opines that "it [the information society] is a society where the economy reflects growth owing to technological advances."14 And Williams is far from alone. In Britain, for example, a much respected school of thought has devised a neo-Schumpeterian approach to change. Combining Schumpeter's argument that major technological innovations bring about creative destruction with Kondratieff's theme of long waves of economic development, these researchers contend that IT represents the establishment of a new epoch. This new techno-economic paradigm constitutes the Information Age that is set to mature early in the next century.15

Common sense tells us that these technological definitions of the information society do seem appropriate. If it is possible to see a "series of inventions"—steam power, the internal combustion engine, electricity, the flying shuttle—as characteristic of the industrial society, then why not accept the virtuoso developments in IT as evidence of a new type of society?16 As Naisbitt states, "Computer technology is to the Information Age what mechanization was to the industrial revolution."17 And why not?

Unfortunately, technological definitions of the information society must encounter a number of well-founded objections, including the following:

(1) If technology is the main criterion for defining a society, then why not just call the emerging era a high-tech society or an automated age? Given the variety of ways to describe a society in which IT predominates—silicon society, cybernetic society, robotic age—why choose to designate it an information society? If technology is the key, then why is the prefix "information" attached?

(2) When one reads of profound and portentous changes that new technology is bringing about, one cannot but be struck by its palpable presence. There is a self-evident reality about the hereness of the new technologies. Since each of us can see it with our own eyes, then it does seem obvious that the technologies are valid as distinguishing features of a new society.

But probing further, one cannot but be struck also by the astonishing vagueness of technology in most of these books. We ask for an empirical measure—in this society now, how much IT is there and how far does this take us toward qualifying for information society status? How much IT is required in order to identify an information society? Asking simply for a usable measure, one quickly becomes aware that a good many of those who emphasize technology are not able to provide us with anything so mundanely real worldly or testable. IT, it begins to appear, is everywhere ...and nowhere too.

This problem of measurement, and the associated difficulty of stipulating the point on the technological scale at which a society is judged to have entered an Information Age, is surely central to any acceptable definition of a distinctively new type of society. It is ignored by popular futurists: the new technologies are announced, and it is unproblematically presumed that this announcement in and of itself heralds the information society. This issue is, surprisingly, also bypassed by scholars who yet assert that IT is the major index of an information society. They are content to describe technological innovations in general terms, somehow presuming that this is enough to distinguish the new society.

(3) The final objection to technological definitions of the information society is frequently made. Critics object to those who assert that, in a given era, technologies are first invented and then subsequently have an impact on the society, thereby impelling people to respond by adjusting to the new. Technology in these versions is privileged above all else; hence, it comes to identify an entire social world: the Steam Age, the Age of the Automobile, the Atomic Age.

The central objection here is not that this is unavoidably technologically determinist—in that technology is regarded as the prime social dynamic—and as such an oversimplification of processes of change. It most certainly is this, but more important, it relegates into an entirely separate division social, economic, and political dimensions of technological innovation. These follow from, and are subordinate to, the premier league of technology that appears to be self-perpetuating, though it leaves its impress on all aspects of society.

But technology is not aloof from the social realm in this way. On the contrary, it is an integral and, indeed, constitutive part of the social. For instance, research and development decisions express priorities, and from these value judgments, particular types of technology are produced (e.g., military projects received substantially more funding than health work in the twentieth century western world; not surprisingly, a consequence is state-of-the-art weapon systems that dwarf the advances of treatment, say, of the common cold). Many studies have shown how technologies bear the impress of social values. Again, market power has an obvious influence on what gets manufactured technologically: corporations think of the customers and potential customers prior to production so it is not surprising that there are limits to what gets made imposed by ability to pay criteria.

Economic. There is an established subdivision of economics that concerns itself with the economics of information. As a founder of this specialism, the late Fritz Machlup (1902-1983) devoted much of his professional life to the goal of assessing the size and growth of the information industries. Machlup's pioneering work, The Production and Distribution of Knowledge in the United States (1962), has been seminal in establishing measures of the information society in economic terms.[18]

Machlup attempted to trace the information industries in statistical terms. Distinguishing five broad industry groups (two of which are education and media), he attempted to ascribe an economic value to each and to trace its contribution to gross national product (GNP). If the trend is for these groups to account for an increased proportion of GNP, then one may claim to chart the emergence through time of an information economy. This is just what Machlup proposed in this early study, which calculated that 29 percent of the GNP of the United States in 1958 came from the knowledge industries, which at the time was a remarkable rate of expansion.

As early as the 1960s, management guru Peter Drucker was contending that knowledge had become the foundation of the modern economy as we have shifted "from an economy of goods [to]... a knowledge economy."[19] Today it is commonplace to argue that we have evolved into a society where the "distinguishing characteristic...is that knowledge and organization are the prime creators of wealth."[20]

Probably the best known, and certainly the most cited, study of the emergence of an information economy conceived on these lines comes in a nine-volume report from Porat.[21] In allocating industries to his five categories, Machlup had adopted Catholic definitions of "knowledge production," broadly including both those that created new information and those that communicated it. Porat echoed much of Machlup's approach in his reliance on government statistical sources to design a computer model of the U.S. economy in the late sixties, but divided the economy between the primary, secondary and noninformation sectors. This tripartite schema stemmed from his identification of a weakness in Machlup's work, in which there was a failure to account for information activities that were disguised from initial examination, for example, because they are an in-house element of other industries. Porat included in the primary information sector all those industries that make available their information in established markets or elsewhere, where an economic value can be readily ascribed (e.g., mass media, education, advertising, computer manufacture).

This quantification of the economic significance of information is an impressive achievement. It is not surprising that those convinced of the emergence of an information society have routinely turned to Machlup and, especially, Porat as authoritative demonstrations of a rising curve of information activity, one set to lead the way to a new age.

However, there are difficulties with the economics of information approach.22 One is that, behind the weighty statistical tables that are resonant of objective demonstration, there is a great deal of hidden interpretation and value judgment as to how to construct categories and what to include and exclude from the information sector.

Another difficulty is that the aggregated data inevitably homogenize very disparate economic activities. In the round, it may be possible to say that growth in the economic worth of advertising and television is indicative of an information society, but one is left with an urge to distinguish between informational activities on qualitative grounds. In asking which economically assessed characteristics are more central or strategic to the emergence of an information society, one is requesting scholars to distinguish between, say, information stemming from policy research centers, corporate think tanks transnational finance houses, manufacturers of 35-mm cameras, software designers, and the copywriters of Saatchi and Saatchi.

Of course, these economists are concerned solely with developing quantitative measurements of the information sector, so the issue of the qualitative worth of information would be of limited relevance to them. However, even on their own terms, there are problems. One, mentioned earlier, is the question about the point on the economic graph that one enters an information society. Is it when 50 percent of GNP is dedicated to informational activities? This may seem to be a reasonable point, one at which, in straightforward quantitative terms, information begins to predominate. Sadly for information society theorists, however, we are some distance even from that point. Replication studies of Machlup and Porat lead one to qualify any initial sighting of the new age. Rubin and Taylor, in a large-scale update of Machlup's study, concluded that in the United States the contribution of knowledge industries to GNP increased from 28.6 percent to 34.3 percent between 1958 and 1980, with virtually no change since 1970, this constituting an extremely modest rate of growth relative to the average rate of growth of other components of total GNP."23 Furthermore, the same authors' replication of Porat's influential study found little expansion of the information sector during the seventies when compared with other contributors to GNP. These econometric studies scarcely trumpet the arrival of an information society.

Occupational. A popular measure of the emergence of an information society is the one that focuses on occupational change. Put simply, the contention is that we have achieved an information society when the predominance of occupations is found in information work. That is, the information society has arrived when clerks, teachers, lawyers, and entertainers outnumber coal miners, steelworkers, dockers, and builders.

On the surface, the changing distribution of jobs seems an appropriate measure. After all, it appears obvious that as work that demands physical strength and manual dexterity, such as hewing coal and farming the land, declines to be replaced by more and more manipulation of figures and text, such as in education and large bureaucracies, then so we are entering a new type of society. Today "only a shrinking minority of the labor force toils in factories...and the labor market is now dominated by information operatives who make their living by virtue of the fact that they possess the information needed to get things done."24

This trend is seized upon by many reports. For instance, two influential Organization for Economic Cooperation and Development publications produced figures from all member countries, signaling "continued growth...in those occupations primarily concerned with the creation and handling of information and with its infrastructure support."25 Elsewhere, Porat identifies an "astonishing growth rate" of the "information work force," which doubled every 18.7 years between 1860 and 1980, thereby propelling the United States toward "the edge of an information economy."26

The shift in the distribution of occupations is at the heart of the most influential theory of the information society. Here, Daniel Bell sees in the emergence of a white collar society (and, hence, information work) and the decline of industrial labour, changes as profound as the end of class-based political conflict, more communal consciousness, and the development of equality between the sexes.

I consider and critique Bell’s theorization elsewhere,27 but here it is appropriate to raise some general objections to occupational measures of the information society. A major problem concerns the methodology for allocating workers to particular categories. The end product—a bald statistical figure giving a precise percent age of information workers—hides the complex processes by which researchers construct their categories and allocate people to one or another.

Porat, for instance, develops what has become an influential typology to locate occupations that are primarily engaged in the production, processing, or distribution of information. His is a threefold scheme that encompasses more than 400 occupational types that are reported by the U.S. Census and Bureau of Labor Statistics.28

Jonscher simplifies this further still, discerning just two sectors of the economy: the first, an information sector, is where people whose prime function is creating, processing, and handling information; the second, a production sector, is where workers are found who chiefly create, process, and handle physical goods.29

These distinctions appear reasonable, precise, and empirically valid, but there are difficulties. Not the least is something Porat is well aware of, namely, that "stating precisely who is an information worker and who is not is a risky proposition."30 Indeed it is, since every occupation involves a significant degree of information processing and cognition. Porat acknowledges this in his attempt to distinguish noninformational from informational labor on the basis of estimating the degree to which each type is involved with information. In other words, the categorization is a matter of judging the extent to which jobs are informational or not.

For example, the railway signal man must have a stock of knowledge about tracks and timetables and roles and routines; he needs to communicate with other signal men down the line, with station personnel and engine drivers, is required to "know the block" of his own and other cabins, must keep a precise and comprehensive ledger of all traffic that moves through his area, and has had little need of physical strength to pull levers since the advent of modern equipment. Yet the railway signal man is, doubtless, a manual worker of the industrial age. Conversely, the person who comes to repair the photocopier may know little about products other than the one for which he has been trained, may well have to work in hot, dirty, and uncomfortable circumstances, and may need considerable strength to move heavy machinery and replace damaged parts. Yet he will undoubtedly be classified as an information worker, since his work with new-age machinery suits Porat's interpretations.

The point to be made here is simple: we need to be skeptical of conclusive figures that are the outcomes of researchers' perceptions of where occupations are to be most appropriately categorized. As a matter of fact, social scientists know very little about the detail and complexity of peoples' jobs; there are precious few ethnographies that record the details of working lives.31 And researchers trying to label "information" and "noninformation" work are just as much in the dark as the rest of their social science colleagues.

It has to be said that counting the number of information workers in a society tells us nothing about the hierarchies—and associated variations in power and estee—of these people. For example, it could be argued that the crucial issue has been the growth of computing and telecommunications engineers, since these may exercise a decisive influence over the pace of technological innovation. A similar, perhaps even greater, rate of expansion in social workers to handle problems of an aging population and increased family dislocation and juvenile delinquency may have little or nothing to do with an information society, though undoubtedly, social workers would be classified with IT engineers as "information workers."

Or it may be argued that it is an "inner circle" of corporate leaders, quite different from their predecessors, that is the most decisive index of the information society.32 These are people who are empowered by communicative skills, analytical abilities, foresight, and capacities to formulate strategic policies, who also enjoy privileged educational backgrounds, connections through shared clubs and boardroom affiliations, plus access to sophisticated information and communications technologies. All of this provides them with extraordinary leverage over social, economic, and political affairs at the national and even international level. They are information specialists but radically different from the run-of-the-mill information workers that quantitative methodologists would crudely lump them with.

If one is searching for an index of the information society in these thinkers, one will be directed to the quality of the contribution of certain groups. Whether one agrees or not with either of these interpretations, the challenge to the definitions of an information society on the basis of a count of raw numbers of information workers should be clear. To thinkers such as Perkin and Gouldner,33 the quantitative change is not the main issue. Indeed, as a proportion of the population, the groups they lay emphasize upon, while having expanded, remain distinct minorities—tiny in the case of Useem's "inner circle" and more numerous where the growth of professions is identified, but never more than 20 or 25 percent of the workforce.

Spatial. The spatial conception of the information society, while it draws on sociology and economics, has at its core the geographer's distinctive stress on space. Here the major emphasis is on the information networks that connect locations and, in consequence, have dramatic effects on the organization of time and space. Goddard (1991) identifies four interrelated elements in the transition to an information society.34

(1) Information is coming to occupy center stage as the key strategic resource on which the organization of the world economy is dependent. The modern world demands the coordination of globally distributed manufacture, planning across and between sovereign states, and marketing throughout continents. Information is axial to these diverse activities and, thus, is of heightened importance in the contemporary world. It follows too that information management is of exceptional pertinence and that, as a result, we witness the rapid expansion of information occupations.

(2) Computer and communications technologies provide the infrastructure that enables information to be processed and distributed. These technologies allow information to be handled on an historically unprecedented scale, facilitate instantaneous and "real-time" trading, and monitor economic, social, and political affairs on a global stage.

(3) There has been an exceptionally rapid growth of the tradable information sector of the economy, by which Goddard means to highlight the explosive growth of services, such as new media (satellite broadcasting, cable, video) and online databases providing information on a host of subjects ranging from stock market dealings, commodity prices, patent listings, and currency fluctuations to abstracts of scientific and technological journals.

Complementing these developments has been the radical reorganization of the world's financial system, which has resulted in the collapse of traditional boundaries that once separated banking, brokerage, financial services, credit agencies and the like. Inside this bewildering world of high finance—which few people understand and still fewer appear able to control—circulates, in electronic form, dazzling sums of capital (one estimate suggests there are $2 trillion Eurodollars in the system, though there were none just over a generation ago).35

(4) The growing "informatization" of the economy is facilitating the integration of national and regional economies.

Courtesy of immediate and effective information processing and exchange economics has become truly global, and with this has come about a reduction in the constraints of space. Companies can now develop global strategies for production, storage, and distribution of goods and services. Financial interests operate continuously, respond immediately and traverse the globe. The boundaries erected by geographical location are being pushed further and further back—and with them the limitations once imposed by time—thanks to the virtuoso ways in which information can be managed and manipulated in the contemporary period.

Added together, these trends—the strategic importance of information, the establishment of an IT infrastructure, the growth of tradable information, and global integration—emphasize the centrality of information networks, linking together locations within and between towns, regions, nations, continents, and the entire world.

As the electricity grid runs throughout an entire nation, extending down to the individual householder's ring main, so too may we envisage now a wired society operating at the national, international, and global levels to provide an information ring main to each home, shop, or office.36 Increasingly, we are all connected to the network, which itself is expanding its reach and capacities.

Many writers emphasize the technological bases of the information network.37 Perhaps predictably then, with these accounts of an emerging network society, considerable attention is given to advances in and obstacles to the development of an Integrated Services Digital Network (ISDN) infrastructure.38

However, notwithstanding the importance of technology, and actually providing a salutary reminder of the easily neglected centrality of telecommunications to IT developments, most thinkers concerned with the emergence of a network marketplace place stress on ways in which networks underline the significance of the flow of information.39

The salient idea here is of information circulating along electronic "highways." Interestingly, no one has been able to quantify how much and at what rate information must flow along these routes to constitute an information society. In fact, no one has produced reliable figures capable of giving us an overall understanding of information traffic.40 We have data on telephone density in relation to population, figures on the expansion of facsimile services, statistics for sales of computer systems, automated telecommunications exchanges, and so on, but lack a clear picture of the size, capacity, and use of the networks.

Nevertheless, all observers are aware of a massive increase in transborder data flows, in telecommunications facilities, in communications between computers at every level from home to transnational organization, in exchanges between stock markets and corporate segments, in access to international databases, and in telex messages. Similarly, there is considerable awareness of increases in the global distribution of mass-mediated information, satellite television being the obvious and preeminent example, though one would have to include news gathering and distribution services in any adequate picture.

As Mulgan has it, "the networks carry an unimaginable volume of messages, conversations, images, and commands."41

Why much greater volume and velocity should impel us to think of information flows in terms of the constitution of a new type of society returns us to the geographer's special concern with space. All things happen in particular places and at specific times, but the characteristics of space and time have been transformed with the advent of the network society. Where once trade was cumbersome and slow moving across distances, it can now be effected instantaneously with computerized communications technologies; where once corporate activity had to be coordinated by slow-moving letters that took days and even weeks to cross the space that divided the interested parties, now it takes place in real time, courtesy of sophisticated telecommunications and video conference facilities.

In short, the constraints of space have been dramatically limited, though certainly not eliminated. And simultaneously, time has itself been shrunk as contact is immediate via computer communications and telecommunications. This "time/space compression," as Giddens terms it, provides corporations, governments, and even individuals with hitherto unachievable options.

No one can deny that information networks are an important feature of contemporary societies: satellites do allow instantaneous communications around the globe, databases can be accessed from Oxford to Los Angeles, Tokyo, and Paris, and facsimile machines and interconnected computer systems are a routine part of modern businesses.

Yet we may still ask: Why should the presence of networks lead analysts to categorize societies as information economies? And when we ask this, we encounter the problem of the imprecision of definitions once again. For instance, when is a network a network? Is it two people speaking to one another by telephone, or computer systems transmitting vast data sets through a packet switching exchange; is it when an office block is "wired," or when terminals in the home can communicate with local banks and shops? The question of what actually constitutes a network is a serious one, and it raises problems not only of how to distinguish between different levels of networking, but also of how we stipulate a point at which we have entered a network/information society.

Cultural. The final conception of an information society is perhaps the most easily acknowledged yet the least measured. Each of us is aware, from the pattern of our everyday lives, that there has been an extraordinary increase in the information in social circulation. There is simply a great deal more of it about than ever before.

Television has been in extensive use for over 30 years in Britain, but now programs run round-the-clock. There is much more radio output available now than even a decade ago, at the local, national, and international levels. Radios are no longer fixed in the front room, but spread through the home, car, office, and with the Walkman, everywhere. Movies have long been an important part of peoples' information environment and indeed, attendance at cinemas has declined significantly. But movies today are more prevalent than ever: available at cinema outlets, broadcast on television, readily borrowed from video rental shops, and cheaply purchased from the shelves of chain stores. Walk along any street and it is almost impossible to miss the advertising hoardings, the billboards, the window displays in shops. Visit any railway or bus station and one cannot avoid being struck by the widespread availability of paperback books and inexpensive magazines, their subject matter including such a range as classical, pulp fiction, middle-brow, and self-therapy—a scale and scope without precedent. In addition, audio tape, compact disc, and radio all offer more, and more readily available, music, poetry, drama, humor, and education to the general public. Newspapers are extensively available, and a good many new titles fall on our doorsteps as free sheets. Junk mail is delivered daily.

All of this testifies to the fact that we inhabit a media-laden society, but the informational features of our world are more thoroughly penetrative than a short list of television, radio, and other media systems suggests. This sort of listing implies that new media surround us, presenting us with messages to which we may or may not respond. But in truth, the informational environment is a great deal more intimate, more constitutive of us, than this suggests. One may consider, for example, the informational dimensions of the clothes we wear, the styling of our hair and faces, the very ways in which we work at our image. From body shape to speech, people are intensely aware of the messages they may be projecting and how they feel about themselves in certain clothes, with a particular hairstyle, etc. A few moments' reflection on the complexities of fashion, the intricacy of the ways in which we design ourselves for everyday presentation, make one well aware that social intercourse involves a greater degree of informational content now than previously.

This intrusion of information into the most intimate realms of home, bedroom, and body is complemented by the growth of institutions dedicated to investing everyday life with symbolic significance. One thinks of the global advertising business, of publishing empires, of the fashion industry, of worldwide agencies of media production that bring to the domestic scene reflections of our own ways of life and images of other lifestyles, thereby presenting us with alternative meanings that may be absorbed, rejected, and reinterpreted, but all the while adding to the vocabulary of the symbolic environment.

Readers will recognize and acknowledge this extraordinary expansion of the informational content of modern life. Contemporary culture is manifestly more heavily information laden than any of its predecessors. We exist in a media-saturated environment, which means that life is quintessential about symbolization, about exchanging and receiving—or trying to exchange and resisting reception of—messages about ourselves and others. It is in acknowledgment of this explosion of signification that many writers conceive of our having entered an information society. They rarely attempt to gage this development in quantitative terms, but rather start from the "obviousness" of our living in a sea of signs, fuller than at any earlier epoch.

Paradoxically, it is perhaps this very explosion of information that leads some writers to announce the death of the sign. Blitzed by signs, designing ourselves with signs, unable to escape signs wherever we may go, the result is, oddly, a collapse of meaning. As Baudrillard puts it, "there is more and more information, and less and less meaning."42 Signs once had a reference (clothes, for example, signified a given status, the political statement a distinct philosophy, the TV news was "what really happened"). However, in this postmodern era, we are enmeshed in such a bewildering web of signs that they lose their salience. Signs come from so many directions and are so diverse, fast changing, and contradictory that their power to signify is dimmed. In addition, audiences are creative, self-aware, and reflective, so much so that all signs are greeted with skepticism and a quizzical eye, hence easily inverted, reinterpreted, and refracted from their intended meaning. Thus, the notion that signs represent some reality apart from themselves loses its credibility.

Experientially, the idea of an information society is recognized easily enough, but as a definition of a new society, it is considerably more wayward than any of the notions we have considered. Given the absence of criteria we might use to measure the growth of signification in recent years, it is difficult to see how students of postmodernism such as Poster can depict the present as characterized by a novel mode of information.43 How can we know this other than from our sense that there is more symbolic interplay going on? And on what basis can we distinguish this society from, say, that of the 1920s, other than purely as a matter of degree of difference? Those who reflect on the postmodern condition have interesting things to say about the character of contemporary culture but as regards establishing a clear definition of the information society, they are glaringly deficient.

Quality and Quantity

Reviewing these varying definitions of the information society, what becomes abundantly clear is that they are either underdeveloped or imprecise, or both. Whether it is a technological, economic, occupational, spatial, or cultural conception, we are left with highly problematical notions of what constitutes, and how to distinguish, an information society.

It is important that we remain aware of these difficulties. Though as a heuristic device, the term "information society" has some value in exploring features of the contemporary world, it is far too inexact to be acceptable as a definitive term. Now, however, I want to raise some further difficulties with the language of the information society. The first problem concerns the quantitative versus qualitative measures to which I have already alluded. My earlier concern was chiefly that quantitative approaches failed to distinguish more strategically significant information activity from that which was routine and low level and that this homogenization was misleading. Here I want to raise again the quality/quantity issue insofar as it bears upon the question of whether the information society marks a break with previous sorts of societies.

Most definitions of the information society offer a quantitative measure (numbers of white collar workers, percentage of GNP devoted to information, etc.) and assume that, at some unspecified point, we enter an information society when this condition begins to predominate. But there are no clear grounds for designating as a new type of society one in which all we witness is greater quantities of information in circulation and storage. If there is just more information, then it is hard to understand why anyone should suggest that we have before us something radically new. This is a point made well by Giddens, when he observes that all societies, as soon as they are formed into nation states, are information societies insofar as routine gathering, storage, and control of information about population and resources are essential to their operation.44 On this axis, all that differentiates the present era from, say, seventeenth century England, is much greater quantities of information that are amassed, dissembled, and processed.

The blunt point is that quantitative measures—simply more information—cannot of themselves identify a break with previous systems, while it is at least theoretically possible to regard small but decisive qualitative changes as marking a system break. After all, just because there are many more automobiles today than 30 years ago does not qualify us to speak of a "car society." What is especially odd is that so many of those who identify an information society as a new type of society do so by presuming that this qualitative change can be defined simply by calculating how much information is in circulation, how many people work in information jobs, and so on. What we have here is the assumption that quantitative increases transform, in unspecified ways, into qualitative changes in the social system.

It is noticeable that those scholars such as Herbert Schiller and David Harvey,45 who stress the continuities of the present with those of the past, while they acknowledge an increasingly central role played by information, have at the forefront of their minds the need to differentiate between categories of information and the purposes to which it is put. In other words, those who insist that the informationalized society is not radically different from the past are at pains to differentiate information on qualitative grounds. For instance, they will examine how information availability has been affected by the application of market criteria and contend that the wealthier sectors of society gain access to particularly high-quality information, which consolidates their privileges and powers. Yet, while they emphasize these sorts of qualitative dimensions of informatization, they do so to highlight continuities of the socioeconomic system. Conversely, those who consider that the information society is a radically different system most often recourse to quantitative indices to demonstrate a profound qualitative change.

Roszak provides an interesting insight into this paradox in his critique of information society themes.46 His examination emphasizes the importance of qualitatively distinguishing information, extending to it what each of us does on an everyday basis when we differentiate between phenomena such as data, knowledge, experience, and wisdom. Certainly, these are themselves slippery terms—one person’s knowledge attainment (say, a graduation degree) can be another’s information (say, the pass rate of a university)—but they are an essential part of our daily lives. In Roszak’s view, the present "cult of information" functions to destroy these sorts of qualitative distinctions, which are the stuff of real life. It does this by insisting that information is purely quantitative, subject to statistical measurement. But to achieve calculations of the economic value of the information industries, of the proportion of GNP expended on information activities, the percentage of national income going to the information professions, and so on, the qualitative dimensions of the subject (is the information useful? is it true or false?) are laid aside. "For the information theorist, it does not matter whether we are transmitting a fact a judgment, a shallow cliche, a deep teaching, a sublime truth, or a nasty obscenity."47 These qualitative issues are laid aside as information is homogenized and made amenable to numbering: "Information comes to be a purely quantitative measure of communicative exchanges."48

The astonishing thing to Roszak is that along with this quantitative measure of information comes the assertion that more information is profoundly transforming social life. Having produced awesome statistics on information activity by blurring the sort of qualitative distinctions we all make in our daily lives, information society theorists then assert that these trends are set to qualitatively change our entire lives.

Roszak vigorously contests these ways of thinking about information...Roszak insists that the "master ideas" that underpin our civilization are not based upon information at all. Principles such as "all men are created equal," "my country right or wrong," "live and let live," "we are all God's children," and "do unto others as you would be done by" are central ideas of our society, but all come before information.49

It is important to say that Roszak is not arguing that these and other master ideas are necessarily correct...But what he is emphasizing is that ideas, and the necessarily qualitative engagement these entail, take precedence over quantitative approaches to information. And what he especially objects to is that information society theorists reverse that situation at the same time as they smuggle in the (false) idea that more information is fundamentally transforming the society in which we live.

What is Information?

Roszak's rejection of statistical measures leads us to consider perhaps the most significant feature of approaches to the information society. We are led here largely because his advocacy is to reintroduce qualitative judgment into discussions of information. Roszak asks questions like the following: Is more information necessarily making us a better informed citizenry? Does the availability of more information make us better informed? What sort of information is being generated and stored, and what value is this to the wider society? What sort of information occupations are expanding, why and to what ends?

What is being proposed here is that we insist on examination of the meaning of information. And this is surely a common-sense understanding of the term. After all, the first definition of information that springs to mind is the semantic one: information is meaningful; it has a subject; it is intelligence or instruction about something or someone.

If one were to apply this concept of information to an attempt at defining an information society, it would follow that we would be discussing these characteristics of the information. We would be saying that information about these sorts of issues, those areas, that process are what constitutes the new age. However, it is precisely this common-sense definition of information that the information society theorists jettison. What is, in fact, abandoned is a notion of information having a semantic content.

The definitions of the information society I have reviewed perceive information in nonmeaningful ways. That is, searching for quantitative evidence of the growth of information, a wide range of thinkers have conceived it in the classic terms of Shannon and Weaver's information theory.50 Here, a distinctive definition is used, one that is sharply distinguished from the semantic concept in common parlance. In this theory, information is a quantity that is measured in "bits" and defined in terms of the probabilities of occurrence of symbols. It is a definition derived from and useful to the communications engineer whose interest is with the storage and transmission of symbols, the minimum index of which is on/off (yes/no or 0/1).

This approach allows the otherwise vexatious concept of information to be mathematically tractable, but this is at the price of excluding the equally vexing, yet crucial, issue of meaning and, integral to meaning, the question of the information's quality. On an everyday level when we receive or exchange information, the prime concerns are its meaning and value: is it significant, accurate, absurd, interesting, adequate, or helpful? But in terms of the information theory that underpins so many measures of the explosion of information, these dimensions are irrelevant. Here, information is defined independent of its content, seen as a physical element as much as is energy or matter. As one of the foremost information society devotees puts it, information exists. It does not need to be perceived to exist. It does not need to be understood to exist. It requires no intelligence to interpret it. It does not have to have meaning to exist. It exists.51

In fact, in these terms, two messages, one that is heavily loaded with meaning and the other pure nonsense, can be equivalent. As Roszak says, here "information has come to denote whatever can be coded for transmission through a channel that connects a source with a receiver, regardless of semantic content."52 This allows us to quantify information but at the cost of abandonment of its meaning and quality.53

If this definition of information is the one that pertains in technological and spatial approaches to the information society (where the quantities stored, processed, and transmitted are indicative of the sort of indexes produced), we come across a similar elision of meaning from economists' definitions. It may not be in terms of bits, but at the same time, the semantic qualities are evacuated and replaced by the common denominator of price.54

To the information engineer, the prime concern is with the number of yes/no symbols; to the information economist, it is with their vendibillity. But as the economist moves from consideration of the concept of information to its measurement, what is lost is the heterogeneity that springs from its manifold meanings. The "endeavor to put dollar tags on such things as education, research, and art" unavoidably abandons the semantic qualities of information.55 Boulding observed a generation ago that "The bit...abstracts completely from the content of information...and while it is enormously useful for telephone engineers...for purposes of the social system theorist we need a measure which takes account of significance and which would weight, for instance, the gossip of a teenager rather low and the communications over the hot line between Moscow and Washington rather high."56 How odd then that economists have responded to the qualitative problem, which is the essence of information, with a quantitative approach, which being reliant on cost and price, is at best "a kind of qualitative guesswork."57

"Valuing the invaluable," to adopt Machlup's terminology, means substituting information content with the measuring rod of money. We are then able to produce impressive statistics, but in the process we have lost the notion that information is about something.58

Finally, though culture is quintessential about meanings, about how and why people live as they do, it is striking that with the celebration of the nonreferential character of symbols by enthusiasts of postmodernism, we have a congruence with communications theory and the economic approach to information. Here too we have a fascination with the profusion of information, an expansion so prodigious that it has lost its hold semantically. Symbols are now everywhere and generated all of the time, so much so that their meanings have imploded, hence ceasing to signify.

What is most noteworthy is that information society theorists, having jettisoned meaning from their concept of information in order to produce quantitative measures of its growth, then conclude that such is its increased economic worth, the scale of its generation, or simply the amount of symbols swirling around, that society must encounter profoundly meaningful change. We have, in other words, the assessment of information in nonsocial terms—it just is—but we must adjust to its social consequences. This is a familiar situation to sociologists who often come across assertions that phenomena are aloof from society in their development (notably technology and science) but carry within them momentous social consequences. It is demonstrably inadequate as an analysis of social change.59

Doubtless, being able to quantify the spread of information in general terms has some uses, but it is certainly not sufficient to convince us that in consequence of an expansion, society has profoundly changed. For any genuine appreciation of what an information society is like, and how different or similar it is to other social systems, we must surely examine the meaning and quality of the information. What sort of information has increased? Who has generated what kind of information, and for what purposes and with what consequences has it been generated?

Notes

1. William J. Martin, "The Information Society - Idea or Entity?" Aslib Proceedings (40: 11-12, 1988), p. 303.

2. Daniel Bell, The Coming of Post-Industrial Society: A Venture in Social Forecasting (Harmondsworth: Penguin, 1973), and a legion of followers.

3. See for example Jean Baudrillard, In the Shadow of the Silent Majorities (New York, NY: Semiotext, 1983); and Mark Poster, The Mode of Information: Poststructuralism and Social Context (Cambridge: Polity Press, 1990).

4. See for example Michael Piore & Charles Sabel, The Second Industrial Divide (New York, NY: Basic Books, 1984); and Larry Hirschhorn, Beyond Mechanization: Work and Technology in a Postindustrial Age (Cambridge, MA: MIT Press, 1984).

5. James R. Beniger, The Control Revolution: Technological and Economic Origins of the Information Society (Cambridge, MA: Harvard University Press, 1986).

6. Manuel Castells, The Informational City: Information Technology, Economic Restructuring and the Urban Regional Process (Oxford: Blackwell, 1989).

7. See for example Herbert I. Schiller, Who Knows: Information in the Age of the Fortune 500 (Norwood, NJ: Ablex, 1981); and Herbert I. Schiller, Information and the Crisis Economy (Norwood, NJ: Ablex, 1984).

8. See for example Michel Aglietta, A Theory of Capitalist Regulation (London: New Left Books, 1979); and Alain Lipietz, Mirages and Miracles: The Crises of Global Fordism (London: Verso, 1979).

9. David Harvey, The Condition of Postmodernity: An Enquiry into the Origins of Cultural Change (Oxford: Blackwell, 1989).

10. Anthony Giddens, The Nation-State and Violence: Volume Two of a Contemporary Critique of Historical Materialism (Cambridge: Polity, 1985).

11. Jurgen Habermas, The Structural Transformation of the Public Sphere: An Inquiry into a Category of Bourgeois Society (Cambridge: Polity, 1962); and Nicholas Garnham, Capitalism and Communication: Global Culture and the Economics of Information (London: Sage, 1990).

12. Christopher Evans, The Mighty Micro: The Impact of the Micro-Chip Revolution (London: Gollancz, 1979), p. 13.

13. Frank Webster and Kevin Robins, Information Technology: A Luddite Analysis (Norwood, NJ: Ablex, 1986), Ch. 2.

14. Fred Williams (ed.), Measuring the Information Society (London: Sage, 1988), p. 15.

15. Christopher Freeman and Carlota Perez, "Structural Crises of Adjustment, Business Cycles, and Investment Behavior," in Giovanni Dosi et al. (eds.), Technical Change and Economic Theory (London: Frances Pinter, 1988), pp. 38-66; Peter Hall & Paschal Preston, The Carrier Wave: New Information Technology and the Geography of Innovation, 1846-2003 (London: Unwin Hyman, 1988); Christopher Freeman, Technology Policy and Economic Performance (London: Frances Pinter, 1987); and Christopher Freeman, J. Clark, and L. Solte, Unemployment and Technical Innovation: A Study of Long Waves and Economic Development (London: Frances Pinter, 1982).

16. David Landes, The Unbound Prometheus: Technological Change and Industrial Development in Western Europe from 1750 to the Present (Cambridge: Cambridge University Press, 1969).

17. John Naisbitt, Megatrends: Ten New Directions Transforming Our Lives (London: Futura, 1984), p. 28.

18. Fritz Machlup, The Production and Distribution of Knowledge in the United States (Princeton, NJ: Princeton University Press, 1962).

19. Peter F. Drucker, The Age of Discontinuity (London: Heineman, 1969), pp. 247, 249.

20. Neil Dias Karunaratne, "Issues in Measuring the Information Economy," Journal of Economic Studies (13: 3, 1986), p. 52.

21. Marc Uri Porat, The Information Economy: Sources and Methods for Measuring the Primary Information Sector (Washington, D.C.: U.S. Department of Commerce, Office of Telecommunications, 1977); and Marc Uri Porat, The Information Economy: Definition and Measurement (Washington, D.C.: U.S. Department of Commerce, Office of Telecommunications, 1977).

22. Peter Monk, Technological Change in the Information Economy (London: Frances Pinter, 1989).

23. Michael Rubin and Mary Taylor, The Knowledge Industry in the United States (Princeton, NJ: Princeton University Press, 1986).

24. Tom Stonier, The Wealth of Information: A Profile of the Post-Industrial Economy (London: Thames Methuen, 1983), p. 7,8.

25. Organisation for Economic Cooperation and Development, Information Activities, Electronics and Telecommunications Activities: Impact on Employment, Growth and Trade (Paris: OECD, 1981).

26. Porat, The Information Economy: Definition and Measurement, pp.131, 204.

27. Kevin Robins and Frank Webster, "Information as Capital: A Critique of Daniel Bell," in Jennifer Daryl Slack and Fred Fejes (eds.), The Ideology of the Information Age (Norwood, NJ: Ablex, 1987), pp. 95-117.

28. Marc Uri Porat, "Communication Policy in an Information Society," in G.O. Robinson (ed.), Communications for Tomorrow (New York, NY: Praeger, 1978), pp. 5-6.

29. C. Jonscher, "Information Resources and Economic Productivity," Information Economics and Policy (1:1983), pp. 13-35.

30. Porat, "Communications Policy in an Information Society," p. 5.

31. Studs Terkel, Working: People Talk about What They Do All Day and How They Feel about What They Do (Harmondsworth: Peregrine, 1977).

32. Michael Useem, The Inner Circle: Larger Corporations and the Rise of Business Political Activity in the US and UK (New York, NY: Oxford University Press, 1984); and Michael Useem and Jerome Karabel, "Pathways to Top Corporate Management," American Sociological Review (51: 1986), pp. 184-200.

33. Harold Perkin, The Rise of Professional Society: Britain Since 1880 (London: Routledge, 1989).

34. John Goddard, "Networks of Transactions," Times Higher Education Supplement, February 22, 1991, p. VI.

35. Harvey, p. 163.

36. James Martin, The Wired Society (Englewood Cliffs, NJ: Prentice Hall, 1978); and Iann Barron and Ray Curnow, The Future with Microelectronics: Forecasting the Effects of Information Technology (London: Frances Pinter, 1979).

37. See for example Mark Hepworth, The Condition of Postmodernity: An Enquiry into the Origins of Cultural Change (London: Bellhaven, 1989).

38. Herbert S. Dordick et al., The Emerging Network Marketplace (Norwood, NJ: Ablex, 1981).

39. See Castells.

40. Economic Commission for Europe, The Telecommunications Industry: Growth and Structural Change (New York, NY: United Nations, 1987).

41. Geoff Mulgan, Communications and Control: Networks and the New Economies of Communication (Cambridge: Policy, 1991).

42. Baudrillard, p. 95.

43. See Poster.

44. Giddens, p. 178.

45. See Schiller, Who Knows; and Harvey.

46. See for example Theodore Roszak, The Cult of Information: The Folklore of Computers and the True Art of Thinking (Cambridge: Latterworth Press, 1986).

47. Roszak, p. 14.

48. Roszak, p. 11.

49. Roszak, p. 91.

50. Claude Shannon and Warren Weaver, The Mathematical Theory of Communications (Urbana, IL: University of Illinois Press, 1949).

51. Tom Stonier, Information and the Internal Structure of the Universe: An Exploration into Information Physics (London: Springer-Verlag, 1990), p. 21.

52. Roszak, p. 13.

53. See for example John Young, Information Theory (Butterworth, 1971).

54. See for example Kenneth Arrow, "The Economics of Information," in Michael L. Dertouzos and Joel Moses (eds.), The Computer Age: A Twenty Year View (Cambridge, MA: MIT Press, 1979), pp. 306-317.

55. Fritz Machlup, Knowledge: Its Creation, Distribution and Economic Significance: Volume 1, Knowledge and Knowledge Production (New Jersey: Princeton University Press, 1980), p. 23.

56. K.E. Boulding, "The Economics of Knowledge and the Knowledge of Economics," American Economic Review (56: 1-13, 1966).

57. Ibid.

58. Esfandias Maasoumi, "Information Theory," in John Eatwell, et. al., The New Palgrave: A Dictionary of Economics (London: Macmillan, 1987), pp. 846-851.

59. See for example David Dickson, Alternative Technology and the Politics of Technical Change (London: Collins/Fontana, 1974); and Steve Woolgar, Science: The Very Idea (Chichester: Ellis Horwood, 1988).

Chapter 5: Alone Together: Will Being Wired Set Us Free? *

by Andrew Kupfer

> Imagine, if you can, a small room, hexagonal in shape, like the cell of a bee. An armchair is in the center, by its side a reading desk—that is all the furniture. And in the armchair there sits a swaddling lump of flesh—a woman, about five feet high, with a face as white as fungus.
>
> An electric bell rang. "I suppose I must see who it is," she thought. The chair was worked by machinery, and it rolled to the other side of the room. "Who is it?" she called. She knew several thousand people; in certain directions human intercourse had advanced enormously...The round plate that she held in her hands began to glow. A faint blue light shot across it, darkening to purple, and presently she could see the image of her son, who lived on the other side of the earth, and he could see her.
>
> —E.M. Forster, "The Machine Stops," 1914
>
> "Come on, honey. Remember those IBM machines. Let's get at it before people go out of style."
>
> —Bobby Darin in "State Fair," 1962

Ever since protohumans with sloping foreheads learned to set things on fire, people have feared and hated technology as much as they have been in its thrall. They have eyed with suspicion the printing press, the automobile, the telephone, and the television as solvents of the glue that binds people together. Each new technology brings a warning: To fall under its spell will be to sacrifice not only simplicity but also community, to metamorphose into alienated, isolated, sedentary blobs. In Forster's story, when the machine stops, everybody dies.

This kind of trepidation is sometimes overdrawn —even the advent of the washing machine produced expressions of yearning for simpler times—but it isn't really misplaced. The printing press vanquished the knowledge oligarchy, yet popular culture seems ever more trivial and debased. Modern medicine often prolongs life beyond all reason or desire.

Now information technology is poised to alter the scope of human intercourse, and the familiar combination of promise and dread makes itself felt once again—with an urgency seldom seen in the two centuries since the Industrial Revolution. The new technology holds the potential to change human settlement patterns, change the way people interact with each other, change our ideas of what it mans to be human.

Information technology will have the power to reverse what may have been an aberration in human history: the industrial model of society. While people in agrarian societies had for millennia worked the land around their homes to the rhythm of the sun, industrialization created the time clock and the separate workplace. Wired technology already is assaulting the industrial concept of the workday: as technology brings greater realism to electronic communications, the workplace for many will become untethered from geography, letting people live anywhere. The fear is that in liberating us from geography and the clock, networks will destroy intimacy, both by making solitude impossible and by making physical presence immaterial to communication.

One reason we are wary about information technology is that it is still strange to us, new enough that we notice it all the time. We still marvel at what computers can do, and how we can carry in our laptops enough computing horsepower to have filled an entire laboratory not so many years ago. We view information technology as special, almost magical. Vincent Mosco of the Harvard Center for Information Policy Research, who has written extensively on the history of technology and the way electrification changed population distribution, says people felt the same way about electricity when it was introduced in the nineteenth century. "Companies used electricity to flash advertisements off the clouds," much in the way that Gothamites summon Batman in times of trouble, says Mosco. "I like that image of people gathering outdoors and watching lights flashing in the sky and seeing that as the spectacle of communications." Today computers, the Internet, and the information superhighway are the magical elements, and even the basic rules of etiquette are unformed, reminiscent of the early days of the telephone. Paul Saffo of the Institute for the Future in Menlo Park, California, says: "Alexander Graham Bell proposed a greeting of ‘Hoy! Hoy!’—a variation of ‘Ahoy!’ It didn’t catch on." Instead his great rival Thomas Edison stole a bit of the jam from his crumpet by inventing, as a telephone salutation, the word "hello," a variant of the British exclamation "hallo."

Eventually, though, computer communications —like electricity and telephone—will quite literally fade into the woodwork. When that happens, wired technology will obliterate the significance of two of the great symbols of the Industrial Revolution, the train and the clock, and along with them the idea that society can organize everything to run on set schedules. The temporal shift this technology permits—even demands—is likely to be its most profound and enduring effect.

With an economy that straddles many time zones, the nine-to-five workday will disappear for those for whom it hasn’t already. People will become accustomed to flitting between their different roles of work, recreation, and repose, constantly prey to interruption, even addicted to it. "The rush and a flow of events is like electronic heroin," says Saffo. "And once you get it into your veins it’s really hard to stop. You’ll figure out a way to interrupt yourself." People may live in bucolic and pastoral settings but not live a pastoral life, competing via cyberspace for work against thousands of others, finishing each job in days or hours, then moving on to the next, like electronic versions of Charlie Chaplin’s assembly-line worker in "Modern Times".

Many assume that people who can leave company headquarters will choose to work in their homes, and wired enthusiasts anticipate a resurgence of familial togetherness. But at least one expert on how the home reflects changes in American society says we may well see less family interaction than we do today. Clifford Clark, an American studies professor at Carleton College in Northfield, Minnesota, predicts: "We will see different family members sitting around different screens in different rooms."

That could touch off domestic turf battles: Our houses aren't suited to these purposes, having evolved over the past century from a large number of little spaces to a small number of big ones. The kitchen was once isolated in the back of the house to keep a continuously fired-up stove from overheating the living quarters, but with the invention of the gas range it moved forward and became a social room as much as a workplace. Today it sometimes flows right into the so-called great room, where families sit in front of the jumbotron to watch surround-sound movies. A shortage of solitary workspace may become just one more source of family disharmony.

Knowledge workers, selling their labor to new species of business that will flourish in the wired economy, may need to be ready to go at a moment's notice. Employers already seek workers via computer networks. But in the future the process will be more pervasive and almost automatic. Professor Thomas Malone of the Center for Coordination Science at MIT says such wired workers will form "overnight armies of intellectual mercenaries."

Imagine a company with a task that needs urgent attention—say, designing a lawn mower or writing a computer program. The company might not maintain a cadre within its ranks to do the job. Instead, it trolls the net for talent, sending out a bulletin that describes the tasks to be done and the skills required of team members. The notice might go directly to qualified applicants, based on resumes filed online. Specialists anywhere in the world instantly submit bids to do a piece of the job, simultaneously triggering a query to their personal references. Winning bidders work together via video hookup, each at his or her home base. The project might last a few weeks or a few days or a few hours. Afterwards the team disbands and the members melt back into the talent pool to bid on new jobs.

Socially, the wired society is likely to bring flip-flops in behavior like the changes wrought by the telephone, which made it acceptable for a man to talk to a strange woman without a formal introduction by a third party. The Internet is making it acceptable for a man to exchange explicit sexual fantasies with a strange woman—or with someone who claims to be a woman but who may really be a trio of male cross-dressers sitting around their screen laughing. At times people breach the bounds of decency and stray into the realm of the allegedly criminal: A college student was recently jailed for distributing via the Internet a depraved story in which he imagined the rape, torture, and murder of a woman he knew, and whose name he disclosed. Another young woman soon replied with an online revenge fantasy of her own.

People are starting to put up different barriers to their interactions," says Weiser, speaking as one who doesn't like barriers very much. He usually has eight video windows open on his computer screen at work, showing his engineering colleagues' offices. Weiser also confesses to being the drummer for a band called Severe Tire Damage that sneaked onto the Internet before the Stones concert as an unscheduled opening act.

In time both the guardedness and the anonymity will evanesce, Weiser says: "As more and more business is conducted online, it will become more of a real place, and real-life expectations will take over. One is that I know who you are. We will stop talking to people we don't know." The wired connection will no longer seem like a strange way of meeting people—which won't be the first time a method that once seemed mad became a part of quotidian routine. And the change in attitude might not take as long as you think. A decade ago, if you telephoned a friend and reached an answering machine, you probably thought, "How rude!" Today you are more likely to be miffed by your thoughtless friends who refuse to buy one.

Despite its potential to free people from geography, the likely effect of technology on where people live is murky. While some will be able to leave cities, others won't, and still others won't want to. True, some jobs have already headed for the sticks, particularly back-office operations of financial firms, intensifying a long-term trend that began earlier in the century with improvements in transportation. But many potential movers seem to have sticky feet. Blame this partly on that hobgoblin of managerial minds, force of habit. People might love the idea of sending e-mail to their grandchildren, but as supervisors the same folks don't have the stomach for remote management. People want to see their employees and want to watch them work.

They can't do that via video yet because existing technology is too crude: The picture transmitted by a typical desktop computer videoconference system is a low-resolution, herky-jerky postage stamp. Within the next 10 years, though, better devices will be able to send crystalline images with lifelike color and perfectly fluid motion, conveying words, body language, expression. What will it mean when gazing at a face on a video screen is no different than looking at a face through a window? Will the cities empty and the people disperse like leaves in a fall wind?

If history is any guide, wired technology will create forces that pull in the other direction as well. Successive waves of technology, from the telephone to the automobile to rural electrification, have brought predictions of the emptying of cities. Yet the cities endure, and so they will a century from now. The telephone, for example, led to both dispersion and concentration. Not only did it open up remote areas to commerce, but it also helped make possible the most highly concentrated form of living and working space that we know: the skyscraper. Without the telephone to deliver messages, occupants of upper stories would be cut off unless the architect devoted the entire core of the massive structures to elevators and stairways for messengers.

In the information society, expect to see similar pushes and pulls. Most mobile will be the knowledge workers: people whose jobs largely involve talking to others and handling information —in other words, white-collar office workers. For them, electronic links will mostly suffice; they will be able to choose to live by the seashore, say, or near family and friends.

But as if to obey Newtonian laws of motion, information technology will also pull people to the center. By permitting dispersion, information technology promotes the globalization of the economy, guaranteeing a raison d'etre for international cities like

New York, London, and Tokyo that serve as the nodes for world communications networks—a major reason New York has shown much more resilience than city-bashers predicted. The economic vibrancy of these cities will attract the many people who thirst for amenities like theater, concerts, restaurants, and the continuous paseo of cosmopolitan life.

As they do today, the city dwellers of the information society will depend on a tier of lower-level service workers like barbers and burger flippers, whose work, involving physical contact with other people, cannot be liberated from place by communications technology. (Some higher-level professionals like surgeons will also remain tied to population centers.) Not all the people will be able to follow their bliss to the mountaintops.

Wherever we live, the nature of routine intercourse is likely to be changed by electronic agents —drudges, really, programmed to take over the tedium of interconnectivity. The first commercial prototypes of these agents have recently appeared, including one called Wildfire that acts as an electronic secretary, answering the phone, taking messages, obeying simple verbal commands, and routing phone calls to users wherever they happen to be.

As they become more sophisticated, these software agents will do our shopping, buy our plane tickets, and make our appointments for us, traveling through cyberspace like ghostly echoes of the self. "They won't be intelligent enough to make the clerics nervous," jokes Saffo of the Institute for the Future. "But they will exhibit whimsy and humor, and be interesting enough to convince people to interact with them." Not only will people be talking with these soulless beings, but agents will be interacting with other agents as well. The Hollywood patter of the future may remain, "Have your agent call my agent," but people won't be talking about ten-percenters.

Our ghosts may come to haunt us as well. One nightmare scenario not yet on many worry lists is location tracking. With the auctioning off of vast swaths of the radio spectrum for new wireless services and the promise of cheap, lightweight cellular phones, the cellular industry is poised to sweep into the mass market. New low-powered cellular systems will blanket the country with great numbers of closely spaced transmitters. Nearly everyone will be carrying some sort of wireless communications gadget. Whenever they are on — and they are likely to be left on all the time—a signal will travel to the nearest transmitter, letting the network know where to send each user's messages and phone calls.

Cellular companies will be able to use their fine-meshed networks to pinpoint nearly everyone's location and track their movements. This is how the police, with the help of the phone company, tracked down O.J. Simpson as he was driven along the highway in the infamous white Bronco. Anyone with a cellular telephone scanner could also keep tabs on people's locations, even when new digital cellular systems make our conversations secure from eavesdroppers. (Only our words will be encoded; our identification numbers must stay unscrambled so the network can authorize our calls.)

If you don’t think anyone really cares where you go from moment to moment, be assured that plenty of companies would pay to find out. Marketers, for example, would love to know who visits which stores, and when, and for how long. They could legally buy this information from the telephone company as easily as they buy mailing lists today. And as with mailing lists, we would have no control over who gets access to this information.

If our ever cosier relationship with wired technology makes us fear for our souls, perhaps that is because the stuff is so seductive. Unlike TV, the new technology requires our participation, drawing us in. As such it is insidious. Management professor Alladi Venkatesh of the University of California at Irvine, an expert on the impact of technology on the household, says: "Television is easy to dismiss. Its limitations are obvious. The danger of the computer is that it gives us the impression that it can do for us what TV has not: make us better people."

It is true that the power to make instant connections anywhere in the world, at any time, can bring inestimable comfort. For the millions who are stuck at home because of age or infirmity or because they are caregivers for young children, for insomniacs who need someone to commune with in the blue hours past midnight, for people who want to find out if their car is a lemon, or how to buy a house, or how to cope with a child’s asthma attack, being wired may be the fastest way to connect with others who are willing to share their feelings and knowledge.

But with these gains there is loss. While people may feel just as intensely about friends they make via cyberspace as they do about their face-to-face confreres, the ease with which they form these links means that many are likely to be trivial, short lived, and disposable—junk friends. We may be overwhelmed by a continuous static of information and casual acquaintance, so that finding true soul mates will be even harder than it is today. And the art of quiet repose and contemplation may one day seem as quaint as the 19th-century practice of river gazing—staring at riverscapes to discern their coloristic and picturesque attributes.

MIT’s Malone is worried about these risks but tries to remain an optimist. He says he feels closer to some people he has met over the net than he did even to the friends he made growing up in a small town in New Mexico. Those relationships were mere accidents of geography; he and his new friends chose each other through common interest. In an eerie echo of the cautionary tale that E.M. Forster wrote more than 80 years ago, he says, "There must be thousands of people I know personally..."

This machine will not stop. In time we will no longer ponder its existence, or be able to imagine a world without its constant hum.

Chapter 6: Reality Check *

by Joel Achenbach

The Information Age has one nagging problem: Much of the information is not true. We live in a time besotted with Bad Information.

It's everywhere. It's on the street, traveling by word of mouth. It's lurking in dark recesses of the Internet. It's in the newspaper. It's at your dinner table, passed along as known fact, irrefutable evidence, attributed to unnamed scientists, statisticians, "studies."

There has always been Bad Information in our society, but it moves faster now, via new technologies and a new generation of information manipulators. The supply of Bad Information is not the only problem—there may also be a rise in demand. Perhaps as a social species we have developed a greater tolerance for it as we desperately try to slake our thirst for intrigue, excitement, and mind-tweaking factoids. The plausible has been squeezed out of public discourse by the incredible.

There are seven fundamental types of Bad Information.

Obvious But Wrong Information. The Atlanta Journal Constitution breaks the news that Richard Jewell was the prime suspect in the Olympic bombing. Jewell was obviously the perpetrator, because he had been the "hero" who had found the bomb, and we all know that a "hero" is usually a self-promoting, bogus individual, if not an outright killer. Also, the information was leaked, and leaked information always sounds true. Unfortunately, the FBI had no actual evidence, just a hunch. The government eventually sent him a note telling him he wasn't a suspect anymore. Whatever.

Information Censored for Your Own Good. Americans made sure to buy cars with air bags, preferably on both the driver's and passenger's side. The we learned that air bags can kill small children. The experts knew of the danger and kept it quiet because they thought it would create public panic and lead people not to use air bags and thus die in greater numbers. Meanwhile, millions of Americans are thinking of the dozens of times they have let their kids ride up front. As a rule, when one piece of Good Information goes unknown, it means another piece of Information will turn Bad.

Accurate But Untrue Information. The San Jose Mercury News's three-part series "Dark Alliance" unveiled new information about a connection between the CIA-backed Contras in Nicaragua and crack dealers in inner-city Los Angeles. The paper then implied that the crack epidemic in urban America is a CIA plot, ergo: "To understand how crack came to curse black America, you have to go into the volcanic hills overlooking Managua, the capital of the Republic of Nicaragua." (Defenders of the series say this is literally true—they are now, as we speak, scouring the volcanic hills overlooking Managua, seeking more evidence.)

Millennial Information. Earlier this year there was a great ruckus about "synthetic hormones" that pollute the environment and cause severe decline in sperm counts that threaten the future of the human race. One hot book title carried the alarming title Our Stolen Future. It had to be true, because the book's introduction was written by Al Gore. The problem is, other researchers quickly challenged the scary conclusions; one declared that men are cranking out just as many little gators as 25 years ago. The human race will survive!

Diagnostic Information. You are terribly lethargic and go see a succession of mental health professionals. One says you are depressed, another says you are not depressed but have chronic fatigue syndrome, another says there is no such thing as chronic fatigue syndrome, another says you have multiple personalities because in your childhood your mother was a member of a satanic cult. You say you don't remember your mother being a member of a satanic cult, and the therapist says that's a dead giveaway.

Statistical Information. A sociologist in 1985 reported that under California's no-fault divorce system, women suffered a 73 percent drop in their standard of living in the first year after getting a divorce, while men's standard of living improved 42 percent. The statistics were widely quoted, and influenced a trend toward reinstituting fault-based divorces. The sociologist subsequently admitted her numbers were wrong, the gap grossly inflated.

And finally:

Historical Information. Everyone knows that Marie Antoinette said, "Let them eat cake!" Except she didn't. A fictional character said it.

The most subtle but poisonous effect of Bad Information is the decline of intelligent conversation. It used to be that you couldn't talk about religion and politics, but now you can't talk about religion, politics, UFOs, phonics, nutrition, the Kennedy assassination, O.J. Simpson, Shakespeare's true identity, proper child-rearing techniques, the significance of birth order, and whether power lines give you cancer. That is why Michael Jordan is so popular: He's the only thing we all agree on. Man, that guy can play ball!

The Bad With the Good

Bad Information is insidious because it looks so much like Good Information. It takes an extremely practiced eye, a kind of controlled skepticism that never quite slides into abject nihilism, to spear Good Information from the thick bog of Bad.

"It's harder to tell the difference between good-quality and bad-quality information than it is between a good-quality and a bad-quality shirt. Your mom can teach you how to look at the stitching on a shirt," says Phil Agre, a communications professor at the University of California at San Diego.

Bad Information does not happen by accident. It is promulgated. The sources are increasingly sophisticated. Today, almost everyone has advanced technology for disseminating data, from Web sites to phone banks to cable TV infomercials; everyone has a private public relations staff and a private media relations staff and a private Scientific Advisory Panel to lend "expert" authority to implausible assertions. You need to roll over a new piece of information in your mind; scrutinize the source and say, when necessary, "Wait a second. This guy has BI."

Let’s look at a case study in Bad Information. No event this year has spawned so much Bad Information as the TWA Flight 800 disaster. When it blew up, everyone assumed terrorists were to blame. The government passed new airport security measures that force travelers to turn on their electric shavers to prove that they aren’t killers. These have remained in place even though the government investigators now think it was probably a mechanical failure. But the Flight 800 explosion illustrates one fundamental rule: Bad Information abhors a vacuum. It flourishes where knowledge is sparse.

For example, The New York Times at one point ran a front-page story concluding that the plane had been blown up by a bomb. The newspaper had learned that investigators found microscopic traces of a chemical explosive. But it turned out that the plane had—by chance—been used recently in a training exercise for bomb-sniffing dogs. Who coulda thunk it?

The newspaper had fallen victim to a common logical fallacy called "affirming the consequent." According to George Washington University philosophy professor Peter Caws, this fallacy emerges from an "if-then" proposition. If one thing happens (in this case, a bomb blows up a plane), another thing follows (there will be bomb residue). But finding residue alone doesn’t prove a bomb blew up the plane, because there might be some other explanation for the residue. Nor can we forget the missile theory.

A few weeks ago, Pierre Salinger was giving a speech in Cannes, France, and mentioned that he had a document given him by a French intelligence agent that offered strong evidence that a U.S. Navy missile had shot down TWA Flight 800. He went to his hotel room to go to bed, but he never had a chance to sleep because his phone kept ringing with calls from journalists all over the world. Salinger’s "revelation" made the lead newscasts on TV and radio. The secret document turned out to have been on the Internet for months. It contains no evidence of any kind—it’s a blanket assertion, anonymous, that a Navy missile shot down the plane. The name of the ship is not revealed, nor the captain of the ship, nor the names of anyone else who might know of this. In fact, the "document" was written by a former United Airlines pilot who originally intended it as a private e-mail message for some friends. Salinger hasn’t backed down. Look at his track record, he says: "I was not a person who was giving bad information to people."

This is the only reason, indeed, that the news organization reported what Salinger said: As a former White House press secretary and ABC news correspondent, he seemed like a credible person. Credibility transcends generations— people graduate to the status of "legendary" and "venerable." But say-so is the weakest form of evidence. Salinger was not actually a source of information, but rather a medium for a fourth-hand rumor.

So here’s the information flow: Dan Rather on the "CBS Evening News" reports what Pierre Salinger said in a speech in southern France about a document written by a person in the United States whom Salinger has never met but who, Salinger has been told by an unnamed French intelligence agent, has "strong contacts" with someone, or something, in the Navy.

Through this tortuous route travels information so shocking, so horrible—the Navy shooting down a jetliner!—that you might find it implausible and extremely difficult to believe even if you saw it with your own eyes. Yet there it is on the nightly news.

Quite an Assumption

Lacking a good explanation, we naturally fill in the blanks. A survey in George magazine showed that 41 percent of the American people think the American Government is covering up the truth about TWA Flight 800. And 10 percent think Elvis is alive. (The survey doesn't reveal how many people think the government is covering up the fact that Elvis is alive.)

It's good and necessary for people to be skeptical; the government does, in fact, tell lies. It lied about Vietnam, it lied about Watergate. The African American patients at Tuskegee were told they were being treated for syphilis when in fact they were given placebos for years so researchers could watch the progression of the disease. Oliver North lied to Congress on national television, under oath.

Not even scientists—people devoted to objective truth—are immune to Bad Information. Two scientists in the 1980s announced with great fanfare that they had discovered cold fusion, an almost magical form of energy. Scientists also announced, at various times in the last decade or so, that they had found generic origins of alcoholism, schizophrenia, and manic depression. These claims have been, in large part, retracted.

The latest candidate in the field of science for Bad Information is the Mars rock, which has these tiny squiggly shapes that look like little microbe fossils. Naturally everyone has gone stone-crazy over the implications, but the fact remains that the "discovery" hasn't been confirmed, and it may turn out the fossils are, as scientists put it, "abiotic in origin." Meaning they're just dirt.

For Peter Caws, the philosophy professor, the Mars rock brings to mind a Mark Twain saying about the endeavors of science: "One gets such wholesale returns of conjecture out of such a trifling investment of fact."

Science, however, has a great quality that many industries lack: It actively roots out Bad Information. No scientific claim is considered valid simply because it sounds right or comes from a prize-winning researcher; the finding must be repeatable, verifiable in experiments, and most important, falsifiable. The problem with many conspiracy theories is that they are not, by nature, falsifiable—you cannot disprove that the CIA murdered John F. Kennedy, for example, because the nature of a conspiracy is to deny its existence.

The danger is that we are reaching a moment when nothing can be said to be objectively true, when consensus about reality disappears. The Information Age could leave us with no information at all, only assertions.

This means we are entering a kind of ultra-relativistic Einsteinian universe without constants or fixed positions or simultaneous events—where what "is" depends entirely on the position of the observer.

All assertions can, of course, be backed with data. This is the phenomenon of "Stat Wars," in the words of David Schenk, author of the forthcoming Data Smog: Surviving the Information Glut. He says: "There's so much data out there, it's easy to argue basically any point." Is there such a thing as Gulf War syndrome? The veterans of the war say yes. The Pentagon says no. Both have stats.

How many people went to the Million Man March? The National Park Service said 400,000. The Nation of Islam was outraged and threatened to sue the Park Service for undercounting. Eventually Congress ordered the National Park Service to stop making crowd estimates. No information at all is better than information that might wind up being labeled, at least in court, as being Bad.

Information Devolution

Computer technology and the rise of the Internet have democratized information, which means that information is no longer the province of elite organizations like The Washington Post and CBS News. Now, anyone can have a Web page. Why get your news from seasoned professionals when you can get half-witted rumors from random strangers?

An e-mail message, anonymous, is making the rounds of cyberspace, discussing the oft-used metaphor of the Net as an information superhighway. Suppose that highways were really like the Internet, it says. You'd have this:

A highway hundreds of lanes wide. Most with pitfalls for potholes. Privately operated bridges and overpasses. No highway patrol. A couple of rent-a-cops on bicycles with broken whistles. Five hundred-member vigilante posses with nuclear weapons. A minimum of 237 on-ramps at every intersection. No signs. Wanna get to Ensenada? Holler out the window at a passing truck to ask directions.

Edward Tenner, author of Why Things Bite Back: Technology and the Revenge of Unintended Consequences, notes that one aspect of the computer age is the ability of almost anyone to prepare information that looks authoritative, with careful arrangement of texts and graphics. "Culturally we use graphics as a proxy for authority," Tenner says.

We are witnessing the mal-effects of a theorized phenomenon called Thought Contagion. According to this theory, information spreads like a biological organism or virus. Bad Information may have a kind of Darwinian advantage over its good cousins. Aaron Lynch, author of Thought Contagion: How Belief Spreads Through Society, points out that no one gossips about a man dancing with his wife. Sensational information, including that which is highly implausible or even preposterous, is more pleasurable to pass along.

By e-mail message Lynch elaborates:

Rising population density and improving communications cause thought contagions to spread faster...much like the way crowding and migration foster epidemics of biological contagions. [The] recent advances in Internet hypermedia, greater access to call-in talk radio, and the profusion of TV channels favor the kind of super-fast thought contagions that spread all over society even before anyone has a chance to check the facts.

What's Worse

Bad Information is not the same thing as misinformation. Misinformation is when you are given poor directions to a party, or show up on the wrong day for a dental appointment. Bad Information is when a clerk writes that oxygen canisters to be stowed on a Valujet plane are empty and thus they travel in the cargo hold without protective caps and then they blow up and everyone on board dies.

It's not just "misinformation" if it kills you. We cannot be sure that Bad Information is a real trend. Trends are sometimes confabulations by bored journalists who mistake a few random coincidences for a sweeping cultural change.

When it comes to information, the dictum of "The X-Files" must always be followed: Trust No One. The obvious corollary: In particular, do not trust any information you get from "The X-Files."

Part Two: Business, Commerce, and Services

Introduction

The third modern information revolution has already had extensive impacts on business, commerce, and the services, but we have only seen the beginning stages of the changes which may be induced by the new technologies of the Information Age. In Part Two, seven articles explore the dimensions of these changes in business and commerce, the media, medicine, and education.

The first article, Robert Segal's "The Coming Electronics Commerce (R)evolution," posits that new information and communication technologies are revolutionizing business and commerce in an evolutionary way. It asserts that a viable electronic commerce system requires five elements: a secure network linking buyers and sellers, a database replete with product information, easy-to-use buyer/seller interface software, reliable e-mail, and a mechanism for shipping, financing, and processing orders. It argues that electronic commerce networks will change the fundamental structure of how businesses distribute goods, products, and services, with three key issues being of paramount importance: who will run electronic commerce networks, how will electronic commerce change the structure of distribution, and who will the winners and losers be. Not surprisingly, "The Coming Electronic Commerce (R)evolution" concludes that those manufacturers, wholesalers, dealers, and end users who fail to grasp that the inventory-based model of doing business has been replaced by an information-based model will be doomed to extinction.

In the second article in this volume, "Electronic Commerce: Implications of the Internet for Business Practice and Strategy," Ajit Kambil examines the implications of the Internet and other technologies of the information revolution for business practice and strategy at the firm level. Kambil maintains that the new and emerging technologies will drive transaction costs sharply downward. Because of this, firms will have to reconfigure their organization, increase their agility in responding to opportunities and threats presented by low-cost communications, and be able to reconfigure market strategy on short notice. Therefore, Kambil argues, business managers must recognize that new and emerging information and communication technologies are creating a commercial environment significantly different than that which existed in the past; customize promotions and organizations interfaces to multiple distribution channels and media segments; and integrate marketing strategies across media. Existing firms, Kambil concludes, may not be able to do this well.

The brave new world of electronic commerce will also have—and is already having—an immense impact on the banking industry. Joanna Smith Bers makes this abundantly clear in her article, "Banking and Cyberspace: The New Promised Land," which asserts that electronic commerce will enable banks both to off-load some of their transaction-oriented retail business and to tap into a potentially vast financial services market. Nevertheless, Bers says, banks will still have to cope with state regulations on interstate banking transactions. At the same time, Bers continues, banks will have to develop relationships with software developers or risk the probability that software developers and other non-financial institutions will come between banks and their customers. Indeed, Bers warns, electronic commerce will force banks to reinvent the entire business of banking, as Bank of America and NationsBank began to do when they purchased MECA Software. Home banking, already in place in many locations, is another manifestation of electronic commerce's invasion of banking, and various forms of electronic payment and electronic cash with all of their requirements for fool-proof security are coming online as well. As Bers makes clear, banks will still be integral parts of business and commerce in the Information Age, but they will be considerably different than they have been or are today.

Today's media is already considerably different than that of a few years ago, and tomorrow's media will be even more different, or so a variety of different journalists and media technologists assert in the fourth article in this volume, "Silicon Summit: Will Technology Affect the News?" The journalists and technologists identified five ways in which new information aand communication technologies and the news will interact: (1) News will be one of the significant factors influencing the adoption of new technologies; (2) consumer choice and control will drive journalism's successful adaptation to new media; (3) news content will not remain the exclusive domain of traditional news organizations; (4) news professionals should learn to exploit the natural tension between the technical "possibilities" and the economic realities of new media; and (5) as online information gathering proliferates from the kindergarten classroom to the company cubicle, its "futuristic" perception will give way to greater comfort levels and thus increased audience acceptance of new-media news.

But the journalists and technologists did not agree about everything. For example, some saw the Internet as being a vehicle through which the masses' faith in the media can be restored, but others saw the Internet as providing too much information to ever be useful as a masses-oriented news medium. The journalists and technologists also raised questions about the validity of information that will be reported on the new technologies; with so much information available from so many sources, how is one to judge its validity? Despite their disagreements, however, all were united in the view that even in the Information Age, accurate news and information will be vital for the continuation of political democracy and democratic institutions.

Enrico Coiera next explores the application of information and communication technology to medicine in his article "Medical Informatics." Coiera observes that in medicine, information and communication technologies must be used to solve problems; they can not be used simply for the purpose of applying technology. Defining telemedicine as "the communication of information to facilitate clinical care," Coiera catalogues the ways that information and communication technologies are improving and might improve health care. He also poses several questions that come out of the application of these technologies to medicine. Coiera notes that there are problems with telemedicine, not the least of which is the need for the development of a protocol-based decision support system and common terminologies so that the advantages of new technologies may be more fully realized.

The last two articles in this volume examine the impacts of the Information Age on education. In "School Reform in the Information Age," Howard Mehlinger predicts that inevitably, the new technologies will be used extensively in schools, but stops short of prognosticating how they will be used. Students want to use technology, parents want their children to have access to it, and many teachers want to use it as well.

But Mehlinger is not naive. He cautions that the new technologies will require large amounts of money, and that there are some who want the technological revolution in schools to fail so that traditional ways of learning and teaching will survive. Mehlinger stresses that it has never been easy for schools to change, and that schools and teachers must come to terms with the reality that the emerging information and communication technologies are all potentially under the control of the learners. If schools and teachers do not recognize this elementary fact of the Information Age, Mehlinger warns, then learners will bypass and ignore them.

John Seely Brown and Paul Duguid, the authors of the final article, "Universities in the Digital Age," concentrate on the impact of emerging technologies on colleges and universities. Observing that programs and practices at colleges and universites have changed little even though campuses are "rife with computers," Brown and Duguid postulate that the new technologies provide institutions of higher education the opportunity to move beyond traditional teaching and learning protocols to establish true "knowledge communities" that reach beyond campuses and academic communities. Colleges and universities play important roles in today's society, the authors argue, including not only "educating," but also "credentialing." And beyond these tasks, colleges and universities also introduce students in different ways to "communities of practice" that they will find useful in later life. All these tasks are important, the authors assert, but one of the dangers of using the new technologies in higher education is that as "space and time" are overcome by "distance learning," the introduuction of students to "communities of practice" will be lost.

Recognizing that traditional universities will continue to exist, Brown and Duguid propose to develop alternative configurations to traditional colleges and universities so that the benefits of the new technologies can be realized without the loss of communities of practice. To do this, the authors propose the creation of "degree-granting bodies" (DGBs) centered around specific areas of practice and inquiry. These DGBs would consist of students, practitioners, faculty, and administrators linked by advanced information and communication technologies that would have as their objective providing learners "access to authentic communities of learning, exploration, and knowledge creation," "resources to help them work in both distal and local communities," and "widely accepted representation for work done." If this model is adopted, Brown and Duguid suggest, campuses might look very similar to the way they look today, but "a student's university career...would no longer be through a particular place, time, or pre-selected body of academics, but through a network principally of the student's own making, yet shaped by a DGB and its faculty."

Across the spectrum of human activity examined here—in business and commerce, the media, medicine, and education—it is evident that the technologies of the Information Age have potential to significantly alter human activities and actions as well as organizational structures and practices. It is not always clear what the direction of change will be.

Chapter 7: The Coming Electronic Commerce (R)evolution *

by Robert L. Segal

Staring at the mechanical drawing on his computer screen, an engineer recognizes the need for a new part to improve his product design. Rather than calling a distributor, the engineer connects to an online service that provides substantial information: a roster of vendors that can meet his technical specifications; a product list ranked by price; schematic diagrams; and test results, product reviews, and comments from other engineers.

Satisfied with his information search, the engineer checks for the product's availability at a large, public warehouse and places an order for a sample. A bank affiliated with the online network extends credit if needed and electronically invoices the engineer's department. In turn, an EDI system pays the bill electronically. An express delivery firm delivers the part the next day.

A new customer/vendor relationship is established, but what (or where or who) was the channel of distribution? Over the next few years, advances in computer networking and software will radically transform the structure of distribution channels. While it is too early to declare salespeople an extinct species, technology will fundamentally change the role of manufacturers' sales reps, distributors, and dealers. In the process, a complex mix of winners and losers will emerge.

Strategists often ignore the role that distribution channels play in determining corporate success.1 However, as Peter Drucker points out, "From being organized around the flow of things and the flow of money, [the economy] is becoming organized around the flow of information."2 As information transforms distribution, it will also transform entire industries.

The overarching vision meshing computer technology with the everyday business of buying and selling is being touted as "electronic commerce" (EC). Visions of consumer-oriented electronic commerce (TV shopping networks, CD-ROM product catalogs, etc.) have already attracted considerable media attention. However, the business-to-business market has greater resources and incentives to become the first user of true electronic commerce systems.

A viable electronic commerce system consists of five elements:

- An extremely secure network linking buyers and sellers.
- A database of product/vendor listings, prices, availability, product specifications, and related technical information.
- Software that provides a consistent, easy-to-use interface; a means of accessing and sorting the database; and eventually an expert systems capability to help uncover buyers' needs.

- E-mail capability enabling buyers and sellers to seek information not immediately available online.

- A mechanism for shipping, financing, and processing orders.

Electronic Commerce Today

Although the effect will be revolutionary, the emergence of electronic commerce will be evolutionary. Many advances still need to be made in interface software, communications bandwidth, and security standards. Businesses will have to change purchasing procedures, marketing techniques, and product design processes.

However, many forerunners of electronic commerce already exist. A few companies list products and accept orders via online services such as Prodigy, CompuServe, or America Online. Since these networks lack security, multimedia, and payment features, they pose little challenge to traditional commercial distribution.

Over 200 companies offer CD-ROM-based product catalogs. However, few corporate customers have CD-ROM drives, and more important, the CD-ROM catalogs lack any online connections to vendors. The most ambitious venture so far is CommerceNet.[3] Funded by several Silicon Valley companies and the federal government, CommerceNet operates over the Internet, the forerunner of the information superhighway. On CommerceNet, buyers can seek out detailed product information from individual companies, or they can become members of the Internet Shopping Network, an online distributor of computer products. CommerceNet is still working on the directories and software needed to sort through its growing electronic commerce database. Another entry is Pittsburgh-based IndustryNet. IndustryNet provides an information and shopping forum on the Internet for buyers and sellers of a wide variety of industrial products.

Times Mirror Cable Television and Digital Equipment Corporation are backing a more focused trial dubbed the Electronic Commerce Network.[4] The network ties together several Phoenix-based aerospace/defense contractors, their suppliers, and university engineering departments that provide research and consulting services. Using an Ethernet connection running on the local cable system, the participants can use videoconferencing to discuss initial product designs and later make an online payment for the finished goods. While most of the commercial world is unaware of these developments, EC networks are about to change the fundamental structure of distribution.

The Electronic Commerce Revolution

To truly understand the impact of electronic commerce on distribution, three key issues need to be considered:

- Who will run the electronic commerce networks?

- How will electronic commerce change the structure of distribution?

- Who will the winners and losers be?

Who Will Run the Electronic Commerce Networks? The ownership and management of electronic commerce networks will clearly influence the acceptance of electronic commerce. The online airline reservation systems, some of the first examples of electronic commerce, provide interesting insights into the ownership issue. Leading airlines developed their own proprietary systems. With these reservation systems, carriers attempted to increase travel agent allegiance to the airline, build customer brand loyalty and, eventually, lower costs. Travel agents welcomed the productivity and customer service improvements. However, the agents feared the network might eventually give the airlines more power over them, particularly in negotiating commission levels. Also, the federal government felt that the systems were biased in favor of the airline running the system.

The reservation systems example leads to several key conclusions about ownership of electronic commerce networks:

The network owner must be independent, perceived as independent, or possess extremely high channel power.

With increasing returns to scale (e.g., later users will enjoy a more robust system than the early users), an electronic commerce network must find a way to "bootstrap" its system.[5] Vendors will not sign on without the promise of many buyers, but buyers will not sign on if major brands do not participate in the network.

Unique industry processes, programs, and products will drive electronic commerce networks to form around single industries.

Given these ownership factors and the current state of electronic commerce technology, the network managers and owners will likely come from:

1. Associations. Industry associations understand the industry buying and selling practices and lend the perception of independence. Associations would see the management of an electronic commerce network as justifying their ongoing role (and membership fees) in the industry. Strong associations, such as the National Office Products Association or the National Association of Home Builders could lead the development of EC networks in their industries. The Photo Marketing Association already has a rudimentary EC network running on CompuServe.

2. Resellers. Resellers are in a better position to own and manage an entire network. Instead of just encouraging participation or maintaining the network, resellers could actually process, pick, pack, and ship the orders generated by their EC network. In the business-to-business markets, distributors, wholesalers, and franchisers already maintain extensive databases of product names, numbers, and prices. However, they would still have to work with manufacturers to develop the electronic equivalent of spec sheets, product literature, and other technical information.

3. Manufacturers. Manufacturers are likely candidates to set up and manage EC networks. More so than resellers, manufacturers that sell through direct sales forces are struggling with rising selling costs. EC networks can provide an extremely efficient sales mechanism. In addition, manufacturers may view EC networks as a means of reducing the relative power that their reseller channels exert. Manufacturers also want more direct feedback from their customers and dealers, feedback that an EC network could provide but that a reseller might not or could not provide.

However, manufacturers usually carry only their own brand(s). Therefore, manufacturers operating their own networks will really need a strong relationship to convince their resellers or end-users to jump on board.

4. Technology Companies. An EC network is a complex mix of telecommunications and computer hardware, software, networks, and services. Suppliers of these products are fascinated by EC networks, not only as a means of reaching their customers but as a huge emerging market for their products. Companies like Hewlett-Packard and Digital Equipment Corporation are exploring electronic commerce options through CommerceNet, through the Internet's World Wide Web, and various pilot programs.

Systems integrators, such as EDS or Computer Science Corporation, might design and manage EC networks. Software companies like Microsoft, EDI specialist Sterling Software, or CBMS might position software as the linchpin in any EC network. CBMS is offering a unique system to help value-added resellers (VARs) reduce the complexity of procuring parts from the 15-20 vendors that make up a typical computer system. Even publishing companies like Ziff-Davis have announced EC ventures.

Microsoft deserves special attention. Microsoft's new online service offers many EC features and Windows 95 provides direct access to the Internet. Despite its failed attempt to buy financial software leader Intuit, Microsoft is recruiting vendors that want to sell through its online service. As a product category, software is a natural first market for EC distribution since the actual product can be delivered electronically. Given Microsoft's market position and visibility, its Windows 95 launch could jump-start the EC revolution.

5. Partnerships. The most likely organizational structure is a partnership. EC networks will require a broad mix of technology, capital, order handling and processing, trade financing, and the perception of independence. Few single companies can offer that mix.

A likely scenario for the emergence of electronic commerce is that at first, CD-ROM catalogs and bulletin board shopping services give businesses a taste of the future. Ambitious startups, such as CommerceNet, slowly expand their services and user bases. However, the first viable EC efforts will be proprietary systems linking a manufacturer with its distributors or a distributor with its retailers. Within a short period of time, these proprietary systems will include commercial end users.

Many people assume that the Internet will be the network of choice for electronic commerce. However, many senior managers interviewed by Frank Lynn & Associates do not want their buyers searching across the Internet, wasting time and buying unapproved brands or products. These executives also question the level of security available over the Internet. In response, several technology suppliers are offering to integrate electronic commerce modules into individual companies' internal computer networks. Buyers would access a company-specific electronic commerce system to collect information and make product selections. A centralized purchasing manager would review these choices and funnel them into traditional channels or an external electronic commerce system.

Regardless of the media, end users will begin to recognize the benefits of electronic commerce, particularly its ability to search across multiple vendors' offerings. However, end users will not want to learn separate systems or search each vendor individually. This will cause an "open system" approach to emerge across a specific industry or "community of interest," such as health care, commercial real estate, or office supplies. This system will be "open" in the sense that the system manager is independent of the products sold and permits any manufacturer, reseller, or end user to use the system.

Like most network structures, pressure will build to merge the growing number of industry-specific systems into larger, branded networks. This is exactly what happened with automated teller machine networks, the early telephone networks, credit cards, and the Internet itself. Networks have an inherent tendency to coalesce. As noted earlier, some companies, such as Microsoft, USWest, Time-Warner, AT&T, Bank of America, or MCI, may eventually create broad, brand-named EC systems. They will buy out smaller, regional or industry-specific systems and slug it out with the other big players. Ultimately, the EC systems will extend into the consumer market.

How Will Electronic Commerce Change the Structure of Distribution? Electronic commerce will create a massive restructuring of the current distribution system. The key elements of this restructuring are the barriers to entry, the cost structure, lower prices and shifting roles, consolidation, and channel conflict.

1. Barriers to Entry. Electronic commerce will eliminate many of the barriers to entry formerly represented by distribution channels. For market leaders, a strong position in the distribution channel provides a defense against competitors. Channels have limited shelf space, mind share, or financial resources, and they do not like to spread themselves across too many suppliers. Channels also represent a barrier, particularly to smaller manufacturers that lack the volume and economies of scale to create end-user demand—a strong prerequisite for attracting resellers.

However, with electronic commerce, shelf space is virtually unlimited. Electronic commerce companies will want to put as many manufacturers as possible on their networks. In fact, the networks will probably compete on the basis of how many companies' products they offer.

Entrenched manufacturers will certainly retain some advantage, possibly by providing more accurate or timely information, better graphics, or sophisticated analytical tools. However, electronic commerce overall will reduce the barriers that distribution channels traditionally offered the market leaders.

2. Cost Structure. Electronic commerce will substantially reduce the cost of channel marketing. Today, a typical manufacturer offers a real discount of about 25 percent to its distributors to cover their expense and profit requirements. The manufacturer incurs an additional cost (7-15 percent of its net revenue) to manage its reseller network. Overall, this means that about one out of every three dollars spent by the end user is related to channel activities. Electronic commerce will sharply reduce these costs on both an absolute and a percentage basis. The cost savings will come from three sources:

A. Elimination of the sales function. Frank Lynn & Associates estimates that selling expenses account for $0.35 of the $3 spent on channel activities. Electronic commerce will not wipe out all sales activities—as one New Yorker cartoon put it "no information superhighway, no matter how vast, will eliminate the art of the schmooze." But EC networks will entice many customers to reach for their computer mouse rather than a sales rep's phone number.

B. More competition. Electronic commerce will give customers access to more suppliers. This increased supply will inevitably create more price competition. One electronic commerce project underway is run by the Lawrence Livermore National Laboratory to help reduce costs at Wright Patterson Air Force Base. The Air Force was not required to get bids for anything under $2,500 due to high purchasing costs. Under the Livermore system, the Air Force could not only efficiently request bids at any level, but a wider variety of suppliers could find out about the bids. In the first few months of the program, the Air Force has achieved 10 percent lower purchasing costs and substantial price savings.6 By eliminating significant buying and selling costs, electronic commerce will cause a significant drop in prices.

C. Improved communication. Long lines of communication between end users, channels, and manufacturers result in many inefficiencies. Manufacturers design, build, and ship products that customers do not want. Resellers hold safety stock to guard against unpredictable end-user demand. Product returns tie up all parties involved. Endless hours are spent configuring systems, checking order status, resolving misunderstandings. By consolidating information, empowering end users to seek their own answers, and making data searches easier, the cost of channel marketing will be greatly reduced.

3. Lower Prices, Shifting Roles. Electronic commerce will increase competition and lower marketing and sales expenses. Prices will also head downward because electronic commerce provides more information. End users have limited time for shopping. Typically, they reduce their search costs by quickly narrowing choices to a "short list," using the purchasing department's "approved vendors list," or simply sticking with their existing brands.

Electronic commerce will provide quick, easy, and broad access to product and pricing information. The software will allow buyers to rank the information by a variety of pricing and product criteria. Armed with this broader set of information, buyers will insist on manufacturers meeting the best price/performance mix that shows up on the computer screen.

Interestingly, the promise of lower prices involves a restructuring of traditional buyer/seller roles. Electronic commerce will transfer more of the information function from the manufacturer or reseller to the end user. Normann and Ramirez point out how marketing innovators, such as IKEA, the Swedish furniture company, use this technique to reduce selling costs:

It [IKEA] offers a brand new division of labor...if customers agree to take on certain key tasks traditionally done by manufacturers and retailers—the assembly of products and their delivery to customers' homes—then IKEA promises to deliver well-designed products at substantially lower prices.

Electronic commerce offers the same, new division of labor.7 If customers will search electronically for information instead of asking a salesperson, manufacturers can offer lower prices and probably better service.

4. Consolidation. Ultimately, electronic commerce poses a substantial threat to many resellers. Large resellers base their strategies on low, volume-driven pricing and one-stop shopping. Small resellers exist and thrive because they provide more personal and focused support.

Electronic commerce allows customers to shop and access information directly. With almost no support requirement other than logistics, large distributors will seek even greater economies of scale by moving into entirely new industries, acting as public warehouses. Michael Pickett, chief executive of Merisel, the large computer distributor, sees an era of "virtual distributors" transporting everything from PCs to polyethylene.8 The resultant economies of scale and the infrastructure requirements will likely cause mergers and bankruptcies among today's large resellers.

Electronic commerce will not replace all of the relationship and support elements now offered by small resellers. However, little reason exists for these resellers to hold much inventory or even to take title to products.

5. Channel Conflict. Consolidation will not happen overnight. Therefore, as manufacturers begin to use EC systems to reach end users directly, traditional resellers will complain loudly about channel conflict.

Fearing the EC capabilities of Windows 95, one reseller group sued Microsoft even before the product became publicly available. From a legal perspective, the dealers claimed that Microsoft was tying the purchase of its online system to the purchase of the operating system. Actually, the resellers feared that Microsoft was forcing them to sell the means of their own destruction. Microsoft could use the EC features built into Windows 95 to sell subsequent software directly to end users, bypassing the dealers.9

Conflict of this type is inevitable whenever one channel is eclipsed by another channel (e.g., superstores replacing small dealers, or distributors selling into accounts previously managed by direct sales forces). Electronic commerce is no exception. In fact, the emergence of dramatic conflict (especially prior to actual sales and especially legal action) is proof of the substantial changes EC networks will bring to traditional distribution. The conflict may slightly delay the growth of electronic commerce, but companies have developed a large repertoire of techniques for managing conflict among their channels.10

A Strategic Opportunity

Traditional channel marketing systems will undergo a massive transformation in the next few years as online communication radically alters the way buyers and sellers exchange information. The transformation will give end users powerful new tools to seek out the best product at the best price with the best service. However, the role and the power of traditional channels will greatly diminish. Power will flow not only to the end user but to the EC network managers, and to those manufacturers that quickly understand the workings of the new EC channel.

The basis of competition will shift from companies with strong distribution channels to those with strong information systems. The winners will find means of graphically displaying data, updating data on a frequent basis, and responding to e-mail in a creative and real-time mode. The winners will also come from those companies that design products and that score well when filtered by online search engines.

Companies that want to participate in electronic commerce will need to recognize that the consumer market will take a back seat to the business-to-business market. To tap into the commercial electronic commerce channel, companies should move incrementally and broadly. Moving incrementally will hide potential conflicts while the company gains experience with electronic commerce technology. By experimenting broadly with CD-ROMs, the Internet, and private electronic commerce systems, companies can determine which approach best fits their strategic, customer, and technical requirements. As electronic commerce networks expand, companies must prepare to abandon proprietary networks and embrace emerging industry-wide networks.

Innovators see electronic commerce as a strategic opportunity: reducing transaction costs, eliminating barriers to entry, and shifting the basis of competition. However, entrenched manufacturers will find it difficult to transition from their established channels. To minimize conflict, vendors may downplay their efforts until industry-wide networks provide a cover. Traditional channels often accept change if they cannot focus their complaints against a single vendor.

The move to electronic commerce will replace the traditional inventory-based model with an information-based model. If manufacturers, wholesalers, dealers, and end users do not start envisioning their role in such a world, they will quickly find themselves without options.

Notes

1. Frank V. Cespedes, "Channel Management is General Management," California Management Review (Fall 1988).

2. Peter F. Drucker, "The Economy's Power Shift," The Wall Street Journal (September 24, 1992), p. A16.

3. "In Search of the Paperless Contract," Business Week (August 29, 1994), p. 14.

4. John T. Mulqueen, "Going Hollywood," Communications Week (January 31, 1994).

5. Brian W. Arthur, "Positive Feedbacks in the Economy," Scientific American (1990), pp. 92-99.

6. Doug Van Kirk, "Government Lab Advances Electronic Commerce," Infoworld (January 17, 1994), p. 60.

7. Richard Normann and Rafael Ramirez, "From Value Chain to Value Constellation: Designing Interactive Strategy," Harvard Business Review (July-August, 1993), pp. 65-77.

8. John Longwell, "Pickett Outlines 'Virtual Distribution' Concept," Computer Reseller News (March 7, 1994), p. 6.

9. Don Clark, "Retailers Fear Microsoft Network Will Leave Them Out of the Loop," Wall Street Journal (February 13, 1995), p. B6

10. "Managing Channel Conflict," Frank Lynn & Associates, Inc. (1993).

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Chapter 8: Electronic Commerce: Implications of the Internet for Business Practice and Strategy *

by Ajit Kambil

Advances in information technologies and electronics have resulted in two simultaneous shifts: a dramatic expansion of computing hardware and software capabilities and a dramatic fall in the unit cost of information technologies. These shifts have led to the widespread adoption of desktop computers and communications equipment, creating the building blocks of a global information infrastructure.

Today the Internet is the prototype of the global information infrastructure. This paper looks at the implications of the Internet and new low-cost data communications infrastructures on business practice and strategy. Specifically these technologies impact four fundamental firm processes: innovation, production, exchange, and service. This paper then considers the effects of ubiquitous and inexpensive communications on business practice and strategy, identifying suitable firm responses to take advantage of and respond to opportunities and threats presented by this new infostructure.

The Internet as a Prototype of the Global Information Infrastructure

The Internet is a collection of computer networks that interconnect computers all over the world. Computers on the Internet are able to communicate with each other because they use the Internet protocol as a common method for routing and transferring messages across computers.

Users of computers on the Internet have access to a variety of electronic communication, information retrieval and interaction capabilities. The basic functions of the Internet include support for:

- Electronic mail and news services to send or broadcast messages to other users;
- File transfer to access and retrieve files from remote computers; and
- Telnet—the ability to use and connect to remote computers.

As hardware and software technologies advanced to client-server computing, new advanced functions have become available on the Internet. These include wide-area information services, which allow users to search for and retrieve text information distributed over multiple computer servers on the Internet, and the World Wide Web (WWW) services that allow users to navigate and browse multimedia documents on multiple servers using hypertext links. Of these new services, the WWW services are the most important and they operate in a true client-server model. On the user desktop, a client side browser software such as Mosaic and Netscape provides users with a graphical user interface. Using the browser, users interconnect to various servers on the Internet to access multimedia information, interact socially, or undertake commercial transactions.

The use of WWW is increasing rapidly due to its easy-to-use browser software, hypertext capabilities, and access to multimedia information. It will soon surpass all other sources of traffic on the Internet. Emergent services on the Internet include videoconferencing, telephony, and the distribution of audio.

Since 1993, the Internet has grown at an exponential rate. Surveys of the Internet show that the number of host computers connected to the Internet increased from 1.3 million to 6.6 million between January 1993 and July 1995. The Internet also reaches over 150 countries. The National Science Foundation planted the seeds for this rapid growth by subsidizing the Internet backbone networks and the use of the Internet in colleges and schools. However, the more recent dramatic growth in the use of the Internet is driven by customer demand for inexpensive communications, availability of interesting content, lowering of technology costs, and availability of useful software for Internet publishing such as the WWW servers and browsers.

The growth is also fueled by the decentralized nature of the Internet. No one firm owns or controls the Internet—all firms that are connected to the Internet pay for their own connections to the Internet and share in the capitalization and costs of providing backbone services. Thus, no one firm needs to raise all the capital required to organize, implement, and manage the network centrally. The Internet also has an open standards process that benefits both users and providers of Internet software and services. This decentralized planning and funding model for a telecommunications infrastructure distributes investment risks and is radically different from traditional centralized models of telecommunications planning and proprietary investments telephone companies. It permits the network to grow quickly to meet user needs.

Estimates of the number of Internet users vary widely. Current estimates (in July 1995) are approximately 30 million users. These numbers are changing rapidly as the various online services purchase Internet providers and upgrade their services to provide full Internet access. A user survey by the Hermes project at the University of Michigan found users are well educated and affluent, making them an ideal target for marketing. This demographic survey also showed users of the Internet were primarily men, with a large number of international users. However, as new and different types of information content is made available over the Internet, the demographics of Internet users is becoming more diverse to include more women, the elderly, and children. Students are increasingly exposed to the Internet in the K-12 setting, and nearly all universities provide students with Internet access.

Respondents to the Hermes survey also said that they gathered purchase-related information over the network, stating that convenience was more important than price for many purchase decisions. This is to be expected for an affluent user group. In addition, users stated that their gathering of purchase-related information on the Internet surpassed the use and effectiveness of direct mail.

The growth in corporate use of the Internet and its usage for accessing marketing information highlight the increasing importance of the Internet as a commercial infrastructure. Today the Internet provides the largest common interactive data communications infrastructure in the world. It already provides wide access to content and a platform for dissemination to users and publishers of information. In the future this infrastructure will advance to provide real-time multimedia capabilities, implemented and managed in a decentralized manner over communication networks provided by various international vendors. The business use of these capabilities and the emerging infrastructure will dramatically alter business practice and competition.

Business Use of the Internet

Today the cost to become an Internet publisher on the WWW can be less than $3000 for hardware and software and as low as $250 a month for a 56 kbp/s line to connect to the Internet.[1] With such a system, an Internet publisher can serve thousands of users daily and publish and disseminate millions of pages. Similarly the cost of electronic mail is substantially below the cost of paper mail. The marginal costs of storage, communications, and dissemination of a thirty-page document can be less than a penny.

Given declining costs of using the Internet, firms have used it primarily to reduce communications and publishing costs and to improve the innovation, production, sales, and service processes of the firm. For example, both corporate and academic researchers extensively use the Internet to communicate research problems and results. Using newsgroups, electronic mail, list services and the WWW, individuals are able to pose questions and receive answers from their peers. As universities, firms, and publishers increasingly go online with working papers, technical reports and journal articles, individuals have instant access to relevant materials to support research and innovation. Information about innovations, or the innovations themselves, can be distributed worldwide in a matter of minutes.

At Morgan Stanley, an international investment bank, Internet technologies are being used to create the company's electronic office. The routine reports, forms, and documents used within the firm are distributed on World Wide Web servers within the company. These servers on the company's internal Internet are protected from external break-ins with firewalls and proxy servers that prevent external and unauthorized access to information. Information on the internal servers may include mundane information such as telephone directories, to more critical information such as equity analysis reports, or even SEC filings retrieved from the global Internet external to the firm. As security and authentication issues are resolved, more communications with clients will occur on the Internet. Internet technologies were chosen as a platform for the electronic office for many reasons, including the flexibility of the technology to scale upwards, the open nonproprietary standards and the lower costs in comparison to alternate technologies. In the first 18 months of operation, Morgan Stanley estimates that use of WWW technologies has saved the company over $1 million in paper handling and storage costs incurred in the daily production work of the bank.

Other firms are using the Internet primarily for sales and service by advertising and providing customers with relevant information about a product or service. For example, General Motors' Saturn division publishes information about its products, dealers, and prices for consumers over the Internet. They also advertise at major sites on the Internet, so that users are aware of their product. In contrast, General Electric's Plastics division implemented a series of WWW pages that are targeted to their industrial customers with detailed information about their products. These include technical specifications as well as process information for the effective use of the products. The customers of GE Plastics receive Internet software that allows them to connect directly to GE's home page when they dial into the Internet. GE Plastic's Internet site is effective as it reduces the costs of customer support and provides their prospective or existing customers with rich value-added information to service and use effectively the products they buy from GE.

To date, the Internet is mainly used to displace communications and publishing costs in product and service firms. These applications do not directly affect the revenues of the firm. Substantial revenue growth from the Internet for firms will require more widespread use of direct electronic transactions and innovative revenue-enhancing customer services. This will require advances in three key infrastructures: software agent technologies, lower cost settlement and payment processes, and transaction templates.

Software agents are pieces of code that can be customized by a user to perform an information search or processing function. Software agent technologies promise to enable lowest price search for a good, or enable users to search for alternative suppliers at very low costs.

Efficient and widespread adoption of paperless payment and settlement systems is the second infrastructure necessary for extensive direct transactions. Various systems currently exist, such as Netbill, Digital Cash, First Virtual, Netcheque, etc. All of these systems promise to lower the transaction costs of payment and settlement dramatically. While some current systems charge at a rate comparable to credit cards, over time the costs of these systems can be expected to drop substantially closer to a few pennies per transaction. The Netbill system is already designed to cost a few pennies per transaction, although it is limited in use for the sale of information products.[2]

Transaction templates are the third infrastructure necessary for widespread electronic commerce. Transaction templates provide standardized ways of describing products as well as transactions. Standardized message formats are important because they provide well-agreed upon models for users to specify products, as well as receive information on quality, price, and other features of the product. The Electronic Data Interchange (EDI) community has developed some standardized templates for message exchange customized to different industry sectors. However, more needs to be done to establish standards for describing consumer goods (in terms of features and quality attributes) and to port EDI systems and standards onto the Internet. Transaction templates will make it easier for software agents to search and compare products and should accelerate the growth of electronic commerce.

As software agents, inexpensive settlement and payment systems, and transaction templates are implemented over a low-cost communications infrastructure, both consumers and firms can expect dramatically lower transactions costs in purchasing goods and services.

Implications of the Internet for Managerial Practice and Business Profits

The key managerial challenge of the emerging global infostructure will be to reconfigure organizations to create and maintain high profits in a low transaction cost environment. Transaction costs are the various costs incurred in the purchase or sale of a good or service. These costs include those of searching for and identifying products; drafting, negotiating and safeguarding the terms of a sale or purchase; payment and settlement; and the costs incurred to enforce contracts or to correct and resolve contract disagreements. As communication becomes inexpensive, and software agents technology and transaction templates are better defined, the transaction costs incurred by firms and individuals will fall. This in turn will make markets much more efficient.

Companies that exploited market inefficiencies arising from information asymmetries between buyers and sellers, or those companies that leveraged transaction cost advantages by locating close to customers to reduce the customers' search and purchase costs, will find their profit margins and competitive advantage erode. Indeed, most distribution and retailing functions will find increasing pressure on margins as market efficiency increases and transaction costs fall.

The decrease in transaction costs also provides new opportunities to managers. Firms will be able to outsource for more inputs and functions and take advantage of economies of scale in production available to external vendors.[3] In this model, the Internet and the emerging infostructure provide firms with the monitoring and information- processing capabilities to manage the sourcing of inputs effectively. This will lower production costs of firms but also reduce any comparative advantage from outsourcing as competitors imitate similar practices.

A second major challenge to managers and individuals is the need to be alert, correctly interpret, evaluate and respond to information and issues that arise in the electronic space. Managers and individuals will find they must process and respond to new issues in an accelerated time period. For example, when a flaw was discovered in Intel's Pentium processor, it was originally transmitted on the Internet, as was the software to determine if there was an error. Intel initially played down the error as insignificant and not likely to affect most users. However, discussions on the Internet created substantial consumer pressure that led Intel to change policy and permit users to replace flawed chips at no charge.

Inexpensive Internet publishing allows individuals to disseminate favorable or unfavorable reports on products and services to a wide audience. Both managers and individuals need to be vigilant of rumors, and managers must address them clearly before it adversely affects products sales. Today individuals, public action groups, companies, and politicians also are using the Internet to further or promote different political agendas. For example, the Bell Operating Companies maintain a WWW page to provide individuals with information on latest telecommunications legislation and the Bell Companies' positions on these bills. Managers and individuals will find it harder to discern the specific biases and political agendas as more information is published in this new media, creating an information overload.

In summary, the key managerial challenge of the late 1990s will be to reposition the firm to thrive in electronic market spaces characterized by low transaction costs. Lowering transaction costs will have a major impact on profitability of firms that are inefficient in terms of production or distribution of products and services. Managers also must formulate strategies, effectively interpret and respond to information in this infostructure, and develop clear and effective corporate communications in this media.

Reconfiguring Firm Strategy and Organization

Firms will have to reconfigure their strategies and organization to respond to inexpensive communications, lower transaction costs, and reductions in profit opportunities from market inefficiencies in the emerging global infostructure. As management and economics researchers have noted, successful firms focus their strategies along a few salient dimensions for competitive advantage. Porter proposes three generic strategies: cost leadership, differentiation, and niche. Treacy and Wiersema similarly identify three strategies—low cost, innovation and customer intimacy—as ways of creating value for customers and sustaining market leadership. Industrial organization economists identify economies of scale, scope, externalities, and innovation as sources of market power and higher or monopoly returns on investments.

Adapting the prior work, the following are strategic foci for reorganizing firm strategy to adapt to a world of increased market efficiency. These strategic foci do not necessarily require the use of the emerging infostructure, but identify ways of enhancing market power to realize superior profits in the new environment.

The strategic choices managers confront in responding to the emerging global infostructure are to:

- Establish market leadership by leveraging economies of scale, scope or externalities.
- Establish market leadership through innovation.
- Establish market leadership though focus on superior customer service.
- Enhance brand identity.
- Exit from an industry segment.

Economies of Scale, Scope, or Externalities. Economies of scale or scope can permit firms to lower their costs and increase margins. For example, in the retailing industry, organizations such as Walmart and Federated have realized economies of scale through acquisitions or expansion and lowered unit costs in merchandise procurement and distribution. As firms transact over the Internet, it will be easier to compare the prices and services of firms that sell similar undifferentiated products. For example, consider a vendor who opens an electronic storefront to sell computer equipment and a product (e.g., a Pentium desktop computer). If the products and services are undifferentiated and not substantially different across firms, customers will choose the lowest price option. For the vendor to realize substantial profits in the electronic market, he or she must have sufficient scale to negotiate lower prices from the suppliers of computers and a high turnover in product to realize substantial net profit. Thus, achieving scale economies is one strategy for effective competition in the electronic space.

Firms can also realize market power from positive consumption externalities or weak interdependencies between customers. For example, the dominant WWW browser, Netscape, is provided virtually for free and has established a large market share. Netscape is constantly enhancing its browser to provide new features that rely on its proprietary seer. As more users use the Netscape browsers, other firms that develop innovative features on the WWW are licensing their technologies to Netscape, giving Netscape a market advantage in the markets for server and browser software. This in turn creates a bandwagon effect, leading more users to adopt Netscape technologies and greater dominance of Netscape products in the marketplace.

Innovations. A second source of market leadership and superior returns arises from innovation in production, product, or service. When innovations are proprietary and protected by patent, copyright or trade secret, they can give the firm market leadership and superior returns on investment. Examples of firms that base their strategy around innovation in products and production include Merck and 3M.

Innovations in the emerging infostructure include supporting tools for electronic communications and commerce, such as new WWW server software and security protocols and mechanisms.

Superior Service. A third source of market leadership and the ability to generate superior rents arises from providing superior service. The emerging infostructure is especially suited to supporting this strategy by enabling specialized or learning relationships with the customer. For example, a customer can specify in advance various purchasing preferences and needs to a vendor or to a vendor's specialized software agent. The vendor's software then can identify a select set of product options for the customer. The software also can remember prior purchases to suggest to the customer new purchases that build on prior purchases. Such a system reduces the customer's search costs and memory costs, but requires precise and sometimes private information from the customer. The Internet and similar networks make the cost of collecting such specialized customer information much lower for firms. Firms that collect this information and maintain it for their own use can then enter into a repeated service relationship with their customer, leveraging and growing information assets to improve the service relationship and thus generate greater revenues. Firms can also use the Internet to provide specialized information to the customer to enhance the service relationship.

An example of a firm using such tools is Individual Inc., which provides a customizable news filtering service to clients. A firm that enhances customer relations through the Internet is Federal Express, which allows users to track the exact status of any package sent over Federal Express services.

Enhancing Brand Identities. It is imperative for firms to establish recognized and valued brands in the global infostructure. While communications networks and software agents will enable individuals and firms to incur lower costs in searching for products, both individuals and managers will confront greater amounts of published information to interpret in order to determine the quality of goods available to them over the network. One way of reducing the information overload and processing required of managers or customers is to establish a brand identity. A brand identity typically associates a number of valued characteristics with the branded product and reduces the information processing required of the customer to value the product. A brand establishes a reputation for the seller and a promise between the seller and customer that the seller will honor the commitments associated with the brand identity.

Brands established over other media do not automatically transfer to the Internet and the new media. The Internet provides a media with low-cost entry for talented individuals to bypass traditional brand management efforts, and to become opinion leaders in the establishment of brands. Examples of opinion leaders in the Internet include the editors of Wired magazine and its HOTWIRED site on the WWW, the individuals who developed the Yahoo server at Stanford to point to interesting sites on the Internet, or Professor Wayne Marr of Clemson University who rates business schools and their presence on the Internet. Managers must develop brand management strategies that adapt to the new opinion leaders in this media.

Exit. Inefficient firms that are unable to refocus their strategy to the models outlined above can also choose to exit from an industry segment. Early exits are likely to realize higher value than later exits when operating margins and earnings decline.

In summary, firms will have to refocus their strategies. Successful firms will avoid the price wars enabled by software agents undertaking lowest price searches. If the firm has a cost leadership strategy, it must ensure sufficient scale to turn over large transaction volumes on standard products, and internal efficiencies to generate a small margin but large profits based on the volume. If a firm competes on the basis of innovation, it must acquire and maintain the resources and environments supportive of innovation, and if a firm competes on superior service it has to invest in information, training, and other assets to sustain such a strategy. Hence firms will have to refocus and organize around a fundamental source of competitive advantage arising from economies of scale, scope, externalities or proprietary advantages from innovation or service to realize higher profits. If they are unable to transform their strategies, these firms should exit those businesses that will be rendered unprofitable by the Internet or similar communication infrastructures. Finally, managers will have to restore and enhance their brand strategies to overcome the information overload confronted by customers in this media.

Conclusions

To date, the use of the Internet for electronic commerce has been limited to publication of information, advertising, and communications among individuals. Yet the Internet holds the possibility of transforming commerce by enabling electronic transactions. As technical problems in security systems, payment, and settlement architectures and basic

Internet access are resolved, the accelerated diffusion and use of the Internet will evolve. As new software agents and transaction templates are developed, an increasing growth of commercial transactions on the Internet and similar networks will occur.

The consequences of transferring more commercial activity to electronic media will be dramatic reductions in transaction costs and profits gained from exploiting differences among vendors in these costs. As transactions costs fall, firms will have to rely on different and new sources of market power to realize superior profits. This will require major restructuring of business strategy and operations.

As firms prepare to undertake commercial activity in this new media, managers must develop a coherent Internet strategy. This requires managers to:

1. Recognize that the interactive new media is different from television and print, and users will have to utilize the media with entirely different attention spans and behavior patterns.

2. Customize promotions and organization interfaces to multiple distribution channels and media segments. The Internet enables individuals to participate in smaller, more specialized electronic interest groups. Companies and marketers need to recognize and respond to this channel fragmentation.

3. Integrate marketing strategies across media. Many firms today separate the Internet activities from other promotional and selling activities of the firm, missing opportunities to cross-sell.

To adapt to the new competitive realities of the global infostructure, firms will have to rebuild their strategies and reengineer operations in terms of location, marketing, and distribution. Existing assets, such as warehouses, optimized to distributing through stores, will be suboptimal for home delivery. Existing firms may not be well positioned for electronic commerce, where product information is distributed electronically and products themselves are delivered by the mail.

The strategies and steps outlined above should help the firm to establish a presence in this new media more effectively in an environment of low transaction costs. The widespread adoption of electronic commerce should increase productivity by making transactions substantially more efficient.

Notes

1. A Pentium computer with 1 GB of disk running Linux and public domain web server software.

2. Interview with Professor Marvin Sirbu at Carnegie Mellon University, inventor of the Netbill system.

3. External vendors can realize economies of scale advantages not available to a single firm by aggregating demand of multiple firms for a product or service.

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Chapter 9: Banking and Cyberspace: The New Promised Land *

by Joanna Smith Bers

Cyberspace is not just another mere alternative distribution system for banks; it is an electronic frontier in which banks can more cost effectively deploy products and services to a virtually boundless customer base, staking their claim to the vast spectrum of revenue opportunities in the emerging era of electronic commerce—provided, that is, they can redefine their roles as both service providers and transaction facilitators.

Strategy is critical in this intensely competitive time of electronic banking revolution, and it's a question of how—not if—banks will enter this brave new cyberworld. Today, there are already some 30 million Internet users—all potential bank customers—and the numbers are growing by about 10 percent a month. The Internet represents a near-perfect alternative delivery channel for banks. Without having to make huge investments in technology, it is a way for banks to off-load some of their transaction-oriented retail business, while tapping into a market that sources say is ripe with financial services potential. Recent statistics indicate that the Net is dominated by users that earn more than $45,000 annually.

For now, the Internet is shaping up to be a consumer-driven retail banking infrastructure; in the near term, however, the world of electronic commerce will open up new opportunities for corporations and merchants on the Internet as well, and sources say, could become a catalyst for electronic data interchange (EDI), one of many Internet ideas currently being explored by Citibank, among others.

But for banks, this brave new world is still wrought with some of the trappings of more traditional banking. Different from their nonfinancial competitors, the highly regulated business of banking could face similar restrictions in Cyberspace. Software applications, for example, will have to be "intelligent" enough to impose the proper state regulations on interstate banking transactions because in Cyberspace, geographical divisions may evaporate, but state laws won't, warns Matt Chapman, chairman and CEO of CFI ProServices, Inc., based in Portland, OR.

While regulatory guidelines still have to be hammered out, banks are forging ahead, notably through the delivery of bank products and services on the Internet. The traditional, old-line philosophy of the bank-owned distribution channel—where financial institutions owned the customer relationship—has been slow to dissipate. But Bank of America and NationBank's recent acquisition of MECA Software, Inc., maker of Managing Your Money, is a healthy sign that bankers have taken notice of personal finance management applications like Microsoft Money and Intuit's Quicken, which sources argue could severely encroach on banks' payments business and push banks farther from their customers.

Competition on the electronic frontier is forcing bankers to fundamentally reinvent the very business of banking, and, even more, develop relationships with software developers, despite their hesitancy to partner with nonfinancial companies that are forming their own payment systems relationships and threaten, by their broad-based appeal, to come between the banks and their customers. The choice: either expend vast resources to develop proprietary front-end applications or find a personal finance software company that will subscribe to a more traditional bank philosophy.

When Bank of America and NationsBank chose the latter route—and, in their eyes, rescued the banking industry—by purchasing MECA Software for the economical price of $35 million, it was to ensure the existence of a "bank-friendly" personal finance front-end application. "The relationship that someone has today for financial products is one that they have with a financial institution," says G. Patrick Phillips, EVP of Charlotte-based NationsBank." And being able to reinforce that relationship using software rather than reinforcing the software manufacturer as being provider of that financial service is important to our institution." Or, plainly put by San Francisco-based Bank of America’s vice chairman Thomas E. Peterson, "MECA licenses the bank to [use Managing Your Money], and the bank owns the customer. In other companies, the customer is not the bank customer anymore for all intents and purposes; he or she is the customer of the software company."

But some industry players contend that a bank-owned personal finance software package, for example, is reinventing the wheel. Enter Intuit CEO Scott Cook. "The best thing I could do is ask banks, ‘Have you asked your customers if they think you own them?’" says Cook. "The point is, customers don’t think you own them, and they don’t want to be owned...Look at it that way, then you have to do your level best to serve the customer in the best way possible."

Of course, Cook could be a little biased. As head of a company that is about to launch a financial services server that will allow Quicken customers to access not only their banks, but also every bank with which Intuit has an alliance (initially using just Quicken as its front-end), Cook has reason to be enthused. While the downside to this is that bank customers will have access to competitive products, including nonbank offerings, the upside is that these same banks have the opportunity to sell to a broader audience. And banks such as the new First Security Network Bank, a virtual bank launched by Pineville, KY-based Cardinal Bancshares, are agreeable to the new rules of the electronic frontier. Why? For the single reason that they will conform to whatever their customers demand, even at the risk of directly competing with other financial services institutions and software companies." We don’t want to try to tell our customers how they need to do banking," says Michael Karlin, president of First Security Network Bank. "We want, therefore, to be open to as many front ends as possible. If we work out a relationship with Intuit or Microsoft or MECA, where we can use those front ends, or our customers can use those front ends to get into the bank, that will be great."

Chase Manhattan Bank’s early adoption of Microsoft Money and its relationship with Intuit are evidence of the bank’s multi-channel distribution philosophy. "Any one company, whether it’s Intuit, Microsoft or anyone else, will not automatically disrupt [the bank-customer] relationship," says Steve Hirsch, vice president in charge of emerging delivery at Chase Manhattan. While Microsoft Corp. is viewed by many in banking circles as a legitimate threat, Hirsch suggests the company, as with any potential competitor, bares watching. "Competition in banking has changed dramatically over the past [several] years, so there are any number of new competitors interested in financial services, and Microsoft clearly is one of them. But there is no overreaction on our part."

As for Microsoft, CEO Bill Gates—retrenching in the wake of the aborted merger with Intuit—is revamping his electronic commerce strategy using the less popular Microsoft Money as the company's front end to a potentially Goliath electronic financial services plan that could very well touch all facets of banking. For starters, Gates is planning an introduction of the revamped Money product to seize market share in the personal finance arena. Even more, the imminent launch of Microsoft Network—which the company intends to bundle with Windows 95—is Gates' bid to dominate the on-line services market. Add in Microsoft's alliance with Visa International to establish secure on-line transactions and, in doing so, achieve a stake in the lucrative payment systems business, and its newly announced electronic cash card venture to give it yet another piece of the payments business. This is the Age of Electronic Banking, in a big way.

Such vast resources—and so little regulation, the U.S. Department of Justice aside — understandably give bankers pause. Microsoft Windows's 80-percent market share is the "virtual bank" link to every PC user in the country. Some industry players argue that Microsoft could potentially monopolize retail banking. The threat is not that Microsoft wants to become a bank per se, but that the software giant will dominate the transaction business, potentially leaving banks to become mere monetary depositories, says Peter Levine, senior vice president of Stamford, CT-based Gartner Group. "Banks are no longer interested in making the interest they make off of a $2,500 minimum balance—the difference between what they pay you and what they charge [for loans]— they want transaction revenue," he says. "Well guess what? If Gates takes the transaction revenue, banks are left with the ugly side of the business."

Which is precisely what banks are working to avoid. No matter which front-end applications banks choose, they must also securely and efficiently connect them to the bank's systems for an effective home banking system. In the past, banks developed custom connectivity solutions. While banks have to incorporate firewalls to safeguard their data, connectivity to front-end applications does not have to be bank-specific should middleware vendors be able to tie their systems to a uniform connection. The appeal of a uniform connection is its economy—a single type of connection compatible with multiple vendor applications. In an attempt to provide that uniform connection, Visa Interactive has developed two standards: the access device messaging standard, connecting front-end applications to a Visa host system, and the electronic banking messaging standard, to be used by middleware companies connecting banks to the host system. Together, Visa's communications standards create a uniform method for banks to tie their systems into as many front-ends as they wish. In addition, by using the Visa host, banks can access a bill payment system, Visa's bi-directional, back-end authorization and settlement system called E-pay. E-pay, which launched last month and competes with Intuit's NPCI, uses VisaNet to not only transfer funds, but also to transfer data relative to bill payment so that bills can be both sent out to consumers and paid to merchants. As VisaNet is a worldwide processing system that handles billions of transactions, banks can take advantage of its economies of scale, says D. Fraser Bullock, president and COO of Visa Interactive. Visa Interactive's technology is currently compatible with MECA Software and its own front-end application. On the back-end, Applied Communications, Inc., Tandem Computers, Deluxe Data, Braun, Simmons & Co., Early, Cloud & Co., and US Order have agreed to meet Visa's electronic banking messaging standard.

Once electronic commerce is in full swing, the move by players from home banking into the payments business is what sources say will drive its exponential growth. Credit cards, a natural form of payment for Internet and on-line services shopping, will be the interim solution until alternate forms of payment, such as electronic cash, emerge. Regardless of how consumers make payment, the most pressing issue of electronic commerce centers on securing Internet-based transactions against exposure to hackers and merchant fraud.

Today, ensuring payment security is a twofold process: safeguarding disclosure of financial information and verifying that consumers are whom they purport to be. To this end, encryption technology and personal identification numbers (PINs) are used. But there is a range of ways this security is delivered. Three big players in the credit card payment systems business are First Virtual Holdings, CyberCash, Inc., and Netscape Communications Corp., each of which secure consumers' financial information differently.

San Diego-based First Virtual protects consumers by never allowing their information to go on-line. Rather, information is disclosed over the telephone; First Virtual then assigns consumers PINs. Upon making an Internet transaction, merchants send the consumer's PIN to First Virtual, which then e-mails the consumer to verify that he or she actually wants to make the purchase. When the consumer consents, First Virtual dials Visa or MasterCard, collects the money and deposits it into the merchant's account. To further facilitate consumer PIN registration, First Virtual is working with several large bank credit card issuers to assign cardholders a First Virtual PIN in the same manner as bank ATM PINs are assigned. "That way we can enable a very large installed base very easily, and, at the same time, provide greater security for the banking world," says First Virtual CEO Lee Stein.

Without using encryption technology, Stein has been able to establish First Virtual as a viable transaction payment provider in a market that potentially spans the entire Internet consumer base. And because encrypted transaction technology development has not kept pace with consumer demand to shop on the Net, says Stein, First Virtual has amassed much bank business and merchant allegiance.

But First Virtual is one of many players looking at financial services as a way to hit it big in Cyberspace, not the least of which is Netscape. Netscape's secure transaction technology is a more evolved method of protecting consumer information in that information within its browser is protected in the Netscape-developed secure sockets layer (SSL), a security protocol which rests between an Internet application and the Internet protocol (IP), whereby data is encrypted using RSA Data Security Corp.'s public key technology. This ensures that the pipeline between the consumer, merchant, and credit card company is hack-free. As a result, a consumer can disclose credit card information over the Net knowing that only the merchant, the bank, and MasterCard International—the credit card company with which Netscape has an alliance—are able to de-encrypt that information, says Netscape's Charles Jadallah, director of financial services.

What is at issue is the development of an industry-wide standard security protocol, which has given way to the Netscape-MasterCard and Microsoft-Visa alliances. This activity means that consumers could see a seamless secure transaction system adopted more quickly, thereby creating a forum for electronic commerce that wouldn't require consumers to register with any one company to secure their credit card transactions. But a crucial aspect of developing that standard will be implementing a public key certification authority, says Cathy Medich, executive director of Menlo Park, CA-based CommerceNet, a consortium of financial institutions and corporations working to ensure secure Internet transactions. A certification authority would assign Internet users public key certificates which would then be used for authentication and digital signature verification.

Such a standard could be problematic in the future for Reston, VA-based CyberCash, which currently secures credit and debit card payment transactions with RSA Data Security's encryption technology, but does so through an application that runs on top of browsers, as opposed to being integrated within them. Thus, access to this service requires account registration, which is not a seamless consumer-Internet interface. Still, until all browsers are secure, this cross-platform solution has been adopted by banks such as Wells Fargo and First National Bank of Omaha. And because it only secures the payment transaction, CyberCash has been able to negotiate export licenses for its software, which opens up international markets.

Beyond secure bank card transactions, CyberCash is also developing two electronic money products which will be piloted in August and introduced in the last quarter of 1995. The products are a money messaging service and micro payments service. The money messaging service is the equivalent of a check or hard currency, says CyberCash CEO William Melton. "It has all the best benefits of cash: there is no float involved, there is no risk involved. And it has the advantage of a check in that you can use it at a distance. It can be used to purchase a product and it can be used for "peer-to-peer" transactions (individuals sending money to each other, regardless if the receiver has a CyberCash account) although an account must be opened to take ownership of the transferred funds. CyberCash earns its revenue by charging a postage fee to transfer funds.

For small value transactions, consumers can access CyberCash's micro payments product. For consumers downloading New York Times articles for 25 cents, or maps of the San Fernando Valley for a nickel a piece off of the Internet, this product can quickly make transactions without forcing consumers to key in what they want and to whom the money goes. So CyberCash has created a cyberpurse in which funds can be transferred from DDAs or the electronic messaging service to pay for small-ticket items. As a product is purchased, the value in the purse decreases. "It's a virtual smart card," says Melton. And rather than charge a postage fee, which could be more expensive than the item purchased, CyberCash charges three to five percent of the transaction value as payment for its service.

Where CyberCash micro payments end, Amsterdam-based DigiCash gets started. "CyberCash is [currently] an online account-based system," says DigiCash’s CEO David Chaum. "[DigiCash’s] E-cash is a bearer instrument. Possession of the bits is possession of the money." By this fall, DigiCash will bring E-cash to the Internet, after a wildly successful and somewhat controversial pilot where DigiCash introduced free "cyberbucks" into Internet commerce to attract customers. The result: DigiCash’s 75 retailers have accepted the "monopoly" money at a two-bucks-to-the-dollar exchange rate. As more people sign up with DigiCash, this new form of currency—totally outside the Federal Reserve’s reach—raises issues about the potentially disastrous economic implications of taking monetary control away from the centralized agency.

But E-cash is different; it’s the electronic equivalent of real money, incorporating the Chaum-developed blinding technology to keep individuals, merchants, and their banks in the dark as to a consumer’s identity. The DigiCash consumers, however, are able to track their transactions straight to the payee’s bank to ensure against the misappropriation of funds. "It’s more traceable than plain cash," says Chaum. And unlike cyberbucks, E-cash will be issued by banks and controlled by central banks that will be responsible for monetary security and to protect against systemic risk. "Our company doesn’t intend to actually operate an electronic cash system. We intend to license the technology to banks," he says.

With the dawn of electronic commerce, Chaum says, retail banks will serve an important function in society, adding: "There’s no reason to think that other people should be able to piggy-back on the payment system banks have built."

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Chapter 10: Silicon Summit:
Will Technology Affect the News?
Executive Summary *

by The Radio and Television News Directors Foundation

...New technologies will present new challenges to radio and television news.... [in] four areas:

1. Which technologies will present opportunities or challenges to broadcast news?
2. What capabilities do those technologies have for news?
3. How will they change the relationship with the news audience?
4. How will they change the nature of the news business?

There are no quick or easy answers to any of those questions...The successful adaptation of news to new media may require certain scenarios:

1) News will become a "killer app." A "killer app" refers to a killer application or a use of technology that causes widespread adoption of particular hardware or software. News, defined as information of interest to the individual, will be one of the significant factors influencing the adoption of new technologies.

2) Consumer choice and control will drive journalism's successful adaptation to new media. One of the inherent characteristics of these new communication systems is that the audience is elevated to a co-equal level with the news organization and journalist. News organizations that attempt to impose their existing hierarchical structure on the new media ultimately misunderstand the nuance of "interactive" technology and will, in all likelihood, fail to successfully transfer news into new media.

3) News content will not remain the exclusive domain of traditional news organizations. Commercial, governmental, and other non-news organizations may use the "news" to lure their audience toward other information.

4) News professionals should learn to exploit the natural tension between the technical "possibilities" and the economic realities of new media. Reporters and editors must add data management and library science to their journalism skills arsenal.

5) The audience is a complex entity. People resist change and do not easily unlearn old habits and learn new ones. However, lifestyle factors, unrelated to the new media, already are transforming newspaper circulation and radio and TV viewership. As online information-gathering proliferates from the kindergarten classroom to the company cubicle, its "futuristic" perception will give way to greater comfort levels and thus increased audience acceptance of new-media news.

...Generally...the Internet is evolving into a useful tool for reporting and for communications...The Internet's potential for distributing news...has not yet developed a self-sustaining economic mechanism to support a news cycle...Another technology, interactive TV, had promised a bright future, but has not lived up to its promise.

If journalism is practiced online, it promises to expand the capabilities of a reporter to present material by incorporating original sources of material into a story, such as background or historical documents, or video or audio clips, said Steven Pizzo, senior editor for Web Review magazine. But others question whether an audience conditioned to vegging out in front of the tube will take advantage of those opportunities. The Internet brings not only the ability of news organizations to reach viewers in a different medium, but also empowers viewers to become their own producers, leading to more "news" sources, whether professional and reliable or not.

One of the most interesting [issues is] how new technologies will change the relationships between news and viewer. There [is] some thought that the two would be brought closer together, increasing the trust that has eroded between audience and news producers.

News on Demand

Partly because the technology of the new age attracts the most attention, it is as good a place as any to start. Who hasn't been dazzled by the wide array of material newly available from around the world at the click of the mouse? Who wasn't enthralled by the eager projections of the Internet zipping over cable at speeds hundreds of times than that provided by the telephone network, or the suggestion of a wireless future, in which all resources would flow invisibly into your information collection device?

Of those technologies, of course, the Internet is the most prominent. Once merely a quirky network developed by the Pentagon and used primarily by academic researchers and hobbyists, it has exploded into the commercial world with World Wide Web sites for car makers and liquor bottlers and movie makers and dozens of other industries, including news organizations.

For journalism, Pizzo said he believes the Internet can serve a higher purpose. He believes that the Internet, with its multimedia ability and power to link readers to other locations on the Net, can serve the fundamental social purpose of restoring the public's trust in journalism that has disintegrated over the years. If he is quoting a public figure, for example, Pizzo said, he "could have Real Audio clip, a 2-minute clip and just invite the reader to listen. The clip itself will tell the reader the tone of the President's voice, his mood." He finds this approach resonates more than just a little quote. "Readers don't get as excited as reporters do about news stories because they don't see the original secret papers," Pizzo said. With the new technology, material can be scanned into a file and linked to the story. On a story like the flat tax, readers can be linked to dozens of Web sites on the topic.

Technologist Matt Brocchini, with the software powerhouse Oracle, agreed: "The fact that an individual can drill down and get behind the facade of the reporting, down to the real stuff, is definitely revolutionary. There is no question that that's a revolution." Global Network Navigator's Lisa Gansky uses the Internet as a means of backing up what she sees and hears from traditional news media: "If there's a story that I'm suspicious of or I actually want to get more—I'm keen to get more detail—I do go on the Net." But woe to the news source in the 21st century who betrays that trust; it will be quickly replaced, she said. For Ed Christie, of SRI Consulting, today's Internet is a starting point. He said that the Net is "not the end. It is simply a way to learn how we can do things once we do have these broadband networks, which are not going to be here in 2.3 years or 4.2 years." But once we have them, "there we go."

Not Ready for Prime Time

For journalist Gina Smith, all this talk about the glories of the Internet overstates the case for a decent, but not overwhelming, technology. She said...that communications and computers will affect news "a lot less than everybody thinks."

Every time a new medium appears, "the impulse among everyone is to assume how everything is going to change completely." Smith concede[s] that the Net is changing, with new developments such as real-time audio and video.

But the fact is, she said, most people do not have modems fast enough to make good use of the technology. Those 14.4 Kbps modems, which are in most computers now, are not nearly fast enough for a multimedia news product, and the quality of two-way video at 28.8 Kbps "is dreadful."

Christie agreed, saying: "You can get additional information on the World Wide Web. But most people aren't willing to put up with "click and wait." Smith predicted it will be 10 years before two-way audio and video on the Net will "become real enough for us to exploit" in delivering news. It may take some time for the right set of skills to develop, as Christie said. Early TV, he said, was "a bunch of people who read the commercials like they used to on the radio, and it didn't work. And it took a while to sort that out. And it's going to take awhile to sort this out, too."

On the other hand, the Net is a great tool for reporters to use now for their research, Smith [says]. She also advise[s] TV and radio stations to "work on getting your personalities online" as a way to keep the audience and build new relationships. She compared the situation to the cable industry 20 years ago, and said magazines missed their opportunity. Why is it that CNN was created, and not Business Week Television, she asked. "Why not Sports Illustrated?" (After the discussion was taped, Sports Illustrated announced a partnership with CNN for a new sports cable channel, CNN-SI.)

Odyssey president, Nick Donatiello agreed, advising stations "to get some (online) experience, but don't expect very much." Donatiello would like to see the new media enhance current news delivery. Rather than seeing online or other technologies replace TV, radio, or newspapers, Donatiello said existing outlets could ask themselves what new media can do to help remedy the problems that result in declining viewership and readership.

News and Other New Media

There is a tendency when discussing new methods of delivering news to focus almost exclusively on the Internet and its World Wide Web aspects. But participants in the discussion made it clear there are other technologies, some that show promise and others that have not shown much yet. CD-ROMs fall into the second category, said San Francisco State professor John Burks. As he looked over the new media, it was clear to him that using the word "pathetic" wasn't an exaggeration.

The CD-ROM isn't just clunky and hard to operate, Burks wrote, once you get it up and running, the content is "usually fourth-rate." For Don Roman of Pacific Telesis, the ultimate in news technology may well be the video equivalent of the Internet. Instead of providing just text and graphics, video also will be stored in servers, giving viewers many more choices of exploring the same topic. Roman noted that a traditional newscast has an editor who makes the decisions on which story will lead the newscast and which stories will be in each segment. Those brief items are different from a longer report, such as those shown on a PBS news program. And so, Roman ask[s]: "And why couldn't you have both? If you had your news on a file server, you can go in and get the 30-second story or you can get the 5-minute story, depending on where your interests are."

Eventually, Roman said, broadcast news will be interactive, "or have the capability for being as interactive—in the sense of selecting what you want to see—as the Internet is, and not very much down the road from now." The end result, conceivably, is that by selecting items of interest, viewers could construct their own newscast. In order for that future to develop, however, it will cost billions of dollars to lay fiber cable, Smith said, adding it would "happen in a minute" if there were a "compelling application" justifying the expense.

Online technologies have the potential to deliver news and information to a very narrowly defined audience, and...that trend toward specialization is developing in existing media as well. Burks is working on a project with KGO-TV, San Francisco, sending out zoned broadcasts over cable, so that different communities would have different, more localized programming and ads. (The over-the-air KGO-TV signal stays the same everywhere.)

The same zoning technology also could make interactive entertainment TV possible, Burks said. Narrow segmentation of news "isn't necessarily a bad thing," Semon said: "If the news is presented to a little bit different audiences because of the segmentation, does it really matter if it's BET or Galavision or MTV? If the format gets an individual to watch because of an affinity group, but it's the same news, we become better informed."

Brocchini noted that not long ago, he thought interactive TV would deliver the news. Now the World Wide Web is taking center stage. Brocchini said he would like to imagine that it will not matter which delivery system is used, that information will be delivered by whatever suits us—online, TV, paper, personal digital assistant (PDA), or whatever else is around.

Gauging the Audience

Focusing on the technology of tomorrow's news is so exciting, it is easy to overlook the other half of this equation—the customer. Who is the audience for these services? How will they react when these grand new developments come our way?

...The technological possibilities of the new news business will be wonderful even if, in the opinion of some, it will take a while to materialize. Researcher Armando Valdez noted that today, "news audiences are largely passive receptors of information that is gathered, packaged, and delivered by news professionals." In the future, he argues, audiences will be "active users" of information resources, picking and choosing on their own from the information-rich Web, or from Roman's concept of video servers with news stories ready to go.

Other[s] [do] not agree. "You can lead an audience to a mouse, or keyboard, or big-screen TV with keyboard/remote, or whatever, but will they use it?" says Smith. Listen to Smith, and you get the idea that Kevin Costner's "Field of Dreams" Iowa ballfield would have been overgrown with weeds.

Smith doesn't care if they build it—she's not coming: "I get home from work, I'm so exhausted. I'm lucky to pour a glass of Chardonnay and make it to the couch. And I don't want to sit down and say: 'All right. I want to see sports first, because I care about football. And no O.J. And now I want this and that.' All these decisions take time. Most people don't have the time to even think about the choice, much less..." As Gansky observed: "Remember, we are a culture in which people buy pre-fabricated term papers to get through college." Or as Christie put it, news "is passive. I go home. I turn it on. I watch it."

Americans are people of habit, and those who expect a quick change will be disappointed, he said: "You can't change the habits of an audience of American people who are not used to dialing into a computer to get their news or choose sports or weather." Donatiello said that even if people get used to the many choices available to them, it won't be "so they can get a fifth layer of detail on the flat tax," much as Pizzo would like. If used at all, it would be for entertainment, Donatiello said. Part of the problem with trying to build an on-line business now is that the demographics are "extremely bland," as Smith put it.

According to Smith, most of the 6 million Web users are "upper-middle class suburban white guys. Women, minorities, and anyone over age 50 barely show a presence." Nick Donatiello disagrees, saying that about 10 percent of American households are online and that women may make up 40 percent of online users.

As Valdez point[s] out: "Diversity may be sacrificed at the altar of new technology." He noted that the National Telecommunications and Information Administration (NTIA), part of the Commerce Department, found that affluent families, most of them white, comprise most of the households with computers. Overall, Valdez looked at the online crowd and saw another group. He said the audience for the new technology is "much more complex than we'd like to admit."

He describes the Internet community as "a hobby audience." But there are many people who "are not keyboard literate, are not likely to become keyboard literate, and don't want to become keyboard literate for a while." It may disappoint the technologists, but sometimes the audience lags behind in terms of interest and "desire to do things that we would like them to do," Valdez said. Burks saw that there is yet another audience out there, the people who are between 13 and 21 now, who started out playing video games, and who will accept or even demand "steerability"—the ability to be comfortable with a myriad of choices and to pick from them.

Validity and the New Media

The technologies have the power to forge a vastly different bond among readers and news providers. But [there are] different views of how that realignment might occur. For Pizzo, the capabilities of online publishing are a blessing. "I believe that this medium offers me an opportunity to begin restoring this profession's credibility," he wrote.

The problem, Pizzo said, is that national journalists are covering more partisan and divisive issues and that both sides of an issue believe reporters are twisting facts, which also is a reflection of readers' polarization. "Countering the trend has proved a problem, not just for print journalists, but broadcast outlets as well."

Editors cut print stories, but the problem is magnified for radio and television when precious transmission time means that even the most complicated story has to be rendered down to its most fundamental element, a process that can cause a gap to grow between reporter and the audience. Pizzo said: "Once readers have regained their trust of journalists they once again begin using the news (and the multimedia resources included in them) to make decisions on the issues that face the nation and world." He added: "Until that happens, journalists are just contributing to the noise of battle. I believe that online publishing holds the best promise for getting there." Gansky said she recognized that "there will he shakeouts in the understanding of what constitutes a trusted professional."...[S]he noted that the media for providing news are going to work synergistically, not separately.

Consumers will develop new habits, and will "begin to trust one medium and several voices in a medium for certain kinds of stories, depth, or, you know, minority angles, or local angles of what's really happening in Bosnia from people who are online who have some identity there." From her own experience in the 1991 fires around Oakland, Gansky noted..."We found that information from authorities (i.e., police and firefighters) often was false, faulty, and out of date in the swirl of confusion created by many fires. We began to mistrust their information." What they did trust was communicating with neighbors on portable radios, and checking out the scene on motorbikes. For Gansky, the development of grass-roots news sources (scorched or otherwise) means that the sources of news will be far more diverse than today.

Brocchini sees advantages in the sheer mass of information developed by online participants, much as Gansky's neighbors gathered it, but on a dramatically larger scale. He wrote: "In fact, I'd say the 'mob journalism' of USENET is often more reliable than much professional journalism. It's harder to slip an error past many USENET communities than it would be to get the same thing by some magazine fact-checkers. The group is self-policing." However, as Brocchini well knows, it may take wading through dozens of USENET postings before the self-policing takes hold and accurate information is presented. Even then, it still may be hard to evaluate.

Pizzo took a different view, noting there is "an enormous amount of garbage out there." As he reads through news-like postings, he finds items that resemble news stories, "yet all the facts are wrong." People must become "more intelligent consumers of this product than they ever were before." As Viacom Cable's Doug Semon pointed out, as everyone becomes a news provider, it will take some time for the public to pick out which sources it trusts. Or, as Ronald Reagan put it in another context: "Trust, but verify." In that environment, established organizations, whether network news or local stations, could "have a head start, but it will be incumbent on them to maintain this advantage."

Role of the Editor

After considering the pros and cons of the developing technologies and the effects on the audience, one large question remains: How will the news business evolve? Or, to put it another way, can...the professional journalist, be replaced by a string of ones and zeros?

The question is not that far-fetched. America Online, CompuServe, and a host of specialized online business services already allow customers to set up collection files based on key words or topics. These primitive "intelligent agents" search through the services to find all of the stories on a given topic. It is not that hard to imagine sending more advanced "infobuts" onto the Web, or some other computerized medium, to perform many of the same tasks, and come back with some long stories, some short stories, some foreign or some political stories, in whatever order the searcher wants, in other words, creating a computer-compiled newscast.

That is an extreme view, although Pizzo, Semon, and Valdez each suggested their own variations on that theme. As Semon put it: "If all this information is available electronically, then it would be relatively simple to write a computer program where you could specify what you wanted to know, and it could go find it for you."

Many [journalists]...however, [aren't] that far apart in their projections about how the news business will evolve. For Brocchini, journalists will be packagers and producers and filters, who will use their judgment to compile the news because the audience does not want to be deluged with "a huge selection of unedited material." This filtering function may be more important than ever because of the glut of unreliable information sources, he said. Valdez said journalists will have a variety of roles: "repository and information resource; authenticators and archivists; information gatekeepers and brokers."

The most hopeful sign that, yes, there is a future, may have come from Semon, another of the technologists, who said: "I'm not sure that I'd want to read news that was written by somebody like me. I would prefer to leave that to people that are qualified to do that and have some experience."

Then again, there were predictions that the next generation of news may resemble what we have now, although the structure of the industry may change. When Roman's future of file-server TV does come, he predicted: "You're going to see a real diminished role for local TV stations, which I'm not sure is the message that local news directors want to hear." At that point, the mass audience for each of what we call channels will start to break down so that "a five rating will be fantastic," in a world of hundreds of channels, Roman said.

...Roman noted that in the 500-channel universe of file servers and declining market share, there will be less money for traditional news operations to spend on sets, graphics, satellite units, reporters, and writers. On the other hand, while the future might not be bright for TV broadcasters, Roman said, it will be "very bright" for TV news producers and journalists, who will provide the content for all of those channels.

The most common model cited by the panel was the old TV show, "Max Headroom," in which reporter Edison Carter of Network XXIII flew around the city, camera on his shoulder, reporting and shooting stories as they happened, while network moguls monitored the instant ratings. Brocchini suggested a system in which all these "news providers" feed their material into a larger network, and get paid according to how many people see it.

Burks, however, found a downside to a close link between individual provider and a service, because all that would be covered would be the hottest stories, with more important stories or even depressing stories (a tax increase, for example), left to less experienced reporters.

Working within today's news structure, Burks said, journalism education might need to train reporters to be much more versatile than they are now. A reporter might have to write a wire-service version of a story to go online, a short piece for one database or news show, a longer version for another outlet, and perhaps a magazine article. Add the Max Headroom scenario, and Burks' advice to students is: "Be ready, if not to do all those things, to think that way, to be multimediated when they walk out the door."

We are still far from that future, and the competitors to traditional news are still developing. For some, the road is rockier than for others.... Pizzo commented frequently on the problems being faced by online publications, like Web Review for which he wrote, trying to sell ads, but without the circulation figures used by print publications. (In late May, 1996,...Web Review suspended publication. It had enjoyed a relatively long life in cyberspace: nine months.)

Publisher Dale Dougherty said...that the advertiser-supported model wasn't covering the costs of the editorial, design, production, and technical staffs. His epitaph for the magazine: "In the end, we cannot keep giving it away." The advertising approach wasn't working, so Dougherty asked whether his 50,000 readers would pay $19.95 for a 6-month subscription. "You are voting on the future of the Web and what you will find there," Dougherty said. "Web Review is not alone in having these problems."

Pizzo said in an interview after the magazine closed that it is not true that publishing in cyberspace is cheaper than the paper product. His magazine spent $800,000 over its 9-month life for editors, research aides, Lexis Nexis, attorneys, and all of the other overhead that accompanies good journalism. Pizzo said it could be 5 years before the industry figured out a model to support an independent online publication. Until then, there must be a print companion or other affiliate bringing in the money, he added, predicting that eventually all of the best Internet content will be in "gated communities," online sites paid for by users. The free material will be "outside in the slums."

Conclusion

We started this discussion with the admonition that there were no right answers to the questions about how to react to, and go with the flow of, developments in technology. If anything, the discussion...showed that there is not one right and true path to Information Age enlightenment. There are several paths that you can take, each with the potential to get you to your destination.

One key point to bear in mind is that whatever new capabilities the technology may bring, there will be old skills that will be refined and new skills that will be developed. But the technology, as Semon observed, is only a benefit if the product being sent along it has value. That value is created by understanding the needs and habits of the audience, by establishing a level of trust with the audience, and by supplying information that is worthwhile.

As Valdez put it, whatever changes that news organizations have to implement to remake themselves for the future, they should do so "without losing sight of the vital role of news and information to a democratic nation and democratic institutions."

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Chapter 11: Medical Informatics *

by Enrico Coiera

Medical informatics is as much about computers as cardiology is about stethoscopes. For those who have studied the application of information technologies in medicine, the past decade has delivered one unassailable lesson. Any attempt to use information technology will fail dramatically when the motivation is the application of technology for its own sake rather than the solution of clinical problems.[1]

The role of the information sciences in medicine continues to grow, and the past few years have seen informatics begin to move into the mainstream of clinical practice. The scope of this field is, however, enormous. Informatics finds application in the design of decision support systems for practitioners,[2] in the development of computer tools for research,[3] and in the study of the very essence of medicine—its corpus of knowledge.[4] The study of informatics in the next century will probably be as fundamental to the practice of medicine as the study of anatomy has been this century.

I will consider recent advances in medical informatics with two seemingly contradictory themes in mind—apparently unbridled technological promise against less than satisfying practical achievement—and against three criteria —possibility, practicability, and desirability. Possibility reflects the science of information —what in theory can be achieved? Practicability addresses the potential for successfully engineering a system—what can be built given the constraints of the real world? Desirability looks at the fundamental motivation for using a given technology.

These criteria are suggested because a framework is necessary to judge the claims made for these new technologies by those who seek to profit from them. Just as there is a longstanding symbiosis between pharmaceutical industry and medicine, there is a newer and consequently less examined relation between medicine and the computing and telecommunication industries. Clinicians should try to judge the claims of these newcomers in the same cautious way that they would examine claims about a new drug.[5] Perhaps more so, given that clinicians are far more knowledgeable about pharmacology than they are about informatics and telecommunications.

In this article I will first review recent activities in telemedicine. Since this is a new subject, research themes are only just becoming apparent. Then I will discuss protocol-based decision support systems, which may be the first substantive clinical information system to appear in routine clinical practice. Finally, I will examine the current state of clinical coding. The terminology and coding enterprise is a concerted attempt to describe uniformly the structure, content, and nature of medical knowledge.

Telemedicine

Definitions of telemedicine abound. The essence of telemedicine is the exchange of information at a distance, whether that information is voice, an image, elements of a medical record, or commands to a surgical robot. It seems reasonable to think of telemedicine as the communication of information to facilitate clinical care. And it is not a new enterprise—Einthoven experimented with telephone transmissions using his new invention, the electrocardiograph, at the beginning of the century.[6]

At its inception telemedicine was essentially about providing communication links between medical experts in remote locations. The health care system, however, is clearly inefficient because of its poor communication infrastructure and telemedicine is now seen as a critical way of reducing that cost. One estimate suggests that the health system in the United States could save $30 billion a year with improved telecommunications.[7] Consequently, telemedicine has now become an important subject for research and development. As might be expected, the renewed interest in telemedicine also has much to do with the excitement of new technologies. Currently, the press is flooded with articles about the information superhighway, the Internet, and the rapid growth in the use of mobile telephones. Telemedicine is often presented in the guise of sophisticated new communications technology for specialist activities such as teleradiology and telepathology. These are championed by telecommunication companies because they have the potential to become highly profitable businesses for them.[8] Perhaps influenced by these forces, much of the research in telemedicine is driven by the possibilities of technology rather than the needs of clinicians and patients. Yet the communications infrastructure used by health care will not need to be special. The telecommunications market is competitive and the evolving options are numerous. Health care providers will be able to use the services of cable television, mobile cellular carriers, and telecommunication companies. Furthermore, communications technology does not need to be sophisticated to deliver benefit. Appropriate use of today's telephone can make significant improvements to the delivery of care. For example, follow-up of patients is often possible on the telephone.[9] Rapid communication of hospital discharge information using existing electronic data transfer mechanisms is beneficial for general practitioners.[10] The combined use of mobile telephones and paging systems can reduce the 5-10 minutes out of every hour many clinicians spend answering pagers.[11]

Perhaps more interestingly, inexpensive voice messaging systems can deliver simple but powerful services over existing telephone networks. Voice mail for example, has significant potential for improving the process of care.[12] Leirer et al. used a voice mail system to phone reminders about drug treatment automatically to elderly people at home, and they showed that it reduced both tardiness and complete forgetting.[13] As more patients get access to electronic mail, this will offer further avenues for innovative health services. Already in some populations, access to electronic mail is high. Fridsma et al. in California found that 46 percent of their patients at clinic already used e-mail, 89 percent of which was through their place of work.[14]

All these points suggest that the potential for the clinical application of communication technologies is indeed great, but equally that there is much still to learn. In particular, the relation between telemedicine and informatics needs to be explored in greater detail. Informatics focuses on the use of information, and telemedicine on its communication. Although seemingly disparate endeavours, they are intimately linked since the goals of communicating information and deciding on its content cannot be separated.[15] Furthermore, there is little clinical value in information systems built simply to gather data for administrators without remembering that the essence of delivering health care is the communication of information between members of the clinical team. Together, the technologies of information and communication can enhance access to information, whether it is stored electronically or is in the possession of a colleague.

Research Issues

Several key research questions are apparent. Firstly, clinical practice already revolves around communication, often by telephone, and important information exchanged in this way is often lost because it is not documented.[16] Capturing the informal information currently lost in health care's communication channels may soon become an important issue for those developing the formal electronic patient record. Deciding what information is important and how that information is made available will require the resolution of issues of confidentiality and security, as well as the technology of storage and retrieval of voice recordings.

Secondly, people's understanding of the effects of technology on communication is still in its infancy. Researchers in human-computer interaction believe that before these technologies can be successfully introduced, the way in which people communicate needs to be understood.[17] In one recent study the presence of a computer during doctor-patient consultations had detectable negative effects on the way doctors communicated.[18] While they were at the computer, doctors gave short responses to patients' questions, delayed responding, glanced at the screen rather than looking at the patient, or structured the interview around the computer rather than the patient. On the positive side, recent experiences in Norway have identified benefits to remote telemedical consultation. Services that provided isolated general practitioners with access to specialist skills had an unexpected side effect. The skills of the general practitioners were increased by repeated interactions with specialists during the management of cases that were previously referred.[19] This may arise through the dynamics of the relationship between a remote general practitioner and a specialist. Unlike in most educational settings, both are motivated to form a coach and apprentice relationship for the immediate management of a patient.

Finally, along with new communication possibilities, come new medicolegal implications. In the United States the courts have decided that radiologists are negligent if they fail to inform clinicians personally of a diagnosis. "Communication of an unusual finding in an x-ray, so that it may be beneficially utilised, is as important as the finding itself."[20] Furthermore, leaving a message with an intermediary is not enough —"certain medical emergencies may require the most direct and immediate response involving personal consultation and exchange."[21] The fact that such communication requirements are beginning to be mandated reflects the community's changing perceptions of best medical practice.

The rapid arrival of telemedicine suggests that the health care community is beginning to identify the benefits of good clinical communications practice and to realise the costs of poor communication. The next few years should see the research in telemedicine mature. The main focus will become the application of communication technologies rather than their development. This represents the same shift in focus that was required of medical informatics, in which initially much effort was spent in developing technologies specifically for medicine.

Protocol-Based Decision Support

Many see the development of protocol-based medicine as the essential cultural change in clinical practice that will permit the design of useful clinical information systems.22 It was rightly seen as inappropriate for early computer system designers to try to regularise clinical practice to suit the nature of their systems. The move to evidence-based medicine now begins to make it acceptable for clinicians to follow standard assessment and treatment protocols.23 In this case it is quite appropriate for clinicians to use information systems to help them.

The ultimate goal of a protocol-based decision support system is to provide a set of tools that allows a clinician to access up-to-date guidelines and then apply them to the management of their patients. Simple protocol systems will probably appear in clinical practice by the end of the decade.24 In some sense, first-generation systems have already appeared as treatment guidelines and clinical trial data can now be accessed on the Internet.25

Evidence suggests, however, that even when guidelines are available, clinicians forget to follow them or deviate from them without clear cause.26 Forgetting preplanned management tasks seems to be especially likely when making clinical decisions in high stress situations.27 Yet enforcing uniform adherence to guidelines is probably unacceptable, given the complexity of individual cases. It should be possible, however, to make it as easy as possible for clinicians to access guidelines during routine care, making it less likely that steps will be inadvertently forgotten or altered.

This will require the design of more complex systems that will be integrated into the electronic patient record such that protocols can be stored and manipulated by clinicians. For example, best practice recommendations may need to be customised for local conditions or for individual patients. Furthermore, guidelines may be incorporated directly into patient records. As elements of the guideline are completed, they could be automatically noted. The records of care generated in this manner might ultimately be used for population based outcomes analysis...

Terminological Systems

Medical coding systems such as versions of the International Classification of Diseases (ICD), the systematised nomenclature of medicine (SNOMED(30a)), and the Read system(30b) are becoming increasingly familiar to clinicians. Their rationale is as follows. Once captured electronically, clinical data should be available for subsequent aggregation and analysis. However, the words used to describe conditions vary so much that simple analysis is often not possible. Furthermore, the meanings attached to terms may vary. If there was an agreed set of terms to describe the process of care then data analysis would be simplified.28 The goal of research into medical terminologies is to arrive at a consensus on the most appropriate set of terms and the way they should be structured.

The fundamental advance in terminological research over the past year or so is the realisation that the goal of constructing a complete and universal thesaurus of medical terms is ill posed. Terminology evolves in a context of use, and attempting to define context-independent terminologies is ultimately implausible. Coupled with this view comes the pragmatic understanding that a more robust scientific approach needs to be brought to the enterprise of terminology construction...

The ideal terminological system would be a complete, formal, and universal language that allowed all medical concepts to be described and reasoned about. Some researchers have explicitly asserted that building such a singular and "correct" medical language is their goal.29 This task emphasises two clear requirements: the ability for the terminological language to cover all the concepts that need to be reasoned about and the independence of the terminology from any particular reasoning task. A further requirement occasionally discussed is that when alternative terminologies exist, they must be logically related such that one can be translated into the other.

Despite the enormous health care investment currently devoted to achieving these goals, current evidence indicates that they are not possible. No set of codes or terms can be universally applied in medicine. There are two fundamental and related obstacles to devising a universal terminological system. The first is the problem that model construction-terminologies are simply a way of modelling the world, and the world is always richer and more complex than any model that humans can devise. The second is the problem of symbol grounding. The words we use to label objects do not necessarily reflect the way we think about the objects, nor do they necessarily reflect defined objects in the real world. The cumulative evidence from recent thinking in cognitive science, computer science, and artificial intelligence provides a formidable set of supporting arguments...

The Way Forward

In the short term, administration agencies keen to obtain aggregate clinical data are driven to adopt existing systems, even if they are imperfect. This has led to much debate among those supporting particular systems of their merits over competing ones.30

Doctors in the United Kingdom have been asked to adopt the version 3 Read codes for use not only in personal clinical systems but also in audit, research, outcomes, and guidelines.31 Such a decision can now be seen to be necessarily interim. What is really needed to help rational choices in the longer term is impartial empirical research, comparing the cost and efficacy of different systems in support of well-defined tasks and contexts. For example, in a recent study comparing the utility of different coding schemes in classifying problem lists from medical records, none of the major systems was found to be comprehensive. The unified medical language system (UMLS) and the systematised nomenclature of medicine were found to be superior to Read and ICD-9 clinical modifications.32

In contrast with the British approach, however, the Board of Directors of the American Medical Informatics Association has suggested that it is not necessary or desirable to have all codes coming from a single master system. It suggests that several existing and tested approaches should be embraced, despite their imperfections, in order to progress quickly. A first phase system could be created by borrowing from the different existing code systems, each created for and therefore better suited to different subject domains.33

The longer term need will be to introduce more maintainable and extensible systems as the cost of supporting existing systems becomes insupportable. A solution based in part on multiple compositional systems would seem to be most desirable. Since any general medical terminology will cover only a small part of the specific vocabulary of any medical specialty, separate systems may need to be developed for use between and within specialties—"vocabularies need to be constructed in a manner that preserves the context of each discipline and ensures translation between disciplines."34 Indeed over a century ago, when Farr constructed the classification system ultimately resulting in the ICD, he noted that "several classifications may, therefore, be used with advantage; and the physician, the pathologist, or the jurist, each from his own point of view, may legitimately classify the diseases and the causes of death in the way that he thinks best adapted to facilitate his enquiries."35

Specialised compositional systems will thus need to be constructed that agree on a restricted subset of terms necessary for the passage of information between specialties—a kind of Esperanto between different cultures. Work on such communication standards is at present still in its infancy,36 and more substantive work should be expected in the future. Currently, terms are created without explicit tasks in mind, in the hope that all unseen eventualities will be served. Interspecialty systems would probably need to be tightly task based to ensure maximum utility.

Conclusion

I have reviewed three apparently quite separate areas—telemedicine, protocol-based decision support systems, and terminologies. They can now be seen to be inextricably entwined since the goals of communicating information and deciding on the content of information cannot be separated. Human communication entails information exchange in a context.37 What is said depends on the intended message, the method used to convey the message, who is speaking, and who is being spoken to. The development of protocol-based systems and their supporting terminological systems is a perfect example of that symbiosis.

Recent advances in medical informatics leave the following conclusions:

- The application of information and communication technologies in health care should be problem rather than technology driven.
- The use of existing communication technologies such as mobile telephones, voice mail, and e-mail may significantly improve delivery of health care.

- Research is needed to understand human communication processes and needs in health care. Clinical information systems have an important role in the delivery of evidence-based clinical practice.

- The appropriate use of computerised protocols can significantly improve clinical outcome.

- Universal and complete clinical coding schemes are unrealisable, and the continued modification of centralised thesauruses may be technically and financially unsustainable.

- Multiple task-specific terminologies developed in conjunction with clinical protocols may offer the most effective and maintainable long-term strategy.

Notes

1. E. Coiera, "Question the Assumptions," in P. Barahona and J.P. Christensen (eds.), Knowledge and Decisions in Health Telematics (Amsterdam: IOS Press, 1994), pp. 61-6; J. Wyatt, "Promoting Use of Medical Knowledge Systems: Lessons from Computerised ECG Interpreters," in Barahona and Christensen, pp. 73-80; and J. Van der Lei, "Computer-Based Decision Support: The Unfulfilled Promise," in Barahona and Christensen, pp. 67-72.

2. R.A. Miller, "Medical Diagnostic Decision Support Systems—Past, Present, and Future: A Threaded Bibliography and Brief Commentary," Journal of the American Medical Association (1994;1), pp. 8-27.

3. L. Hunter (ed.), Artificial Intelligence and Molecular Biology (Menlo Park, CA: AAAI Press/MIT Press, 1993).

4. E. Keravnou (ed.), Deep Models for Medical Knowledge Engineering (Amsterdam: Elsevier Science, 1992).

5. J. Wyatt, "The Evaluation of Clinical Decision Support Systems: A Discussion of the Methodology Used in the ACORN Project," Proceedings of AIME 87: Lecture Notes in Medical Informatics (Berlin: Springer, 1987), pp. 15-24.

6. B.J. Nymo, "Telemedicine," Telektronikk (1993;89,1) pp. 4-11.

7. A.D. Little, Telecommunications: Can It Help America's Health Care Problems? (Cambridge, MA: Arthur D Little, 1992).

8. R.A. Bowles and R. Teale, "Communications Services in Support of Collaborative Health Care," BT Technology Journal (1994;12,3), pp. 29-44.

9. J.N. Rao, "Follow Up by Telephone," British Medical Journal (hereafter BMJ), (1994;309), pp. 1527-8.

10. P.J. Branger, J.C. van der Wouden, B.R. Schudel, E. Verboog, J.S. Duisterhout, et al., "Electronic Communication Between Providers of Primary and Secondary Care," BMJ (1992;309), pp. 1068-70.

11. K. Fitzpatrick and E. Vineski, "The Role of Cordless Phones in Improving Patient Care," Physician Assistance (June 1993), pp. 87-92.

12. J. Constable, "Active Voice," BJ Healthcare Computing and Information Management (1994;11), pp. 30-1.

13. V.O. Leirer, D.G. Morrow, E.D. Tanke, and G.M. Pariante, "Elders' Nonadherence: Its Assessment and Medication Reminding by Voice Mail," Gerontologist (1991;31), pp. 514-20.

14. D.B. Fridsma, P. Ford, and R. Altman, "A Survey of Patient Access to Electronic Mail: Attitudes, Barriers and Opportunities," Proceedings of the Symposium on Computer Applications in Medicine (Journal of the American Medical Informatics Association 1994; symposium supplement), pp. 15-19.

15. J.C. McCarthy and F. Monk, "Channels, Conversation, Co-operation and Relevance: All You Wanted to Know about Communication but were Afraid to Ask," Collaborative Computing (1994;1), pp. 35-60.

16. R. Stoupa and J. Campbell, "Documentation of Ambulatory Care Rendered by Telephone: Use of a Computerized Nursing Module, in R. Miller (ed.), Proceedings of the Symposium on Computer Applications in Medicine (Los Alamitos, CA: IEEE Computer Society Press, 1990), pp. 890-3.

17. J.C. McCarthy and F. Monk, pp. 35-60.

18. D. Greatbach, P. Luff, C. Heath, and P. Campion, "Interpersonal Communication and Human-Computer Interaction: An Examination of the Use of Computers in Medical Consultations," Interacting with Computers (1993;5), pp. 193-216.

19. S. Akelsen and S. Lillehaug, "Teaching and Learning Aspects of Remote Medical Consultation," Telekronikk (1993;89), pp. 42-7.

20. T.J. Kline and T.S. Kline, "Radiologists, Communication and Resolution," VA Medicolegal Issue. Radiology (1992;184), pp. 131-4.

21. Ibid.

22. J. Durinck, E. Coiera, R. Baud, et al., "The Role of Knowledge Based Systems in Clinical Practice," in: Barahona and Christenen, pp. 199- 203.

23. C.D. Mulrow, "Rationale for Systematic Reviews," BMJ (1994;309), pp. 597-9.

24. J.L. Renaud-Salis, "Distributed Clinical Management-Information Systems: An Enabling Technology for Future Health Care Programmes," in Barahona and Christensen, pp. 139-46.

25. F. Goodlee, "The Cochrane Collaboration," BMJ (1994;309), pp. 969-70.

26. Renaud-Salis, pp. 139-46.

27. E. Coiera, V. Tombs, G. Higgins, and T.H. Clutton-Brock, "Real-time Clinical Decision Making," HP Laboratories Technical Report 1994; No 79 (HFL-94-59).

28. M. Ackerman, M. Bail, P.D. Clayton, M.E. Frisse, R.M. Gardner, et al., "Standards for Medical Identifiers, Codes and Messages Needed to Create an Efficient Computer-Stored Medical Record," Journal of the American Medical Informatics Association (1994;1), pp. 1-7.

29. J.J. Cimino, "Controlled Medical Vocabulary Construction: Methods from the CANON Group," Journal of the American Medical Informatics Association (1994;1), pp. 296-7; and D. Evans, J.J. Cimino, W.R. Hersh, S.M. Huff, and D.S. Bell, "Toward a Medical-Concept Representational Language," Journal of the American Medical Informatics Association (1994;1), pp. 207-17.

30. S. Tuttle and S.J. Nelson, "The Role of the UMLS in 'Storing' and 'Sharing' Across Systems," International Journal of Biomededical Computing (1994;34), pp. 207-37.

31. K.C. Calman, "New National Thesaurus," CMO's Update (1994;4), p. 1.

32. J.R. Campbell and T.H. Payne, "A Comparison of Four Schemes for Radification of Problem Lists," Proceedings of the Symposium on Computer Applications in Medicine (Journal of the American Medical Informatics Association 1994; symposium supplement), pp. 201-4.

33. M. Ackerman, M. Bail, P.D. Clayton, M.E. Frisse, R.M. Gardner, et al., pp. 1-7.

34. F. Brennan, "On the Relevance of Discipline in Informatics," Journal of the American Medical Informatics Association (1994;1), pp. 200-1.

35. World Health Organisation, Manual of the International Statistical Classification of Diseases, Injuries and Causes of Death (Geneva: WHO, 1977).

36. H. Ma, "Mapping Clause of Arden Syntax with the HL7 and ASTM E 1238-88 Standard," International Journal of Biomedical Computing (1995;38), pp. 9-21.

37. J.C. McCarthy and F. Monk, pp. 35-60.

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Chapter 12: School Reform in the Information Age *

by Howard D. Mehlinger

Archimedes was a great fan of the lever, a piece of technology that was presumably state-of-the-art when he lived. While not every person exhibits Archimedes' enthusiasm for technology, before and since Archimedes and throughout all regions of the world people have used technology to make their lives richer and more comfortable. Indeed, the ability to make and use such tools as the fulcrum and the lever is one of the ways we distinguish human beings from other animal species.

Technology is not only a product of a given culture; it also shapes the culture that created it. The automobile is not merely an American artifact; it influences where we live, where we work, and how we entertain ourselves. It stands as a statement to others about who we are. The automobile has affected courtship patterns and relationships between races and social classes. Getting a driver's license and acquiring a car have become rites of passage in American society. While we make our tools, to a remarkable degree our tools also make us.

Technology and Schooling

Technology has always been an important part of schooling in America, but until recently the technology employed was rather simple and changed slowly. No one reading this article can remember when there were no textbooks, but the kind of textbooks we have today are largely products of the 20th century. Nor did teachers always have their primary tools—the blackboard and chalk. Slate blackboards did not appear in urban schools until the 1830s.

When I was a young boy, one of the rituals at the start of the school year was a trip to the local department store to purchase school supplies: a "Big Chief" tablet, pencils, rubber erasers, pens with removable points (they became dull quickly), and a bottle of ink. Sometimes a pencil box would be added so that I could keep track of my personal supplies. Parents and students today go through similar shopping rituals each year. The technology has changed somewhat (ballpoint pens have replaced ink and straight pens, pencil boxes have given way to backpacks), but it is essentially the same.

There have been many attempts to change the technology of schooling. They have each appeared with great fanfare and expressions of optimism by advocates. In the 1920s, radio was expected to have a major impact on schools; in the 1930s, it was to be film; in the 1950s, television; and in the 1960s, teaching machines. The one piece of new technology from those bygone years that truly found a place was the overhead projector. Introduced in the 1940s by the military, it gradually found its way into the schools. The overhead projector is easy to use and relatively inexpensive, it permits the teacher to prepare notes in advance of class and to project them onto the screen for all to see, and it can be used without darkening the room or turning one's back to the students. In many ways it is the perfect technology for supporting the kind of instruction that takes place in most classrooms today.

More advanced technology has hit the schools at about the same time as have ideas for school restructuring and findings from the cognitive sciences. According to Karen Sheingold, "The successful transformation of student learning and accomplishment in the next decade requires effectively bringing together three agendas—an emerging consensus about learning and teaching, well-integrated uses of technology, and restructuring. Each agenda alone presents possibilities for educational redesign of a very powerful sort. Yet none has realized or is likely to realize its potential in the absence of the other two."[1] I agree.

Skeptics will argue that we are merely going through another cycle of reform. School reforms come almost every decade; the schools absorb as many of the new ideas as they want and reject the rest. The result is that schools change very little where it truly counts—in the classroom. But the synergy of school restructuring, new forms of learning and teaching, and new technology will make the difference this time.

The forces driving the Information Age seem irresistible. It is impossible both to participate fully in the culture and yet resist its defining features. Thus, if the schools are an "immovable object" (and I don't believe they are), they are beginning to meet the "irresistible force"—Information Age technology.

The analogy I carry in my head is that of a volcano erupting in Hawaii, spewing forth ash and lava. We have all seen pictures of such eruptions and what follows. The lava slowly oozes its way down the mountain toward the sea. No device or structure raised by human beings can block it. It either consumes all obstacles in fire or rolls over them. Finally, the lava reaches the sea—nature's immovable object. Throughout the process there is a lot of noise, smoke, and steam that can distract one's attention from the fundamental process that is taking place: the transformation of the landscape. In the most dramatic cases, entirely new islands appear. A volcanic eruption changes the environment in unpredictable ways; it is also irresistible.

Information Age technology is like that volcano. It is changing the landscape of American culture in ways we either take for granted or scarcely notice. There are holdouts. Many of us see no need for placing telephones in our cars or buying mobile telephones. Some believe that television is a corrupting influence and refuse to have a set in their homes. I know such people; I am largely sympathetic to their views. But most people who think television can be corrosive buy one anyway and try to control its use.

I cannot predict how schools will accommodate themselves to the force of computers and other electronic technologies. Some schools will move more quickly than others; some teachers will not change at all. The process may be slow enough that many teachers will be able to retire before they are forced to change. Some will quit teaching, and it is likely that some will remain anachronisms in a greatly altered school environment—antiques of a sort, surrounded by modernity but refusing even to use the telephones in their classrooms.

But schools will change! I don't know whether teachers will use the new technologies in the ways constructivists anticipate; other refonners have urged teachers to adopt similar progressive ideas in the past with mostly negative results. Perhaps technology will support constructivist approaches and make learner-centered instruction a practice as well as a theory this time. I don't know whether schools will have site-based management or some other kind of organizational structure. Other theories of learning and school organization will certainly appear. The exact shape of future schools is unclear, but of this I am certain: schools will be unable to resist the new technology. The new technology will be used in schools because it appeals to students and may enhance learning and because the schools can offer no reasonable defense for rejecting it.

The use of the new technologies will have a profound effect on schools. The very relationship between students and teachers will be challenged because the technologies enable learners to gain control of their own learning. In the past, schools have been places where people in authority decided what would be taught (and possibly learned), at what age, and in what sequence. They also decided what would not be taught—what would not be approved knowledge. The new technologies provide students access to information that was once under the control of teachers.

Years ago, as a high school teacher, I received a note from a colleague who was teaching a course in American history for the first time. He had given students reading assignments from one set of books while he turned to other books as sources for his lectures. The note said, "The game is up. The students know where I am getting my information." That is happening everywhere today, and the game is truly up. No teacher can compete with the power and the capability of the new technology as a presenter of information. If teachers and schools try to sustain that role, they will be whipped. On the other hand, no teachers will be replaced by a machine unless they attempt to do only what the machine can do better.

It may be that the technology will be used most extensively first by privately financed schools, such as Sylvan Learning Systems, Kaplan Educational Centers, or the schools of the Edison Project. Privately financed schools that successfully demonstrate the value of technology may provide the incentive to persuade public institutions of the instructional value of technology. Perhaps public schools that employ the new technologies successfully in restructured environments will begin as magnet schools or even charter schools; if they succeed, then the use of technology may spread to the remainder of the schools in a district. Possibly the technological challenge to public education will come from home schooling, when parents discover that through technology they not only retain the current advantages of home schooling but also gain access to the academic resources of the public schools and of the world.

The genie is out of the bottle. It is no longer necessary to learn about the American War of Independence by sitting in Mrs. Smith's classroom and hearing her version of it. There are more powerful and efficient ways to learn about the Revolutionary War, and they are all potentially under the control of the learner. Either schools will come to terms with this fact, or schools will be ignored.

It has never been easy for schools to change, and it is not going to be easy now. The current reform effort has been compared to changing a tire on a car that is continuing to speed down the highway. The job is actually much harder than that, because it is not repair but transformation that is required. It is more akin to changing a car into an airplane while continuing to drive the car. We are asking schools to become something different, without a clear picture of what the new institution should look like, even as we continue to satisfy the public that the old purposes of schooling are being served as well as or better than in the past.

Availability and Use of Technology In Schools Today

No one knows for certain what kind of technology exists in schools, how it is used, how much it is used, whether what exists is actually available to teachers, and whether what exists is broken, worn-out, or still in unopened boxes.2 It is hard enough to maintain an up-to-date inventory within a given school district without trying to do the same for the nation. Various individuals and organizations have conducted surveys on technology use, and these provide some clues as to the situation generally.

Computers. We know that the number of computers in schools has grown enormously since 1983. At that time it was estimated that there were fewer than 50,000 computers in the nation's schools; by 1994 the estimate was revised to 5.5 million. In 1981 only about 18% of schools had one or more computers for instructional use; by 1994 this figure had risen to 98%. There is hardly a school in America today without at least one computer.

These figures tell us very little about student access to computers, however. In 1985 the median number of computers in K-6 elementary schools that used computers was three; that number rose to about 18 in 1989. In high schools for the same 2 years the numbers were 16 and 39 respectively. By 1994 the ratio of students to computers across all grades was 14 to 1. Thus, while there has been rapid growth in the number of computers in each school, the opportunity for a typical student to have access to a computer is still limited. For example, as late as 1989 a student might have had access to a computer for one hour per week—about 4 percent of instructional time.

A second issue concerns the location of computers and how they are used. The most common pattern in schools is to cluster 20 or so machines in a single laboratory and then to schedule classes for time in the lab once a week. A decade ago computers were used mainly to teach programming, to teach about computers (computer literacy), and to run drill-and-practice exercises. More recently, computers have been used for enrichment, as work tools, and—less frequently—for purposes of computer literacy. However, computers in elementary schools continue to be used heavily to teach basic skills, and this pattern is growing in high schools. Federal funds for at-risk children have been a major source of school funding for computers, so it is hardly surprising that schools rely on them primarily for teaching basic skills and for remedial instruction. The use of computers to support instruction in the academic areas or to allow students independent exploration is sharply limited. Indeed, many American students have more access to a computer at home than at school.

Most computers are purchased as stand-alone machines. It is possible to connect computers, either through a local area network (LAN) or through a wide area network

(WAN). The advantage of networks is that people can work together and share information. Computer networks are common in business and higher education; the use of networks in schools, though it is growing, is still small. Moreover, school LANs are used mainly to support integrated learning systems (ILSs) within a school. Thus far, relatively little has been done to foster communication among classrooms. Schools with modems have access to commercial network services, such as Prodigy, CompuServe, Apple Link, or America Online. And a rapidly increasing number of schools are beginning to use the Internet, a service originally created by the U.S. Department of Defense to connect researchers at labs and universities and that now connects many kinds of groups worldwide. The Clinton Administration wishes to build a national electronic infrastructure that would increase opportunities for schools to be connected to outside resources.

Video. Video use in schools seems to be growing and taking different forms. Instructional television, in which a program is broadcast to schools at scheduled times during the day from a state-operated or distsict-run studio, continues to exist, but it is not as significant as in the past. Many of these broadcasts were developed nationally through a consortium led by the Agency for Instructional Technology. The programs were designed to fit the school curriculum as determined by the state departments of education that were the most prominent consortium members.

As a result of federal financing through the Star Schools program, many schools are able to use courses delivered nationwide by satellite and originating from a single source at a predetermined time. These programs typically feature courses that are difticult for small schools to offer on their own, e.g., courses in German or Japanese or advanced courses in mathematics and the sciences. Rural schools in particular have taken advantage of these offerings; about one-third of all rural schools have the capability of receiving satellite broadcasts.

Commercial sources also provide programming to schools. In 1994 Whittle Communications, Inc., reportedly offered its programs to more than 12,000 schools and reached 8 million students. The principal program offering was a 10-minute news show called "Channel One." The program and all the equipment provided to the schools were paid for by the two minutes of commercial advertising that accompanied each show. CNN offers a rival news program called "CNN Newsroom." This 15-minute news show is broadcast early in the morning over the regular CNN cable channel. Schools are permitted to tape the program and use it as they please.

The Corporation for Public Broadcasting is developing new programming for schools, and the Learning Channel and the Discovery Channel both provide programs that offer useful information for schools.

As a result of this proliferation of educational programming, the VCR has become a nearly ubiquitous piece of school technology. Virtually every school in the United States has at least one, and many teachers routinely collect tapes to use with their classes. Because it is more flexible and user friendly, the videotape has taken the place of film for instruction.

CD-ROM and videodiscs offer other ways for schools to employ video. The use of these media, while still limited, is growing rapidly. According to Quality Education Data, Inc., 26 percent of all school districts had videodisc technology in 1994, as compared to 18 percent in 1992-93.

Results. It would be wonderful if we could point to specific data that would demonstrate conclusively that the use of one technology or approach produced better results than the use of some other technology or approach. Alas, the problem is not so simple.

First, the existence of a particular technology does not prescribe the way in which it will be used. Yet how a technology is actually used is critically important. One English teacher might use computers mainly for drill on grammar and spelling, while another English teacher might allow students to use the computers for word processing.

Much of the evaluation research on media use is based on a specific intervention and focuses on short-term results. It seeks to determine, for example, whether the students receiving computer-assisted instruction (CAI) perform better on short-answer examinations than do those in a control group. In studies of this kind, the experimental group nearly always wins, but seldom does the investigator study the two groups a year or two later to find out if the gain has survived. Studies of short-term results, though interesting, are of marginal value to policy makers.3

What we need are studies of an altogether different order. When students and teachers are immersed in technology over time, will we detect changes in how students learn and how teachers teach? While it may be important to see some gain on a particular test, those who are trying to reform schools have larger goals in mind. Before we spend billions of dollars to equip every student with a computer at home and one at school and before we spend millions to equip teachers and to provide them with the necessary training, we need to know whether such a colossal investment of public funds makes sense. We cannot be certain, but the study reported below should encourage us.

A Suggestive Experiment

In 1986 Apple Computer, Inc., launched a project called Apple Classrooms of Tomorrow (ACOT).4 The project began with seven classrooms representing what was intended to be a cross section of K-12 schools. Each participating student and teacher received two computers: one for home and one for school. The goal of the project was to see how the routine use of computers would affect how students learn and how teachers teach.

One issue the project hoped to confront was the possibility of any negative effects from prolonged exposure to computers. Some critics have worried that students who use computers extensively will become "brain dead" or less social from looking at the computer screen all day. At the end of two years, the investigators learned that some of their worst fears had been groundless.

- Teachers were not hopeless illiterates where technology was concerned; they could use computers to accomplish their work.

- Children did not become social isolates. ACOT classes showed more evidence of spontaneous cooperative learning than did traditional classes.

- Children did not become bored by the technology over time. Instead, their desire to use it for their own purposes increased with use.

- Even very young children had no problem becoming adept users of the keyboard. With very little training, second- and third-graders were soon typing 25 to 30 words per minute with 95 percent accuracy—more than twice as fast as children of that age can usually write.

- Software was not a major problem. Teachers found programs—including productivity tools— to use in their classes.

Standardized test scores showed that students were performing as well as they might have been expected to do without the computers; some were doing better. The studies showed that ACOT students wrote better and were able to complete units of study more rapidly than their peers in non-ACOT classrooms. In one case, students finished the year's study of mathematics by the beginning of April. In short, academic productivity did not suffer and in some cases even improved.

What I find most interesting, however, is that classroom observers noticed changes in the behavior of teachers and students. Students were taking more responsibility for their own learning, and teachers were working more as mentors and less as presenters of information.

By the end of the fourth year, ACOT classrooms had changed; teachers were teaching differently, though they did not all teach alike. Each teacher seemed to have adjusted his or her own style to the computer-rich environment, but all the teachers were aware of the changes that had occurred in their own professional outlooks.

The students had also changed, especially the ACOT students at West High School, a school serving urban, blue-collar families in Columbus, Ohio. Twenty-one freshmen were selected at random from the student body to participate in a study of ACOT. They stayed with the program until their graduation four years later. All 21 graduated, whereas the student body as a whole had a 30 percent dropout rate. Nineteen of the ACOT students (90 percent) went on to college, while only 15 percent of non-ACOT students sought higher education. Seven of the ACOT students were offered full college scholarships, and several businesses offered to hire those who did not intend to go on to college. ACOT students had half the absentee rate, and they had accumulated more than their share of academic honors. But perhaps the most important finding was the difference exhibited by these students in how they did their work. The ACOT students routinely and without prompting employed inquiry, collaboration, and technological and problem-solving skills of the kind promoted by the school reform movement.

This is only one study, of course, and it would be unwise to place too much weight on its findings. But those who believe that technology is the key to school reform and to more powerful learning by students can take hope from this investigation.

They may also find encouragement in the results of a 1994 study commissioned by the Software Publishers Association and conducted by an independent technology consulting firm, Interactive Educational Systems Design, Inc.[5] The study reviewed research on educational technology that had been conducted from 1990 through 1994. The report was based on 133 research reviews and reports on original research projects. Some of the conclusions of that study follow.

- Educational technology has a significant positive impact on achievement in all subject areas, across all levels of school, and in regular classrooms as well as those for special-needs students.

- Educational technology has positive effects on student attitudes.

- The degree of effectiveness is influenced by the student population, the instructional design, the teacher's role, how its students are grouped, and the levels of student access to technology.

- Technology makes instruction more student-centered, encourages cooperative learning, and stimulates increased teacher/student interaction.

- Positive changes in the learning environment evolve over time and do not occur quickly.

While this study was commissioned by an organization that had a stake in the results, the conclusions seem consistent with other research findings, especially with those of the ACOT study.

The Future of Technology in the Schools

Thus far I have focused on the technology available to schools today. What about the future? We are only at the threshold of the Information Age. Tools we now treat as technical marvels will seem primitive in 5 years. Commodore Pets, IBM PC jrs., and the first Apple machines are throwaway items today. We can predict with certainty that technology will become faster, cheaper, more powerful, and easier to use. We can also predict that new devices that we can scarcely imagine today will be on the market before the end of this decade. Schools that expect to invest in a single computer system and then forget about technology purchases for several years will be surprised and disappointed. Schools must make decisions regarding additions and/or upgrades to their technology every year, in line with their own strategic plans.

Without going into detail regarding specific pieces of hardware, I can say with confidence that schools should expect more integration, interaction, and intelligence from future technology. In their early days in school, computers and video were regarded as separate entities, and it was assumed they would stay that way. In fact, we can expect a continuing integration of these technologies. Voice, data, and images will be brought together into one package. One current example of this process is desktop video. In a single, relatively inexpensive unit, one has telephone (voice), computer (data storage and manipulation), and video (sending and receiving moving images) capabilities. Those who use the machine can talk to people at a distance, exchange documents, work collaboratively, and even see their collaborators on screen.

Technology will also become more interactive. In the field of distance learning, rather than rely strictly on one-way video and two-way audio communication, teachers and students will see one another simultaneously, thereby making distance learning more like face-to-face classroom interaction. Computer-based instruction will also be designed to respond to learners' interests and abilities, giving them greater control over what they need to learn and the pace at which they learn it. And computer searches, which can now be bewildering to the casual user, will become easier and more responsive to what a user needs. Greater interactivity will make instructional programs even more powerful than they are today.

Finally, technology will have greater intelligence. This intelligence will be displayed in several ways. First, the technology will have more features and greater capacity. Second, it will have the capability to learn from the user, so that it can customize its services to fit the user's learning style and interests. Future technology will provide not only databases but knowledge bases. And the technology will be able to stay abreast of that information most valued by the user and to alert him or her to its availability.

Integration, interaction, and intelligence. These are three features we can expect of technology in the future. And they will change the way technology is employed in schools.

Technology Revolution in Schools

What is this revolution? It is the transformation of schooling through the use of technology, and it is occurring in classrooms all over the country. The seeds of the revolution are being planted everywhere, though seldom dramatically. Occasionally, there is an announcement that District A has received a major grant that will lead to the installation of Brand X equipment in all its schools. But these are the exceptions.

What is occurring nearly every week is that one school board has approved the purchase of 10 or 20 computers for use in a school to improve writing skills; another board has approved the high school's use of Channel One; still another has set aside funds so that a high school or middle school can subscribe to online, commercial information services, and so on. This revolution is not characterized by a major assault leading to the rapid sweeping away of every custom and practice of the past. This is a slow but steady revolution. Each decision by a schoolboard, each act of support by a principal, and each initiative by a teacher is changing the nature of schooling.

This revolution is not like any other school reform movement that I have observed, and I have been in the profession for more than 40 years. First, it is a grassroots movement. Actions by state and federal governments and by business and industry have helped fuel the revolution, but they did not provide the spark. Teachers and local school administrators are leading this revolution, and they are not leading it in order to save American business or to prove a new theory of learning. They are buying, installing, and using technology simply because they believe that students will be less bored and will learn more through the use of the technology than without it. In short, they are using technology to make schools better.

This revolution is eclectic and largely devoid of ideology; therefore, what schools do with the technology varies widely. Much technology is used for remediation, especially in the elementary grades; it provides drill-and-practice exercises that are boring for teachers to teach. School officials hope that computers used in this way will hold pupils' attention longer and save wear and tear on teachers. This approach to learning may irritate the constructivists and many others, but as long as society emphasizes mastering basic skills we need not be surprised if some schools use technology to meet these goals and to help students pass required tests.

Other schools are using the technology primarily to provide students with productivity tools, such as word pocessing and spreadsheets, to inspire students to make their work more professional in quality and appearance. In other places, such technology as compressed, interactive video is used to share an instructor across one or more school sites. Technology has its foot in the door of classrooms all across America, and the schools will never be the same.

Some people will be annoyed to learn that there is a revolution under way and that they have not been informed of it or invited to participate. While they may know that millions of dollars have been invested in computers and other technology during the past decade and a half, they have assumed that most teachers have been resisting the technology. They may also believe that these investments have accomplished little because there has been no evidence of sharp improvements in scores on the SAT I or on national achievement tests.

In response to the first point, I agree that many teachers do not yet employ instructional technology and probably will not do so for some time. As in every revolutionary movement, those teachers in the vanguard are the dedicated ones with a special interest in the cause; the rest must be persuaded that the revolution is in their own interests. In the case of technology, we don't make it easy to convince them. Few schools currently provide computers for each teacher, so the computers they do have must be shared. Teachers are provided little training in how to use the new technology, and seldom is there adequate technical support when something breaks down. In such a situation, it makes sense to some teachers to continue doing what they have always done rather than to spend time learning to use technology with all the attendant frustrations.

With regard to the second point, we have considerable evidence that the appropriate use of technology does contribute to student learning. These small-scale experimental results, however, are often overlooked when national results are reported. On a national scale, despite major investments to date, we have only begun to provide schools what they need. Except in a few cases, students have access to a computer for only a short time each week and then often for the purpose of working on preselected exercises. Imagine the outcry if students had access to a textbook only one day a week or if they had to share a pencil with 15 other students. Imagine a business, say an insurance company, that had only one computer for each 15 workers and made them take turns entering their data. When access to computers has been sufficient, the results have been positive for student learning.

We cannot blame teachers or students if technology has failed to transform all schools. There has not been enough time or enough money for the purchase of equipment, for training, or for support. Transforming schooling through technology will work; we have evidence that it does. But it will take time, and it will be expensive.

There are also people who do not want the technology revolution to succeed. Some are offended that this reform is truly a grassroots effort. While the technology revolution is certainly abetted by business and government, unlike most education reforms it has not been a top-down effort. This is not a reform hatched in universities or think tanks and handed on to schools to implement. Indeed, universities and most think tanks are largely unconnected to this reform. Obviously, specific professors and researchers are deeply involved, but institutional responses have been erratic: sometimes positive, occasionally negative, usually absent.

Other people want to improve schools, but they want to do it on the cheap. They hope that more regulation, stiffer accountability measures, and stirring speeches, alternating with scolding lectures when results do not improve, will do the job. They are wrong, and they are cheapskates.

A few, mainly in universities, are offended by the thought of linking technology to learning. For ideological reasons they wish to keep technology out of schools because it might "de-skill" teachers. Technology might place schools in the service of business and industry; it might exacerbate equity problems. These issues are fundamentally important to some college professors, but few teachers are listening. What may be most threatening to university professors is that they have spent their lives becoming experts in narrow areas, and now technology threatens to make their hard-won knowledge available to everyone. Much is made of the threat that the computer poses to K-12 teachers because the computer challenges their role as keepers and presenters of knowledge. If that threat disturbs some K-12 teachers, it is all the more frightening to many college professors.

What Are the Chances For Success?

The likelihood of success for the educational technology revolution cannot be judged in the same way as chances for the success of other educational innovations. First, the movement is driven by teachers rather than by outside experts. Second, teachers are not required to use the technology in prescribed ways; they use it as they choose or reject it if they wish. Third, their students are eager to use technology, and parents want their children to have access to technology in school. Fourth, once teachers have overcome their initial concern about feeling stupid while they learn to use a new tool, they find themselves using the technology in various instructional situations. They are pleased to have learned a new skill, and they gradually change the way they teach. Because of these factors, I cannot imagine that this reform will fail for the same reasons as previous reforms.

The progress of technology in the schools will surely proceed more slowly than its proponents would prefer. The reasons are mainly lack of time and lack of money. While Americans talk expansively about creating "break the mold" schools, by and large they want cheap reforms. They hope that by reorganizing the administration of schools (leading to "Site-based management") or by allowing parents to choose schools for their children, school reform will be successful. They are wrong. These cheap solutions will have little impact. In contrast, enormous amounts of money will have to be spent on rewiring and equipping schools, and still more money must be devoted to staff training. It is not yet clear that Americans want new kinds of schools badly enough to pay for them.

Lack of money will slow the revolution—making it seem more like evolution—but it won’t stop it. If you believe that schools are a part of the American culture, that the American culture is increasingly influenced by Information Age technology, and that teachers participate in the American culture as much as other Americans, then you cannot also believe that teachers will use the technology outside of school but fail to employ it in their classrooms. Technology will be used extensively in schools. That much is inevitable.

Notes

1. Karen Sheingold, "Restructuring for Learning with Technology: The Potential for Synergy," in Karen Sheingold and Marc Tucker (eds.), Restructuring for Learning with Technology (New York: Center for Technology in Education and National Center on Education and the Economy, 1990), p. 9.

2. Establishing precise figures regarding the availability and use of technology in schools is a reckless enterprise. Even when data are gathered carefully and systematically, the numbers are quickly out-of-date. Readers should judge my figures as "best estimates." In arriving at these estimates, I drew heavily on data compiled by Barbara Means et al., Using Technology to Support Education Reform (Washington, D.C.: U.S. Department of Education, 1993), and on data assembled for me by Media Management Services, Inc., which drew upon several databases available to the firm.

3. "Integrated Learning Systems: What Does the Research Say?," Computing Teacher (February 1995), pp. 7-10.

4. My description of the ACOT project was based on an article by David Dwyer, "Apple Classrooms of Tomorrow: What We’ve Learned," Educational Leadership (April 1994), pp.4-10.

5. Report on the Effectiveness of Technology in Schools, 1990-1994 (Washington, D.C.: Software Publishers Association, 1994).

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Chapter 13: Universities in the Digital Age *

by John Seely Brown and Paul Duguid

What will higher education in the digital age look like? We ought to have some idea by now. It's been 25 years since Donald Schon urged universities to start considering life "beyond the stable state." At about the same time, the futurist Alvin Toffler confidently predicted that the Information Age would force academia to accommodate an "accelerating pace of change," prepare for "life-long learning," and even consider "learning contracts" instead of the conventional degree.

A flood of reports and a deluge of technological innovations have followed. Yet beyond the replacement of the library catalog by computer terminals, the use of PCs as sophisticated typewriters, and the explosion of campus e-mail, things don't look very different. Perhaps, as an acquaintance suggested to George Landow, hypertext champion and author of Hypertext: The Convergence of Contemporary Critical Theory and Technology, it's just a matter of lag: "It took only 25 years for the overhead projector to make it from the bowling alley to the classroom. I'm optimistic about academic computing; I've begun to see computers in bowling alleys." Most campuses, of course, are rife with computers. Landow's own Institute for Research into Information and Technology is based at Brown University. Schon teaches at MIT, the spiritual parent of such early high-tech successes as Wang and DEC. Colleagues there include such irreproachable frontiersmen of the digital age as Nicholas Negroponte, Marvin Minsky, and Bill Mitchell. Each is more likely to give you a home page URL than a business card. Their universities aren't waiting for the Internet: they form its major intersections.

So computational backwardness cannot explain the apparent inertia in campus life over the past 25 years. Indeed, it's more likely that campuses are schizophrenic: combinations of high-powered computational infrastructures and highly conventional institutional practices. Moreover, strength in technology can sometimes be a good indicator of institutional conservatism. Those institutions that were able to accumulate the resources (financial, intellectual, social) to develop a computer-intensive infrastructure were most likely to be large, wealthy, and above all—despite Schon's pleas—profoundly stable.

This institutional conservatism doesn't arise in the easy-to-criticize administrative bureaucracies alone. Tenured faculty, for both good and bad reasons, tend to cling to the institutional and disciplinary sources of their own hard-won security. (It took an English academic to say to one of us, "We've done things this way for 500 years; why should we change now?" but similar currents of conservatism run through American faculty senates.) Alumni and parents, too, as the March 15, 1995, New York Times noted, often militate against change. People who have paid a lot for a chunk of tradition usually will resist attempts to dismember it. (In a whirl of medieval costumes and dead languages, commencement invests both parents and alumni with the value of tradition.)

Nonetheless, for all the institutional inertia, campuses are changing. Their student bodies are forcing them to. The archetypal 18-to-22-year-old undergraduate going through school in 4 consecutive years and financed by parents is becoming increasingly rare and unconventional. People are taking up their degrees later and over longer periods, assembling them out of one course here and a few credit hours there, snatched between jobs and bank loans, as time, money, interest, and opportunity arise. It's probably less helpful, then, to say simply that higher education will change because of changing technologies than to say the emerging computational infrastructure will be crucially important in shaping an already changing system.

In contemplating what the future might look like, some suggest that it won't so much "look" as "be" —that the campus of the future will be "virtual," with no need of the physical plant that has been the visible center of academia for so long. This notion of a virtual campus, we suspect, both underestimates how universities as institutions work and overestimates what communications technologies do. Learning, at all levels, relies ultimately on personal interactions and, in particular, on a range of implicit and peripheral forms of communication, some of which technology is still very far from being able to handle proficiently.

Communications technology nonetheless can undoubtedly support many of the interactions between teachers and learners. Moreover, the lower marginal cost of online teaching makes it tempting to ignore what technology does not support. The practical and financial viability of the "online academy" may, however, become as much a cause for concern as celebration, threatening to polarize further an already divided system. The more expensive, conventional campus, with all its rich and respected resources, is less likely to disappear than to become the increasingly restricted preserve of those who can afford it. Net access will be for those who cannot. An online degree will almost certainly not command the same respect as its distant campus cousin. In consequence, despite conventional concerns about 'have-nots" lacking access to technology, technology may in fact become the only access they have to experiences whose full value actually develops off-line.

An alternative approach, and one more in tune with the way people learn, is not to divide the student body between those who get to go to school and those who only get to go online. It will, we argue here, be wiser to arrange things so each student can divide his or her career between time better spent on campus or in communities and time better spent online. All learners need to experience both. So, in contrast to those who suggest that the university of the 21st century will not so much "look" as "be," we suggest that it may "look" in many ways much as it does now but "be" very different, because the most profound changes may occur in the institutional arrangements rather than the physical infrastructure that makes up what people currently think of as a university.

What Do Schools Do?

Our own view of how the college or university of the next millennium may look and be is based on our sense of what it is they do, what roles they play in society, and why people think they are worth the often huge sums of money invested in higher education.

"Higher education" covers a wide spectrum, of course. In 1993, the U.S. Department of Education's National Center for Education Statistics (NCES) reported there were 10,800 post-secondary institutions, of which 5,400 offered diplomas for less than 2 years' work. Of the 3,600 regarded as accredited colleges of higher education, some 2,700 offered 4-year degrees, 800 MAs, and 660 doctorates. About 170 of these institutions are designated research universities. Given this range, much that has been written focuses only on a small part of the higher education enterprise, such as "the research university" or a particular school or discipline. But as Daniel Alpert has argued, part of the failure to change has arisen from the failure to address the ‘‘system as a whole." If only at a very general level, then, we attempt here to discuss the core of the system—degree-granting colleges and universities—and to raise some systemwide issues involving teaching, learning, and credentialing.

We begin by adopting a strategy from business consultants who have to evaluate huge and diversified corporations that address manifold interests. What, we want to ask, are higher education's "core competencies"? What do its accredited institutions do that other institutions don't? Why are individuals, families, states, and government agencies willing to invest so much in it? What is it they want—and the system offers— that is so valuable? The easiest answer—and one in line with the distinctions made in the NCES report—is that it offers degrees.

People in the system don't, of course, like to think of their work in terms of credentials. Many have higher aims and higher goals, and for some, education is an end in itself. But for a large proportion of its clientele, education is an investment—down payment on a career, social status, or, more immediately, just a job. Most students take the degrees they do to get the jobs they want, knowing or hoping that these jobs will repay the investment. For the vast majority, college implicitly provides a route into the general job "draft," much as it more explicitly prepares athletes for the NBA or NFL draft. Academic aspirations and career aspirations are tightly entwined. Undoubtedly, providing credentials is far from all that colleges do. Nevertheless, crass though it may seem, any discussion that does not acknowledge the central importance to colleges and their students of credits and credentials, degrees and diplomas, simply cannot get very far.

Distaste for credentialing causes people to look on credentials themselves in very different ways. Some see a vulgar misrepresentation of what schools really do in detail. Others see them as a succinct and useful representation of the experience gained in a college career. Within the system, many rightly want to consider "how you play the game"; but outside the system, what matters most is whether you won or lost. These two views are not entirely separable. Public perception of degrees can exert strong influence on university practice at the highest levels. As Peter Eisenberger, professor of physics at Princeton, notes in a March 1995 Physics Today article, "Once students hear that investing years and thousands of dollars in a Ph.D. has little or no economic value or intellectual satisfaction, they will start changing their plans." So although it can seem a crude measure, a diploma remains a fairly sensitive indicator of the market status—the economic as well as the intellectual value—of a university, a degree, a discipline, and a graduate.

In the degree market, then, degrees usefully encapsulate or represent several years of work. Simultaneously, they also "usefully misrepresent" much of what goes on in those years, providing both schools and society with important slack in a system that should not be too taut. While its market value remains high, the very crude semiotics of a degree gives both universities and students a certain license to do what the degree doesn't necessarily register. It allows students to "play the game" in a variety of creative ways, on the simple condition that in the end they meet the requirements for "winning" a degree. Behind a front of public respectability, students and faculty undertake activities that are socially valuable but not readily valued in the market. In the end, this slack provides the job market and society as a whole with more diverse and versatile candidates than they probably know to request. To shift our metaphor to legislative terms, the degree is an "omnibus package" intended to draw broad public support. While that support holds, an array of important but not always justifiable measures can be unobtrusively "tacked on" without question. It would help neither students, faculty, nor society to open the package to a "line item veto." In this way, credentialing serves everyone's purposes.

Learning and Lading

The degree, then, is useful for what it mis/represents. As long as it represents certain things about a degree-holder with reasonable accuracy, it can creatively obscure other aspects to advantage. But that still leaves the question, What does a degree represent?

When people look too hard at degrees, we suspect they see a sort of intellectual bill of lading, a receipt for knowledge-on-board. Teaching, in this view, is a delivery service and school a loading site. No one actually says this, but a delivery view nonetheless underlies much of what people perceive about schools. An implicit delivery view also leads some to think of educational technology as a sort of intellectual forklift truck. If it's true that the most effective technology in the classroom is still the overhead projector, this may well be because it and many of the alternatives have been designed with delivery in mind.

The knowledge-delivery view, however, profoundly misunderstands how people learn, where they learn, and when they learn. In the first place, it portrays students as vessels into which the university pours information. This is an extraordinarily passive view of how people leam, one that takes no account of the active participation necessary for learning and knowing. And second, the knowledge-delivery view overlooks all the things that people learn on campus outside as well as inside the classroom. These can be as important to a student's career as teacher-delivered knowledge. People leave college knowing not just things, but knowing people, and knowing not just academic facts, but knowing social strategies for dealing with the world. Reliable friendships and complex social strategies can't be delivered and aren't picked up through lectures, but they give an education much of its value.

Furthermore, people don't usually treat a degree like a bill of lading. Employers, for whom most degrees are ultimately earned, usually look at a degree with infinitely less care than they would a bill of lading. Few outside academia want to examine a transcript. And those who receive degrees rarely act as though it was information delivery that mattered most to them. Alumni tend to blur on classroom information. Details of what they were taught fade exponentially after finals. Few would easily forgive someone who asked them to retake their exams a couple of years—or possibly even a couple of weeks—later.

Short though they may be in some respects, alumni memories do, however, provide some insight into what a degree represents. Alumni do remember groups they joined, scholars they worked with, tasks they accomplished, and friendships they made. We don't have to look much further than the group of Rhodes Scholars around our current president to see how college activities and networks can be far more important in later life than a degree's formal content.

Such networking is not simply a campus sideshow. The groups people join at university, some social, some academic, are important. There's much truth in the old saying "It's not what you know, but who you know," although that doesn't quite reflect the intricate connection between "what" and "who." It's this connection that ultimately explains why parents pay high fees for "good" schools; why students and faculty compete so hard to get to a few campuses, while the vast majority of institutions often struggle to fill their places; why academics are so concerned about where someone received his or her degree and with whom; why diplomas are taken as significant indicators of job worthiness, though transcripts are not; and how university experience helps people find their way through life after university. For the core competency of universities is not transferring knowledge, but developing it, and that's done within intricate and robust networks and communities.

Colleges, Communities, and Learning

The delivery view of education assumes that knowledge comprises discrete, preformed units, which learners ingest in smaller or greater amounts until graduation or indigestion takes over. To become a physicist, such a view suggests, you need to take in a lot of formulas and absorb a lot of experimental data. But, on the one hand, knowledge is not a static, preformed substance: it is constantly changing. Learning involves active engagement in the processes of that change. And, on the other hand, people don't become physicists by learning formulas any more than they become football players by learning plays. In learning how to be a physicist or a football player—how to act as one, talk as one, be recognized as one—it's not the explicit statements, but the implicit practices that count.

Indeed, knowing only the explicit—mouthing the formulas or the plays—is often exactly what gives an outsider away. Insiders know more. By coming to inhabit the relevant community, they get to know not just what the standard answers are, but the real questions and why they matter. You don't pick up those things in textbooks any more than you learn to talk like a native by studying grammar books. Learning involves inhabiting the streets of a community's culture. The community may include astrophysicists, architects, or acupuncturists, but learning involves experiencing its cultural peculiarities.

By describing universities in terms of community, we may seem to be putting academic disciplines somewhere on a cozy line running from neighborhood watch groups to football-team boosters—the sorts of communities that some communitarians have in mind. The communities we have in mind, however, are quite different. These hold together not through voluntarism but through the enduring interpersonal relations that form around shared practices. People come to share this sort of community by sharing the same tasks, obligations, and goals.

Stephen Toulmin, who has explored the community character of academic disciplines, argues that through a complex of shared practices and institutional arrangements (in which the university has come to play a major part), disciplines form "communities of concept users." What is often thought of as "concept-acquisition," he maintains, is really a rich process of "enculturation" as newcomers become members of the community. More recently, two learning researchers, Jean Lave and Etienne Wengel, broadened the scope of Toulmin's analysis by arguing that all learning, whether specifically "academic" or not, involves enculturation in communities. At base, their work suggests, academic communities are quite similar to other communities of practitioners, or "communities of practice," as Lave and Wenger call them.

Communities of practice are, we think, essential and inevitable building blocks of society. Being an inevitable rather than optional form of social arrangement, they have the same credits and debits as society as a whole. They are as likely to be hierarchical as egalitarian; to be restrictive as open; to resist change as to welcome it; to be internally divided as united. It is the practice and the concepts they share that connect members of a community, not a warm glow of communitarian fellow feeling. So we are not claiming, as communitarians do, that it would be useful to form communities and that universities are a good place to form them. Rather, we claim that communities, with all their strengths and shortcomings, grow inevitably and inescapably out of ongoing, shared practice. Learning a community's ways always requires access to that community and that practice.

The real test of a school, then, is the quality of access it provides to academic communities— Toulmin's communities of concepts. A degree reflects not simply the quality of participation of a particular individual, but also the quality of access made available by the institution. That is why choosing a school is so important. Moreover, it's exactly because some schools give credentials without ever giving suitable access to knowing communities that the relationship between learning and credentials is always problematic. People can and do end up with the label but without having had the necessary experience. Consequently, the central thrust of any attempt to retool the education system must involve expanding direct access to communities, not simply to credentials.

But our concern about technological retooling also comes at this issue from the opposite direction. Those who have the label but not the experience present one problem. Those who might have the experience but not the label face another. This is a central problem for proponents of "open learning." Experience without a formal representation has very limited exchange value— as those whose experience comes from the university of life well know. Consequently, we believe that any retooling must be two-pronged: it must seek to provide wider access to communities, and not just to information, and it must expand ways to represent new forms of access and practice.

Graduates and Undergraduates

Graduate education and research illustrate the attempt to bring newcomers into the disciplinary community. Collaboration between aspiring students and established scholars introduces the former to a discipline's practice. With the help of mentors, graduate students work their way ever deeper into a community and its institutions, moving away from a toe-hold on the periphery toward increasingly full participation, like apprentices being led into a craft by masters of the practice. In such a process, medical students learn to treat patients, law students to compose briefs, historians to undertake historical research, physics students to engage in the practice of physics rather than merely learn about it, and so on. It isn't abstract theory but concrete, community practice that's at the top of the pyramid.

Things are obviously different for undergraduates. They, after all, are prime targets of mechanisms of delivery. Nevertheless, as colleges are currently configured, undergraduates usually do gain some forms of community access. If only for didactic purposes, schools usually put before them practitioners from within particular fields or graduate students working on the periphery. These community members, some intentionally and some unintentionally, give undergraduates a glimpse of the reality of what life in those communities is like. Indeed, behind several of the reform movements one sees on campus today —undergraduate research, problem-based learning, field-based senior capstones, and so on—might lie a new sense of the value of introducing undergraduates to real-life aspects of disciplinary practice.

One of the most important things undergraduates gain from such exposures is an implicit sense of how society comprises innumerable distinct communities of practice. From a distance, academic disciplines appear engaged in the collective and seamless pursuit of knowledge. As students begin to engage with the discipline, as they move from exposure to experience, they develop a sense that the different communities on a campus are quite distinct, that apparently common terms have different meanings, apparently shared tools have different uses, and apparently related objects have different interpretations. Coming to understand this, however unconsciously, is a key outcome of a college career. Furthermore, as well as spotting the differences, undergraduates also tend to understand the common social demands all professional communities make. This is an important part of the socializing effect of schools that makes their graduates congenial to corporations.

Beyond the Campus

In the past it was quite easy to regard universities as society's unique and separate centers to which students went for a specified period to learn what they needed for life. The opposition of "town" to "gown" and the notion of the "ivory tower" represented a classic division between the university and its locale. Today, that division has little meaning.

Schools must respond to a growing demand for further education in the town, and they must draw on the knowledge created there, as well.

Demand is growing as people need to go on learning long after the conventional years of school are past. The insights acquired during a 4-year degree never really sufficed for life, but previously, almost everything else needed for a particular job could be picked up in situ. As people change jobs and jobs themselves change with great rapidity, such ad hoc learning is no longer sufficient. People need to re-immerse themselves in specialized communities to follow developments in specialized knowledge. Universities increasingly have to consider how they can support "life-long" learning to meet these needs. Perhaps, as Toffler suggested long ago, they might start to offer "learning contracts" to incoming students, committing colleges to their students for more than a standard 4 years.

As universities contemplate such changes, they need to find ways to reach people beyond the campus. Here, schools can draw on an inherent asset base generated in the daily round of seminars, colloquiums, lectures, and so forth. New means for capturing the transient activities of the classroom (live-boards, which capture the writings on a board for future reference, multimedia recordings, etc.) and for interactive dissemination (principally through Internet-like infrastructures) offer universities ways to provide a dynamic, responsive archive out of what formerly have been transient or broadcast practices.

Inevitably, capitalizing on these resources will require more than unedited dumps of classroom exchanges. To be useful, these exchanges will require the addition of different types of indexing and annotation, new and versatile search tools, and moderated channels for response. Here schools might develop links between students on campus (with time rather than money on their hands) and students off campus (with complementary resources). Students attending classes on campus might be able to index recordings in real time (these might be thought of as the multimedia equivalent of those exemplary class notes that classmates find so valuable today) and to respond to the issues raised by off-campus students through the interactive links.

In reaching out beyond the campus like this, universities are not simply expanding their fee base or extending their patronage. Communities of concepts don’t emerge in the ivory tower alone. Valuable knowledge is created elsewhere in society, too. Consequently, in building better interactive links between town and gown, between a field’s on and off campus members, schools are serving their own needs, too. In the first place, they are also building links to expertise they lack themselves. And, perhaps most important of all, they are contributing to what AnnaLee Saxenian has called "regional advantage": the conventional science park of businesses fed from the university are, in fact, evolving into learning parks where universities and businesses feed one another. This process more firmly situates schools and their strengths within their regions rather than isolating them within their campuses.

From Delivery to Interactivity

With such changes, conventional boundaries such as those between "town" and "gown" or students and alumni will start to blur as schools extend their reach across space and time. New technologies will be increasingly important for doing this. So far, "distance learning," which primarily involves delivering instruction to people off campus, has been the center of attention. As schools consider their options, we think it's important that they look beyond traditional paradigms of distance and delivery. A college's core competency, as we have attempted to say, involves a great deal more than simply delivering knowledge.

Our view is distinct from distance learning in several ways. First, distance teaching was developed with broadcast technology in mind. In the hands of institutions like the Open University (OU) in England, broadcast media have successfully allowed teachers to reach people who had little or no access to conventional schools. Questioning the privilege of the classroom more than the practice, however, such developments have only minimally altered the underlying delivery structure of pedagogy.

Second, when distance learning shifts education on-line and off campus, it can damagingly restrict the essential access to the authentic communities we discussed above. Students in dislocated, virtual campuses are unable either to engage fully with a range of communities, as undergraduates should, or to participate in particular ones, as graduates must.

Third, the focus on distance and delivery overlooks not only the needs of students, but all too often the strengths of new technologies, which are distinctive because they are interactive. Previous communications technologies—books, film, radio, television, telephones, video—have all supported distance and delivery, but they have primarily permitted only one-to-many or one-to-one communications. Knowledge communities, however, are built on more complex interactions, such as continuous conversation. Even in the technologically rich 20th century, such interactions have, for the most part, been possible only in face-to-face situations. The explosion of interactive and midcast (as opposed to broadcast or narrowcast distribution) technologies for the Internet argues that in the 21st century mediated communications will expand the possibility for rich, distal interactions—urging consideration of more than distance in distal education.

Already, innovative teachers and students are taking full advantage of the Internet to move from a paradigm of delivery to one of interactivity. We offer here a few examples of technologies and teachers that strike us as going in the right direction.

Newsgroups, Usenets, Bulletin Boards, and Listserv Mail Lists. All these are based on the rudimentary software of electronic mail. E-mail has proved very useful in keeping teachers and students in touch with one another in one-to-one exchanges, but these groups or lists move beyond that by allowing all their members to address the group as a whole (in much the way someone asking a question in class addresses the whole class). Anyone who subscribes to a group or list can broadcast or mid-cast. Furthermore, many lists and groups capture the apparently ephemeral exchanges and comments of members in an archive that outlives the transient status of classroom questions. In sum, these systems essentially embrace both the features of many-to-many, real-time, conversation-like interaction and those of more enduring, written exchanges.

Such group interactions and their archives are particularly useful for auditors—"lurkers" as they are sometimes known on the Net. Like a good conversation or debate, group exchanges can be as illuminating for those who don't contribute as for those who do. And many lists have more silent partners than active ones. Evidence of the many lurkers haunting the virtual space often comes only when participants suggest taking an interesting discussion off-list. Then lurkers suddenly materialize to protest attempts to make a fruitful public discussion private.

Annotation Systems. Anyone who has lurked on a list knows that for every good conversation that gets going, there are a dozen false starts. For every useful contribution, there can be a dozen uninformed and highly opinionated ones that derail everyone. Often, conversational wheels merely spin or promising trains of thought get sidetracked. This is particularly true when too many participants are not well versed in the topic. Dan Huttenlocher, a professor in Cornell's computer science department, discovered all this when he created a list for informal undergraduate class discussions. He was disappointed to find how little it helped. "Particularly for undergraduates," he notes, "a list makes conversation easy, but focus difficult. Students don't need the opportunity to talk. What they need is something to talk about." Conversely, when he put problem sets on a class ftp server, Huttenlocher found this gave students a great deal to talk about, but no means for many-to-many conversation.

In response, with Jim Davis of the Xerox Design Research Institute at Cornell, Huttenlocher designed "CoNote," a World Wide Web annotation tool that allows students looking at a Web document both to post and to read questions and comments attached to that document. As a result, students can raise and discuss tricky issues, learn from others, discover they aren't the only ones stuck, and generally enter into lively debates about issues of importance to the class. Textual scholars have long known the importance of the interplay of text and commentary. This interplay can be traced back through the conventional footnotes and marginal notes to Talmudic commentaries. William Sherman has recently noted the importance of marginalia (or adversaria as they were called) to Renaissance science. Hypertext annotation systems like Huttenlocher's help continue this robust interactivity between a text and its readers in new technological forms while extending the right to annotate publicly beyond a privileged few. (There are now several similar annotation systems in use on the World Wide Web. MIT Press, for example, uses a similar system with online texts of books, allowing readers to respond to authors.)

Shared Online Environments. Nowhere on the Net has conversation become as lively as in MUDs and MOOs, shared online environments that allow all participating to see whatever anyone writes, though the participants may be continents apart. MUDs (Multi-User Dungeons) allow several players on computers connected by modems to play the game "Dungeons and Dragons" together. MOOs (object-oriented MUDs) remove the game goals, turning the dungeons into a computationally manipulable set of "rooms" where people can meet for online discussions and programming. MOOs have become the clubs and coffee houses, pubs and cafes of the Internet.

For courses that have difficulty finding enough live bodies on one campus, a MOO offers an interesting medium for interactive distal learning. James O'Donnell's graduate course on Boethius, conducted in the fall of 1994 for credit from the graduate school at the University of Pennsylvania, is an early example. Graduate medieval Latinists are few and usually far between, but Penn's LatinMOO allowed students from the United States and Asia to form a reasonable quorum. (The course on Boethius spanned some nine time zones.)

Penn's LatinMOO was much more than a simple chat line. It comprised a "complex" with a quadrangle, several classrooms, a Latin-only common room, and a virtual Coke machine around which people would gather to chat. O'Donnell opened the Boethius classroom to students enrolled in the class, while he made other parts of the MOO available for Latin students from his regular courses (including a "live" undergraduate class on Boethius) to get together more informally. To widen the conversation, O'Donnell combined other Net facilities with the MOO. In addition to putting the central text on a Web site with links to a commentary and other resources, he started a Boethius e-mail list that included all students in the MOO seminar and the live class, but essentially created space for virtual "auditors." This opened discussion to students and academics from around the world, while distinguishing levels of participation and access.

From Distance to Open

New online courses and new course technology emerge all the time. Our aim here has not been to attempt either a catalog or a survey. We offer these as examples of distal education that seem to us implicitly to go beyond issues of distance and to honor the interactive, communal character of learning and the emerging capabilities of the Net. In particular, they allow students to engage in what Dewey called "productive inquiry."

To some extent, addressing the needs of students in this way reflects the aspirations of what is called "open learning." Proponents of open learning seek to empower learners by breaking down barriers to education raised by conventional institutions. They wish to provide unhindered access to learning resources, so that technologically supported freedom of information may be turned into freedom of education for people pursuing their own learning needs. While such a shift responds better to the way people learn by facilitating interactivity and active engagement and inquiry rather than passive reception, even open learning underestimates some important roles institutions play.

First, as we have noted, a good deal of what an undergraduate diploma signifies comes from the way education socializes students, making them unreflectively familiar with the distinct mores of diverse communities. While open learning pursues access to information, it ignores the more important issues of access to communities.

Second, while open learning challenges the university's conventional role as gatekeeper to academic information, it simultaneously underestimates the importance of institutions representing educational achievement. As we argued earlier, it is the representation of experience that has exchange value in the job market. Employers who have proved generally reluctant to accept credentials from the university of life are unlikely to behave very differently with open learning on the Net.

Consequently, while the shift from distance to open learning is conceptually important, it fails to address both the communal and the institutional needs of learners. Institutional roles in providing access, oversight, and credentialing will remain important in the digital age. The institutional arrangements required by those roles, however, seem likely to change.

Alternative Configurations

If we ignore, as some prefer, the way credentials provide both constraints on and resources for the higher education system—a valuable form of mis/representation as we described them—then it's possible to see the march toward first distance learning and now open learning as a fairly direct march of progress. With the development of various technologies, it can be claimed, students have slowly been able to take advantage of each new form of distance learning: the correspondence course, the broadcast-media course, and now Net courses. The future, as proponents of the electronic university assume, is simply to continue this progressive trend and move toward an "Electronic Worldwide University."

If, however, learning requires genuine participation, distance learning often provide its illusion only, while actually keeping students at a disempowering distance. This is a particular risk with use of the Net. As anyone who has sent e-mail to the White House, Congress, or even a newspaper knows, the Net can provide a powerful impression of interactivity and exchange while in practice denying both. Similar problems are likely to arise for online students. A distal learner, for example, may achieve access to public forums used by a campus class, but the campus community's private, off-line interactions will remain both inaccessible and invisible. Where Stanley Fish was once challenged by the question "Is there a text in this class?" the Net raises the challenge of discovering if there is "a class with this text?"

We suspect that, though Net interactions offer profoundly useful means to support and develop existing communities, they are not so good at helping a community to form or a newcomer to join. Dan Huttenlocher argues that from his experience there is an important synergy between his live classes and their online interactions that the online exchanges alone couldn't provide. "The Net isn't a good place to form communities," he claims, ‘‘though it's a very good place to keep them going." Clearly, someone with only online access to Huttenlocher's course material would not benefit from this synergy.

The experience of LatinMOO at first seems to challenge Huttenlocher's claim. A cadre of Boethius scholars did appear to form wholly online. Yet even here online participation was significantly dependent on a deep base of off-line experiences. All the participants were graduate students, which by our earlier analysis makes them quite distinct from Huttenlocher's class. Graduate students have already been heavily socialized into the patterns of university and graduate work and behavior, whereas undergraduate classes have only started this difficult socializing process. Unlike Huttenlocher, O'Donnell didn't have to instill too many social conventions beyond those of MOOing itself, since participants had already picked up the niceties and the idiosyncrasies of scholarly behavior off-line. In short, O'Donnell's online class was inescapably enabled and enriched from the participants' background in off-line classes.

So for us, the idea of a progressive march toward open learning culminating in a future of virtual universities where all interaction is online is problematic. Furthermore, the accompanying whiggish story of a progressive march, a steady loosening of an age-old university grip on knowledge and access—though appealing —simply isn't true. Our reading of history is different and less relentlessly progressive. Indeed, we suspect that some earlier ways of organizing postsecondary education, though they might appear to have been superseded, could be useful in addressing problems raised but not answered by futuristic notions of a virtual, placeless university for isolated individuals.

The broad gate-keeping role universities now play is, in fact, a relatively recent development. For instance, the professions, which now rely so heavily on universities, previously relied much more on professional apprenticeship. In these areas as elsewhere, university dominion is a recent phenomenon, suggesting that institutional control is being centralized rather than diffused.

In 19th- and early 20th-century Britain, for example, universities themselves oversaw much looser, more highly devolved arrangements. Students from Scotland to Singapore, for example, took courses and earned external degrees from the University of London, most without ever leaving home. Nor were these simply correspondence courses or early forms of distance teaching. The external degree importantly allowed students and teachers to form or join relatively autonomous local groups of like-minded participants thousands of miles from the degree-granting university. High schools opened their facilities to nearby students, particularly women, beyond school leaving age, to allow local scholars to provide university-level courses in places without a university.

In this devolved system of higher education, pedagogy and control were widely distributed, involving both local and remote scholars and communities. This arrangement meant that students were neither dislocated from local networks nor trapped by the limitations of local resources. Local communities gave students opportunities for authentic access and membership while, from a distance, the university provided oversight, materials, standards, and credentials. Consequently, students could draw on the strengths of both the metropolis and the periphery. This type of arrangement significantly opened educational opportunilies for rural women, the poor, and Third World residents who lacked access to universities, and it provided them with recognized and respected credentials.

For various reasons, the use of external degrees has diminished (though the University of London still administers some). Moreover, much of the "open" potential of the external system has given way to distance learning. Paradoxically, because it replaces local resources with metropolitan ones delivered from a distance, distance learning is more part of a trend toward centralization than devolution. Certainly learners have wrested some control from the academy, but in other areas the academy has increased its control. The single (and increasingly large) campus as the sole source—of faculty, disciplines, and colleagues— for matriculating students is the outcome of a 20th-century trend of concentration that has probably been as significant as the opposing triumphs of dispersal.

Any rethinking of resources for distal learning, it seems to us, needs to steer a path between the academy's centralizing tendencies and the optimistic faith that technologically mediated open learning offers a viable alternative. As we suggested above, to meet learners' needs for access to communities and credentials, institutions of higher education are more likely to be reconfigured than bypassed or abandoned.

The forces involved in the reconfiguration are too varied to make the outcome in any way predictable. Yet it seems unreasonable simply to shrug our shoulders at the ineffable character of the future. So instead, in the following section we suggest one way in which the current configuration, often thought of as a single and inseparable institutional unit, might be rethought. Our purpose is not to produce a new blueprint for "the idea of a university," but to undertake a thought experiment concerning the different pieces to be considered in reconfiguring higher education. With new technologies, we suspect, the components of a university, which once moved together, might develop along different trajectories on different time lines. We offer this sketch of a devolving university system as an intuition pump or discussion piece rather than a wish list or prognostication. It should be as useful to consider why it couldn't work as why it might.

Reimagining the University

Our discussion so far suggests that learners need three things from an institution of higher education:

- access to authentic communities of learning, exploration, and knowledge creation;
- resources to help them work in both distal and local communities; and
- widely accepted representations for work done.

If this is the case, then, along with the students themselves, there are three other crucial components of a college: faculty (drawn from communities of practice); facilities; and an institution able to provide formal, accepted representation of work done. At the moment these four components are tightly woven together in particular colleges and their campuses. Distance education seeks to keep all but the students together. The history of the external degree, with its central credentialing but distal teaching, suggests that other configurations are possible. Moreover, as we've suggested, new, interactive technologies are starting to pick away at some previously invisible seams. Here, we pick a little further.

If these components are separable, degree-granting bodies (DGBs) might take up the degree-granting function. These would no doubt have to fight over students and faculty, just as colleges do now. DGBs could take on as many or as few students and faculty as they thought practical, becoming smaller than a liberal arts college or larger than an entire state system. They could set degree requirements and core courses as they saw fit. But a DGB would be essentially administrative, with little need to own much beyond its administrative competency and a building to house its (administrative) staff. Its loyalties might be to a locale or a region, or be national or international. Without the need for the massive capital investment that owning a campus and hiring a faculty requires, DGBs would be highly flexible, able to evolve to meet the needs of students, faculty, and the labor draft. Conversely, of course, they might be less resistant to unhealthy winds of change.

If a DGB could take on an independent status, faculty might also become more independent. Like doctors who contract to HMOs, they would need to find a DGB to sanction their teaching. But also like doctors, they might find more than one DGB to do this. DGB sanction would allow students who study with a particular scholar to gain credit for work done toward a degree from the DGB. Scholars might contract individually or in teams. But, as distinct from the current system, they wouldn't be tied to one place. There is no reason for all the faculty of a DGB, or even all the members of a team, to be in the same place. Some could be on the East Coast, some on the West Coast, and some overseas. They might teach students from several DGBs online or in person, through tutorials, lectures, or seminars, or any combination.

In such an arrangement, fees would be likely to vary depending on the type of teaching offered—a lecture, a tutorial, a research seminar, a lab, or in-work training for graduate, undergraduate, or extension students. DGBs might pay a per capita fee to reward a teacher's ability to attract high-quality students to the DGB. Or, like 18th-century academics, scholars might collect a fee directly from the students they attract. (Adam Smith's Edinburgh lectures were paid for this way—he took a guinea per head and made 100 pounds per annum; so were Hegel's lectures in Jena.) Or again, a DGB might pay for matriculating students while auditors could pay teachers directly. An option like this might help ensure that the structure and content of a course are not shaped by degree and exam requirements alone.

Research might be administered by a DGB or staffed and funded separately. For both teaching and research, faculty could find their own facilities. For some, these would be inevitably extensive, involving labs, equipment, and libraries. Others might need only a classroom. And yet others running small, local tutorial groups or online classes might need few facilities beyond an Internet link or a seminar room, which might be provided rather like branch libraries, dispersed across towns and cities.

Despite the loss of a tied academic administration and faculty, concrete facilities under such an arrangement would no doubt look very much like the campus of today. A particular campus would have to compete for faculty and students in the region, with the quality of its facilities a significant attractor. Both faculty and students using a particular facility might then come from several DGBs. The facility itself might thus become a regional magnet for staff, students, and DGBs. If this were the case, it would be in a city's or a region's interest to maintain a high standard of facilities. Faculty and students wouldn't have to travel to their DGB, but they might want to travel to be close to superior facilities. On the other hand, they wouldn't be locked into one set of facilities. In well-endowed areas, some faculty and many students might use more than one facility. DGBs, faculty, and students might not use campus facilities at all. We would imagine, however, that given the needs for socialization, most DGBs and many faculty might insist that degree candidates spend a set amount of time on campus in groups rather than online individually. DGBs without such a requirement might well find their degrees rapidly falling in value and competitive worth.

Student choices would change significantly in any reconfiguration of this sort. More choices, of course, are likely to mean more complex decisions. The central choice would involve finding a suitable DGB. Perhaps a student would choose one that insists on conventional campus life—and one that has faculty on a particular campus. Or perhaps one that makes no campus demands, or one that includes certain faculty. Or the choice might be one that has faculty in the various regions a student expects to work in over the next few years: northern Scotland, Singapore, or San Francisco. A student also might choose a DGB whose degree in an area of interest is known to have a particularly high exchange value; or one that is prepared to validate certain kinds of in-work experience. But a student wouldn't be committed to working with the faculty of a single campus or a single region; furthermore, he or she might be able to work with local communities of excellence whose credentials are not accepted by universities under present arrangements.

In this way, a distributed system might allow much greater flexibility, employing local sites of professional excellence—research labs, hospitals, architects' offices, law firms, engineering offices, and the like—to offer mentoring programs that give students practical experience and course credits simultaneously. Regions that lack conventional academic facilities might start to attract students through the quality of mentors in the workforce. Students in forestry, viticulture, mining, conservation, or ocean science would, for instance, be able to get credit for working with experts in the field, however far this might be from conventional academic centers.

Essentially, a student's university career in such a system would no longer be through a particular place, time, or pre-selected body of academics, but through a network principally of students' own making, yet shaped by a DGB and its faculty. Students could stay home or travel, mix online and off-line education, work in classes or with mentors, and take their own time. Their college careers wouldn't begin at age 18 and end at age 22.

Direct funding through fees wouldn't change much. DGBs would take tuition fees, while arrangements for faculty and facility per capita payments could be negotiated in a variety of ways, as we have suggested. (Of course, the extensive support provided by alumni to certain institutions might well ensure that these resisted all other pressures to reconfigure.) Subject to accreditation, private institutions could set up their own DGBs; states could set up their own. Some DGBs might try to be exclusive; others inclusive. Each would over time develop its particular reputation, attracting faculty and students through the exchange value of its degrees. Groups concerned about education in their fields—such as the AMA, MLA, or Computer Scientists for Social Responsibility—might try to establish themselves as DGBs. As we suggested earlier, degrees that reflect too much concentration, that represent too accurately the work involved, might well fall in value compared to those that mis/represent greater diversity. For in the end, the goal of a devolved system would be the education of students as capable of change on graduation as the world they encounter.

Conclusion

This sketch is not, of course, a road map for the future. Rather, it is something of a deliberate provocation intended to make the general point that the radical changes occurring in a university's environment—from the reconstitution of its student body to the reengineering of its technological infrastructure—will require different institutional arrangements from those found today. Distance learning, where much of the current interest lies, is, we believe, too deeply enmeshed within current arrangements to produce sufficiently radical change. Open learning, on the other hand, tends to ignore the strengths worth preserving in current arrangements. Without more thought to students and their practical needs, we fear that not only will these technologies be underexploited, but they may well reinforce the current limitations on our higher educational system.

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Part Three: Government and the Military

Introduction

Beyond their impact on business, commerce, and services, emerging information and communication technologies also promise to have significant impacts on the way that the affairs of government and the military are conducted. The new technologies have potential not only to rev-olutionize how those affairs are conducted, but in some ways to strengthen—or challenge—the very philosophical foundations upon which the U.S. and other democratic governments are based.

The first two articles in Part Three make this abundantly clear. The first, "Telecommunications and Democracy," authored by a team of researchers at the Benton Foundation, raises questions about whether the new technologies will extend or impede democracy's reach. Generally optimistic, the authors point to several specific cases in which emerging information and communication technologies may strengthen the democratic underpinnings of the United States and other popularly elected governments by informing citizens, broadening deliberations, increasing voter turnout, and empowering committees. If emerging information and communication technologies have the impact that the Benton Foundation authors outline in this portion of their study, then democracy will indeed be strengthened globally.

But the authors are neither naive nor idealistic. They also recognize that "teledemocracy" presents serious challenges. Will the new information and communication technologies help promote democracy, or will they be used to foster demagoguery? Can the concerns of technophobes be overcome so that they too might participate in the democratic advances that technology might bring? How can the disenfranchised access democratic opportunities via technology? Can equitable access to the democratic process be ensured in a wired environment?

These are serious questions, and so too are the impacts that new information and communication technologies might have on concrete areas of government activity. This section's second article, Martin Fogelman's "Freedom and Censorship in the Emerging Electronic Environment," explores potential impacts of emerging technologies on First Amendment freedoms. Fogelman is concerned that the new technologies may lead to increasingly successful efforts to curtail free speech and free expression as the technologies of the Information Age expand our capabilities to hear and be heard, to see and be seen, and eventually, to touch and be touched. Noting that "the natural lobby for free speech is small and shows no signs of growth," Fogelman calls on "the vigilance and activism of general citizen groups, and of telecommunications and information industry professionals in particular" to fight the good fight to preserve First Amendment freedoms.

Beyond questions of First Amendment freedoms, in the Information Age virtually all areas of government activity will be affected by information and communication technologies. The last four articles in this section concentrate on two areas in which government actions will be affected by information and communication technology, decision making and warfare. (The impact of these technologies on warfare and the military will be explored in greater depths in a later volume.)

Three articles on government decision making, by Peter Huber, Jeffrey Record, and Johanna Neuman, find a middle ground between the Benton Foundation's general optimism and Fogelman's basic concerns about the impact of the third modern information and communication revolution on the relationship between government and society. Huber explores the impact that new information and communication technologies are having and will have on government bureaucracies and regulators; Record addresses the bulk of his commentary to the impacts that these technologies will have on congressional decision making on national security issues; and Neuman addresses the role that the media plays in foreign policy decision making. In all three articles, the arguments that are made could easily be extended to all areas of executive and congressional decision making. However, there is an underlying philosophical difference between the three articles. Huber argues that the new information and commun-ication technologies will drive governments to become better, while Record and Neuman believe that the new technological capabilities will have little overall impact on government behavior.

At the same time, this difference should not be overemphasized. At a deeper level, all three authors are convinced that the individual, not technology, will continue to make government decisions. There are no technological determinists among these three authors, only disagreements over the degrees of impacts that these technologies will have on human behavior.

In "Cyberpower," Peter Huber makes the case that new information and communication technologies are likely to change the equation of how political power is used once elections are over, but fundamentally, people will still be making decisions. "The old game of big promises on election day, soon forgotten in the enjoyment of power, is over," he argues. There is a simple reason for this, Huber maintains. Just as you can "drive to Reno for marriage, divorce, or gambling" if you do not like the laws that exist in your home state on these activities, the new technologies increasingly allow people to expand their outlooks, avoid taxes, evade inept central bankers, and sidestep other forms of government regulations.

Huber believes governments will have no choice but to respond to this new mobility or risk losing tax revenues and suffering depressed economies. If people do not like what government officials, bankers, or regulators are doing under one jurisdiction, they will simply move whatever mobile assets they have to another jurisdiction, whether it be a different city, county, state, or country. By increasing the mobility of many types of assets, but especially financial and intellectual assets, Huber argues, competition between governments will inevitably increase as individuals decide where their various types of assets should reside. The quality of government will improve because of this competition.

Jeffrey Record, in his "Congress, Information Technology, and the Use of Force," sees things somewhat differently. Congress's business is politics, Record asserts. Concentrating on foreign policy and the use of force, Record believes that congressional attitudes in these areas will be influenced by a variety of factors including but not limited to a preoccupation with domestic social and economic challenges, aversion to value-driven uses of force, and hyper-sensitivity to casualties. The additional data and information provided by energizing information and communication technologies will rarely be one of these factors, Record argues. Politics will continue to reign supreme in Congress during the Information Age and this, he asserts, is as it should be.

In "The Media's Impact on International Affairs, Then and Now," Johanna Neuman takes an historical approach and argues that the technologies of the Information Age are much like earlier information and communication technologies in the way that they have impacted and will impact government decision making. To Neuman, "throughout history, whenever the political world has intersected with a new media technology, the resulting clash has provoked a test of leadership before the lessons learned were absorbed into the mainstream of politics." But they always have been absorbed, Neuman observes, and the key has been effective leadership. The same will be true of the new technologies, Neuman believes.

However, she also provides a cautionary note that computers and cyberspace could be different since they will provide to "interest groups and non-governmental organizations,...newspapers, local cultural groups, and corporate advertisers" the ability to compete against governments in presenting their viewpoints and perspectives. This, she observes, could lead to national governments becoming "less relevant," or lead even to a "twilight of sovereignty." Nevertheless, she concludes, decision making requires leadership, and the new technologies do not and will not change that.

While Huber believes that the new technologies will drive improvements in government, Record and Neuman fundamentally agree that little will change during the Information Age in governmental decision making. In military affairs, according to Bruce Berkowitz in his "Warfare in the Information Age," Huber's picture of the future is most accurate, with "information warfare" (IW) having already become a central player in the formulation of post-Cold War U.S. military strategy.

Defining IW as "the use of information systems... for military advantage, either by the United States or by a variety of unfriendly parties," Berkowitz provides an overview of the origins of the concept, its relationship to the Information Age, how to deal with it, and the difficulties of deterring an IW attack on the United States. As difficult as the military challenges posed by IW are, Berkowitz cautions, coping with IW's political, economic, and cultural parameters will be even more daunting. Harking back to some of the concerns expressed by Fogelman in his discussion of the possible impacts of the Information Age on First Amendment freedoms, Berkowitz also warns that the measures required "for countering the IW threat will often collide with essential features of the democratic free market system that an IW policy is intended to protect."

What, then, does the Information Age portend for the affairs of government and the military? Obviously, there is considerable room for debate, but there are no technological determinists among the authors whose works are presented here. Running throughout the perspectives presented in this section, even if it is not specifically stated, is a fundamental emphasis on the continuing importance of human beings in the Information Age, and the decisions that they make. The Benton Foundation's authors caution that new technologies can strengthen or challenge democracy, depending on how human beings use them.

Martin Fogelman calls on citizen groups and telecommunication and information industry professionals to help preserve First Amendment freedoms against challenges that he sees forthcoming in the Information Age. Peter Huber, Jeffrey Record, and Johanna Neuman appreciate what the new technologies can do and will be able to do, but disagree over what the impacts will be. Huber maintains that these technologies will lead people to take actions that will improve government, while Record and Neuman believe that at the end of the day, human beings will still make decisions in government much the way that they have always made decisions. And while Bruce Berkowitz is clearly impressed by the future of information warfare, he does not see the role of human beings in warfare during the Information Age being supplanted by new technologies.

This part's authors seem to agree that in government and the military, human activities and organizations will change, and change significantly, during the Information Age. But many core functions will remain the same. Although none of the authors make the case, it is not too much to return to the observation presented in the preface in Part One: when it comes to government institutions, and especially those entrusted with providing for our national security, immense organizational flexibility and change will be required to help them become better able to effectively deal with increased complexity and be more responsive to changes in their environment. This will not be an easy task, for organizational change will require alterations in the very culture of these institutions.

Chapter 14: Telecommunications and Democracy *

by The Benton Foundation

New telecommunications technologies can extend—or impede—democracy's reach. They can make it easier for people to track legislation, express preferences, keep tabs on officeholders, and marshal support for causes. They hold out the promise of giving the disenfranchised a stake in the American political process—and drawing the disenchanted back from political cynicism. But for that to happen, the new telecommunications will have to be appealing and accessible. And policymakers will have to make democratic participation as important a goal of telecommunications policy as consumer convenience and economic growth.

Extending Democracy's Reach

The advanced telecommunications networks being built today could support increased civic participation—or they could encourage sound bites and demagoguery. They could support the electronic equivalent of public spaces, where people come together as informed citizens—or they could provide only electronic malls, where people are targeted as spectators and consumers. At stake here are the workings of democracy.

Traditionally, citizens gleaned political information from a variety of sources—newspapers, television, radio, neighbors—deliberated about issues and candidates with friends and family, and finally voted at the neighborhood polling station. Today, all this can be accomplished from one's home at a single sitting, providing enormous opportunities for the fulfillment or negation of democracy's promise.

Faster, cheaper, more diverse, and more interactive communications have shown great potential to increase citizen participation in the democratic process. Electronic mail allows constituents instant and direct communication with their online elected representatives. Scores of communities have created "civic networks"—local computer networks designed to promote civic participation by offering local information and communication at little or no cost. Many federal agencies, as well as a growing number of congressional offices, are online, offering government information and new mechanisms for registering citizen opinion to anyone connected to either the Internet or one of the many commercial computer networks.

People can tap into sources of information useful for informed participation in democratic processes—to see how a piece of proposed legislation is proceeding or how an officeholder has voted. They can communicate simultaneously with fellow constituents on matters of importance to the community. And they can see how advocacy groups elsewhere have effectively influenced local decision making. The new telecommunications technologies that make up the emerging National Information Infrastructure (NII) could thus do much to extend the reach of participatory democracy. They could:

- Deepen people's understanding of policy issues;

- Broaden participation in deliberations on political issues;
- Increase the accountability of officeholders;
- Enable more effective advocacy by individuals and groups;
- Register opinions by allowing electronic voting;
- Increase citizen interest in other community activities, thus tightening communal ties and increasing participation in community governance.

Some of this is already happening. Widespread use of video conferencing, 1-800 numbers, online candidate information, and other novel services in the 1994 congressional campaigns showed how telecommunications can change the conduct of electoral politics. Call-in shows, computer conferencing, and e-mail give voters new means of access to public officials, political candidates, and commentators. State and local versions of C-SPAN provide millions of cable households a daily window on state and local politics. As public access to these technologies expands, so, too, will their uses.

Experiments in Teledemocracy

Across the country, pioneers are integrating interactive technology with the political process. Their experiments can inform future advocates for democratic telecommunications policies.

Informing Citizens. By guaranteeing freedom of the press, the Bill of Rights assures citizen access to many varied information sources. But in today's complicated world, it is often difficult to locate useful information about candidates, government policy, or legislation. By linking thousands of databases, the National Information Infrastructure could provide access to the information necessary for citizens to make informed choices. These information resources help engage voters on substance rather than style and help get beyond 30-second advertisements, shorter and shorter sound bites, and horse-race campaign coverage.

In 1994, the Public Information Exchange, League of Women Voters Education Fund, and Project Vote Smart teamed up to inaugurate the Voter Online Information & Communication Exchange (VOICE) project. This first phase of an expected nationwide effort received more than 2,500 inquiries in 2 weeks from the 4 public libraries in which it was housed—Columbus, Ohio; Evanston, Illinois; Oakland, California; and St. Petersburg, Florida. Citizens could find candidate profiles for local, state, and national campaigns in addition to polling place information, voting information, candidate voting records, campaign contributions, and third-party ratings of candidates.

The California Voter Foundation, with computer space donated by Pacific Bell, established an Online Voter Guide for the 1994 election. Information on 32 statewide candidates and candidate job descriptions detailing the duties, salaries, and past and present officeholders was provided by the California Journal, the Center for Civic Literacy, and the candidates themselves. There were 14,000 logins over 5 weeks.

The Democracy Network, run by the Los Angeles-based Center for Governmental Studies, is a working prototype of an interactive video, textual, and audio campaign guide. The 1994 prototype contained video clips of gubernatorial candidates' speeches, policy positions, and campaign advertisements, all of which could be found by simply clicking on the appropriate icon—either on a computer monitor or on a television screen using a mouse or remote control.

Imagine if these offerings were available in every community—say, at libraries, polling stations, and other public places. Or if people could use them as easily as they get cash from automatic teller machines, as Linda Tarr-Whelan of the Center for Policy Alternatives postulates.

Broadening Deliberation. Perhaps the greatest promise of the National Information Infrastructure is its potential to restore "town hall" deliberations to American politics. As the political system becomes more professional, and personal schedules become more hectic and less flexible, citizens no longer have the opportunity to convene at a specific time in a specific place. But interactive telecommunications technologies allow citizens from all walks of life to discuss issues and politics relevant to their communities at their convenience.

For example, in 1994 the Minnesota e-Democracy project created an electronic meeting space where candidates could answer public questions and critique their opponents—and where citizens could find detailed political information on Minnesota politics, comment on the candidates, and discuss the democratic process. The project was Internet-based and was housed on the Twin Cities Free-Net. There were more than 40,000 information retrievals. While public reaction was overwhelmingly favorable, it is telling that some citizens complained that the candidates merely recycled campaign stump speeches during online debates, rather than thoroughly addressing issues. This reflects the candidates' unfamiliarity with the interactive medium and has surfaced in many electronic democracy projects.

In 1994, the National Telecommunications and Information Administration (NTIA) sponsored both an electronic conference and a traditional inquiry on universal telecommunications service. The inquiry followed the standard method of notifying interested parties through the Federal Register and elicited 98 formal responses. The Internet-based virtual conference, however, engaged more than 10,000 participants in the policy debate over universal service. NTIA designated 78 public access points around the country for use by those who could not get onto the Internet any other way. It plans to issue a draft of the conference proceedings and a report in 1995.

Increasing Government Accountability. Telecommunications restores the link between citizens and their government by enabling people to observe the workings of government from their living rooms, get reams of candidate and government information at a single sitting, and see tax dollars at work with streamlined electronic service provision.

The California Channel is a window on institutions many Californians have never seen before, such as the state Supreme Court. The Channel, which offers cable subscribers extensive coverage of the state legislature, has begun experimenting with two-way feeds to allow citizens far from the state capitol to participate at hearings in Sacramento. It feeds state Assembly and Senate sessions to 4.2 million homes. A state version of C-SPAN, it was launched in 1986 with $1 million in funding from foundations, cable companies, and the state Assembly. The programming emphasizes committee hearings, covers oral arguments in the state Supreme Court, and combines the Assembly and Senate in one channel. Having pioneered interactive hearings in which citizens can participate and testify by telephone and video, the channel gives citizens a new direct perspective on state government processes, unfiltered by the political press corps.

Other states, such as Washington and New York, have instituted programs to put the legislature on television. And hundreds of communities across the country have local government channels on their cable system that allow residents to observe city council meetings, school board debates, and other government activities.

If knowledge is power, Congress is attempting to shift the balance of power to the public. In January 1995, the Library of Congress introduced "Thomas." This Internet-based system provides the full texts of the Congressional Record and bills introduced since 1993. It also offers access to the House and Senate’s Gopher servers, which have directories for lawmakers and committees, committee hearing schedules, floor schedules, and visitor information. Future materials to be offered include the Congressional Research Service’s Bill Digest, a file containing summaries and chronologies of legislation.

Across the country, states and counties are experimenting with electronic service delivery. Thirty percent of the people in Tulare County, California, are on welfare, one of the highest percentages in the United States. To save money, reduce errors, lower the time spent by welfare intake workers, and empower individuals, the County installed the "Tulare Touch." This $3.2 million combination of main-frame computer, laser-disk storage, and touch-screen technology saved $20 million in its first year. Using intake worker’s suggestions, the Tulare system guides welfare applicants through the application procedure—saving time, money, and dignity for all involved.

Enabling Advocacy. People are disenchanted with politics because they lack a voice—except at the polls. And they are distracted from democratic processes by the many demands of daily life.

The new telecommunications technologies offer the prospect of being heard—and just as important, of listening and watching what Mitch Kapor of the Electronic Frontier Foundation calls "50,000 C-SPANs." Electronic networks can assist in three distinct stages of advocacy: providing a voice to the disempowered, organizing far-flung constituencies, and waging campaigns.

Online computer conferences do not reveal the participants’ race, gender, or socioeconomic background, providing a forum for people who might not be heard otherwise. For instance, homeless people (at kiosks in public libraries), other residents (dialing in), and public officials (directly connected), engaged in a computer conference on Santa Monica's Public Electronic Network (PEN). This online conference transcended geography, class, occupation, and appearance and might not have occurred if held in real time. Newspapers soon began to report on the conference, and homelessness became a hotly debated topic. Property owners met with the homeless in a face-to-face discussion. The homeless constituency reasserted its online statements that "showers, washers, and lockers" were basic necessities for a job search. The Santa Monica City Council responded by granting $150,000 for the "SHWASH LOCK" program— establishing these basic necessities in locations for use by the homeless.

Established in 1990, the 500-member Smoking Control Advocacy Resource Center Network (SCARCnet) is a private, nonprofit computer communications network with membership restricted to tobacco control advocates. Sponsored by the Advocacy Institute, SCARCnet provides daily smoking control updates and monthly action alerts. In addition, subscribers can send secure e-mail messages to other SCARCnet members, engage in online strategy discussions, and search tobacco control resources.

Communication with public officials, the goal of many advocacy campaigns, can be accomplished by direct e-mail campaigns. In 1994, the Clinton Administration proposed that telecommunications equipment manufacturers install computer chips into all their products that would allow the FBI, CIA, and the National Security Agency to eavesdrop on electronic communications. In response, Computer Professionals for Social Responsibility (CPSR) mounted an electronic petition drive and electronic mail campaign. More than 47,000 people "signed" the electronic petition, presented in a 280-page document to Vice President Gore. Eventually, the Clipper Chip proposal, as it was called, was dropped. CPSR is in the process of writing a "how to" paper on electronic petitioning.

While e-mail can empower, it is a double-edged sword. The ease of sending large volumes of e-mail can also be used to deluge electronic networks with unwanted information or solicitations. This junk e-mail can saturate e-mail accounts and cause important issues to be overlooked. For instance, in 1994 an immigration law firm named Canter & Siegel sent solicitations for business to millions of people on the Internet. Despite the overwhelmingly negative reaction of Internet users, little could be done to stop the solicitations.

Voting. An October 1994 survey in Macworld, a respected computer magazine for Macintosh users, indicated electronic voting to be the single service that consumers most wanted from the NII. Currently, the lack of appropriate software and the inadequacy of the information infrastructure combine to make electronic voting prohibitively expensive. But the components of the necessary software continue to be developed, and the information infrastructure continues to be upgraded. Ed Weems, President of the Election Technology Company, estimates that the technology for voting by television could be available in 2 to 3 years, but the political resistance to such a system may postpone implementation by up to 15 years.

Despite the promise of electronic voting, it is far from clear whether this technology will increase turnout. Current cumbersome registration and voting procedures, which could be carried over into electronic voting systems, suppress voter turnout. And social barriers, such as limited information and citizen cynicism, cannot be combated by switching to electronic voting.

Community Empowerment. Perhaps the best, yet least measurable, way to increase citizen participation in governance is to foster community connections. Civic networks—geographically defined computer networks with dial-up access and, frequently, Internet connectivity—provide discussion groups on community issues ranging from high school sports to recreation tips to local politics in addition to providing Internet e-mail services and database access. Government and nonprofit services are often listed as well. These 21st century town halls bring all the democratic potential—information, deliberation, accountability, and advocacy—of telecommunications technologies under one roof.

The National Public Telecomputing Network (NPTN) promotes the establishment of Free-Nets around the country. A Free-Net is a nonprofit civic network affiliated with NPTN, accessible for little or no charge to the public. Currently there are 45 Free-Nets online and 121 organizing committees. Cleveland's Free-Net is the largest, with 60,000 registered users and 100,000 logins a week. NPTN received a $450,000 grant from the National Telecommunications and Information Administration (NTIA) to extend the Free-Net model into rural areas.

In Iowa, the state underwrote the construction of a 3,000-mile fiber-optic network that provides service to 108 sites in all of Iowa's 99 counties. One classroom in every county is connected to the Iowa Communication Network, allowing students, teachers, and administrators to participate in statewide teleconferences. Future plans are to link 300 additional schools and 100 libraries to the network, bringing Iowans closer together.

In Maryland, the state library system and state government have assumed the civic networking initiative. Maryland's "Sailor Network" provides free Internet connections to all Maryland residents through the public library or the 192 dial-up lines reserved for such use. For personal e-mail accounts, the state charges a modest fee of just under $3 a month. The library system is able to offer this service through funds from the Department of Education's Office of Educational Research and Improvement under the Library Services and Construction Act. With these funds expected to expire by September 1995, the library system plans on asking the Maryland legislature for close to $1 million for fiscal 1996.

Lessons

The infrastructure and applications that foster community connection and democratic participation are advancing by leaps and bounds. But users are still experimenting with social protocols and electronic etiquette taken for granted in face-to-face discussion. Some lessons:

Ensure Broad-Based Access. Even today, as many as 10 percent of the people in the United States have no telephone service, and 35 percent have no cable television. And, according to a 1994 Census Bureau survey, only about 11 percent of U.S. households have a personal computer with a modem. It is imperative that people who do not have access today be included in the construction of a civic network from the beginning. Civic networks should encourage the provision of access points where they have the chance of engendering the greatest good. In addition to public offices and shopping malls, civic network access points should be placed in respected community locations like churches, the Salvation Army, boys' and girls' clubs, community youth centers, unemployment offices, and homeless shelters.

Foster Democracy, not Demagoguery. Benjamin Barber, a Rutgers University political scientist, urges a distinction between real and spurious electronic democracy, noting that "the new demagoguery is much more dangerous because it passes as more democratic." And Ted Becker, a political science professor at Auburn University, points out that the call-in shows and computer conferences staged by politicians might be packaged as electronic town meetings, but really offer only limited, highly structured options for input—candidate propaganda that can take advantage of voters' interest in interactive communications.

Encourage Constructive Interaction. A formal structure helps ensure that the new connections between government and citizens are constructive. For example, Santa Monica's PEN designer, Ken Phillips, concludes that opening the network to the general public without guidance can be counterproductive. Community leaders should help structure the network's tone and demeanor, and system developers should include moderators in future networks.

Develop Partnerships. Groups committed to civic uses of technology have a relatively small voice compared to the large service providers—the Baby Bells, TCIs, and Time-Warners. By developing partnerships and common agendas, public interest groups can secure some public space for alternative voices. Nonprofits should develop a "toolbox" for policymakers that includes model laws and model contracts between public agencies and nonprofits.

Involve the Business Community, but Don't Rely on It. Phillips believes the business community should be brought into community networks early. PEN excluded business from its development due to "paranoia about the system being commercialized." According to Phillips, not only does the business community deserve to be involved because of its integral role in communal life, but its participation will bring individual users to the system as well. But Tracy Westen, President of the Center for Governmental Studies and founder of the California Channel, warns of the lack of public-mindedness that can come from corporate control of programming.

Establish Sustained Funding. As Mario Morino argues in his "Assessment and Evolution of Community Networking," community networks must establish a funding base from fee-based services and sustained funding sources, most often locally based. Government and other grant money can be used to supplement this base, but a sustained funding model must not be dependent on grants. Community networks could find support in basic subscription charges, service charges, organizational and business fees, local subsidies linked to jurisdictional taxes or levies, and funders that commit to long-term funding.

Spread Information on What Works. Today's experiments with electronic democracy show the possibilities for positive outcomes. But even the most successful projects continue to struggle for support and can become idiosyncratic given their focus on particular communities. And fledgling experiments in democracy continue to reinvent the wheel because there is no central resource available. A clearinghouse of information on electronic democracy initiatives, including information and analysis of outcomes, would improve everyone's understanding of what works best.

What's Needed Now—Appeal and Access

The grassroots support for teledemocracy is there. According to a recent Benton Foundation poll, 76 percent of Americans believe companies that profit from the new telecommunications technologies should be required to dedicate part of their resources to community uses and community access to government information. Other recent national surveys—Macworld, October 1994, and Harris, October 1994—show that people want community information and educational resources, not more entertainment. These findings suggest strong support for a government mandate ensuring that the new media encourage noncommercial public uses.

But technical choices being made today can hold open—or foreclose—policy options tomorrow. That is why it's important to identify the public policy priorities for the design of communications systems and the rules for its use. Will the NII be built with distributed, interactive switching —allowing citizens to send as well as receive messages and programming? Should policy-makers establish hardware and software standards for the construction of the NII, providing certainty and security to industry but risking obsolescence and inefficiency? Should citizens be allowed to send encoded messages that cannot be cracked by law enforcement agencies, or should industry be required to install mechanisms that facilitate eavesdropping in the interest of public safety? These questions will affect the prevalence, security, and use of the information infrastructure for community and democratic purposes—questions being asked and answered today, effectively hardwiring tomorrow's services.

Appeal for the Technophobes. For some, the biggest barriers to electronic participation are not cost or access, but technological unfamiliarity. Although confusing interfaces, mismatched hardware and software, disorganized databases, and expensive training programs are daunting, there is progress on the user-friendliness front.

To provide training in the earliest stages of community and organizational networking, NCexChange—a statewide project to meet the electronic communications network needs of North Carolina nonprofit organizations—was awarded a grant from NTIA to develop a "new class of information professional, the community information broker." These brokers will be in multi-issue community-based organizations around the state, like the North Carolina Division of Community Assistance. They will also be in community development corporations, community action agencies, and libraries. Such brokers — trained librarians, AmeriCorps participants, computer enthusiasts, and others—will provide community networking assistance to organizations in designated North Carolina Empowerment Zones and Enterprise Communities.

A complementary training strategy is fostered by Playing to Win, a network of community computing centers in the New York, Boston, and Washington, D.C. areas, that began as a single community computing center in Harlem in 1983. Since then, the network has expanded to include 35 centers, with services including training for word processing and graphic design software. The network provides hardware and software resources, grant-writing assistance, and an association to bring community computing centers together.

Anyone who has tried to "surf the net" realizes that navigating through a universe of information with complicated UNIX commands is like trying to find India by heading west from Spain. One may discover valuable information, but it is often not what was wanted. The National Center for Supercomputing Applications at the University of Illinois at Urbana-Champaign has built a better sextant. Its Mosaic program allows seamless information retrieval from remote databases around the world. By incorporating a graphic interface and "point-and-click" technology, Mosaic foreshadows a generation of Internet-searching applications for people other than computer scientists.

Access for the Disenfranchised. With all-time-low voter turnouts and rising cynicism about elected officials and the democratic process, why should people suddenly get excited about the new opportunities for participatory democracy? In a word: voice. It is true, as Ralph Nader is quick to point out, that the promises of technological innovation for making democracy work have for the most part been unfulfilled—the great educational revolution predicted by boosters of broadcast television and, a generation later, the equally revolutionary paradigm shift in education promised by cable's proponents. But Nader acknowledges the potential value of the NII in encouraging diversity and free access to all government databases by all people. And unlike broadcast and cable television, interactivity is a fundamental component of an effective NII.

New technologies can reinvigorate the political process, but if they remain expensive and complicated, they could widen the economic, social, geographic, and ethnic gulf between the represented and the underrepresented. The real costs associated with buying computers, modems, and software, installing high-capacity phone lines, maintaining online service accounts, and learning about the equipment prohibit the use of the information infrastructure for many people. But even though a computer in every home and a modem on every desk is not currently feasible, the combination of home computers and community computing centers can help ensure that the benefits of the NII go to all. There are some public policy and nonprofit solutions. For instance, lifeline funds—subsidized telephone hook-ups for low-income users—benefit individuals, while community computing centers provide a community location for technology training.

In Texas, the legislature approved a 25-percent discount on all telephony used for distance learning more than 50 percent of the time, helping schools to meet the telecommunications needs of their students and their communities. In Ohio, after months of litigation and negotiations, Ameritech, the leading provider of local telephone service in the Midwest, agreed to fund 14 community media centers in low-income neighborhoods, provide an $8 a month reduction in basic service charges to recipients of public assistance programs, and allow public assistance recipients to establish new phone service without a deposit or a service connection fee.

Even as individuals risk being left behind by the multiple costs of NII access, noncommercial information providers—advocacy groups, schools, artists, and others—risk being marginalized by corporate America's perception that the NII will support only entertainment and consumer services. Some policymakers have begun to explore ways for noncommercial services to be supported by the NII. But with the current mood against public broadcasting in Congress, noncommercial information providers are not hopeful that federal help will be forthcoming.

Supporting Equitable Access in the New Environment. With competition rapidly replacing monopoly power in the telecommunications industry, a new debate about how to define and ensure universal service has begun. Regional telephone companies, in particular, are chafing under their traditional responsibilities as common carriers, and demanding that their competitors be required to help foot the bill for providing basic telecommunications service to all. This debate will unfold in Congress, the Federal Communications Commission, and state legislatures and regulatory commissions. Nonprofit groups need to be involved on all fronts.

In 1994, Senator Daniel Inouye, Chairman of the Senate Communications Subcommittee, introduced legislation that would have created a "public telecommunications infrastructure fund" to support access to advanced networks by nonprofit organizations, local governments, schools, and libraries. The bill also would have reserved 20 percent of advanced telecommunications networks for noncommercial uses. A much narrower approach emerged in the Senate in 1995. It focused on keeping access costs low for libraries, K-12 schools, and rural health care clinics.

Another proposal calls for a new universal service fund from a tax on the gross revenue of all telecommunications firms, including information service providers, cable firms, and telephone companies. This would support subsidies for lifeline access, emergency services, and telecommunications devices for the deaf, as well as public access and civic networking. This notion is being tested in Wisconsin, where telecommunications service providers contribute a small percentage of their gross revenue to a universal service foundation.

To adapt to constantly evolving technologies, universal service should be defined by service and access benchmarks rather than technology-specific standards. The 1986 Vermont Telecommunications Agreement was obsolete as soon as it was signed because it was tied to specific technologies, according to Barbara Grimes, Vermont's Housing and Community Affairs commissioner and a former legislator. When the legislature drafted a new telecommunications statute, she refocused the debate onto what services and levels of service Vermont citizens should have access to and at what cost. Grimes complains, "My constituents demand sophisticated information services throughout Vermont, and it's my job to bring those to them. However, I don't want to have another head-end, fiber-optic, copper, ISDN conversation ever again in my life. I find it incredibly boring, incredibly confusing, and that's not my job."

Franchise agreements for the provision of electronic services are a good tool to promote democratic applications of technology. As new technologies emerge and companies look for new markets, states and cities can rewrite communications services franchise agreements to guarantee that some capacity is set aside for public service uses.

Electronic Democracy at the Millennium

What's the private sector doing? The spread of cellular and mobile data communications, the rise of videoconferencing and worldwide electronic networking, the convergence of computers, broadcast and cable television, and telephony and its various components—all are driven largely by business and entertainment. And the priorities of the largest users and information-services providers could dominate efforts to reformulate telecommunications policy.

Potential rivals and partners, the telephone and television companies are scrambling to stake out the commercial turf of the NII. For instance, TCI, AT&T, and US West conducted a test in Colorado last year to compare the buy rate and costs of video-on-demand and near-video-on-demand, using a new viewer-controlled television remote control. The project provided only home entertainment services.

In addition to numerous opinion polls suggesting consumer indifference to interactive entertainment and retail services, early results of these projects again suggest lackluster enthusiasm for video-on-demand and home shopping. For instance, in TCI's video-on-demand experiment in the Denver area, customers ordered just one movie per household every two weeks. It seems that consumers are much more willing to pay for true interactive services—services through which they can find, comment on, and produce information.

Ending in 1993, AT&T provided information services, video games, and home shopping over interactive television to 30 homes of AT&T employees in the Chicago area. AT&T concluded that there is no single irresistible consumer service. Instead, there are four characteristics in a successful interactive system: entertainment, transaction, communication, and information. For example, consumers will be more likely to support interactive television if, during the showing of a basketball game, they can buy tickets to upcoming games, send replays of spectacular dunks to friends, and check the won-lost record of the opposing team. It seems that there is a direct relationship between the level of interactivity and consumer interest.

What's Government Doing? The National Information Infrastructure initiative made telecommunications a Presidential priority. The Administration is committed to wiring every clinic, library, and classroom to the NII before the end of the century.

Congress once again is working on legislation to allow head-to-head competition between the regional Bell telephone companies, long distance carriers, and cable television systems. But Washington DC is simply trying to catch up to state governments and the courts. A growing number of states already allow some sort of local telephone service competition. And several courts have ruled that the regional Bell companies can provide video services in direct competition with cable companies. Deregulation advocates contend that competition will bring lower rates, accelerate infrastructure construction, and foster increased use of the NII.

In September 1993, the White House formed the Information Infrastructure Task Force (IITF) to articulate and implement the Administration's vision for the NII. The four committees —Information Policy, Telecommunications Policy, Applications and Technology, and NII Security Issues—oversee the numerous public policy issues raised by the construction of the NII.

FedWorld, an initiative of the Commerce Department's National Technical Information Service, dramatically expanded the federal government information available online. Also, the White House and almost every Cabinet-level government agency has services accessible via Gopher and the World Wide Web on the Internet. The federal government has also begun to reverse a trend to sell government information to commercial information providers for resale. For example, a 1994 Office of Management and Budget directive required federal agencies to price information products at the cost of dissemination and to avoid practices that would restrict public access.

The NTIA awarded $24 million in fiscal year 1994 for nonprofits and state and local governments to devise telecommunications plans and to demonstrate applications in health, education, community service, and other uses of public interest. More than 1,000 applications totaling more than $500 million came in from all 50 states and the District of Columbia—signaling extraordinary demand for use of the NII. Of the 92 projects the NTIA funded, the greatest number (27) went to community information efforts, which garnered $7.4 million of the total funds. Before the 1994 elections, Congress budgeted another $64 million to support local planning and public-interest applications for fiscal year 1995. NTIA received more than 4,000 letters of intent for the second round of funding in 1995. But the new Republican majority, which has been moving to trim federal spending, is expected to decide on a lower figure for 1995.

What are Nonprofits Doing? While the private sector focuses on home shopping and 500 channels of television, and the government grapples with the issues of local telecommunications service deregulation, the nonprofit sector is beginning to articulate the need for universal service and noncommercial information services.

In March 1994, at the request of the Clinton Administration, the Benton Foundation convened the Public Interest Summit. Seven hundred representatives of nonprofit groups and foundations discussed telecommunications and universal access, public service delivery, economic development, community development, and democracy. This meeting demonstrated that all non-profit groups, from the Sierra Club to the Association of Junior

Leagues, will be affected by the NII and must pay attention to the issues surrounding its construction.

At the local level, hundreds of nonprofits have initiated projects that fulfill democratic principles with funding from the Corporation for Public Broadcasting and NTIA. For instance, the Center for Neighborhood Technology in Chicago is investing nearly $1 million into a project to integrate recently released data on local home mortgages into a multivariate database depicting the health of individual Chicago neighborhoods. This project combats one of the most vexing difficulties of the NII—information overload. The Center will identify, organize, and integrate neighborhood data in a single user-friendly database, to be made available to the public and to nonprofits.

Another strategy may be for nonprofit groups to become more aggressive participants in the telecommunications marketplace. New York Law School Professor Allen Hammond says nonprofit groups and small businesses should form consortia to buy advanced telecommunications services. By pooling their purchasing power, they stand a better chance of obtaining the most advanced links to the information superhighway. "It's not enough to say it's right, it's good, and we should do it," says Hammond. "You need allies."

Nonprofit groups also must recognize that they play an important role as information providers. "In an information society, nonprofits produce what everybody wants," argues Robert Loeb, President of the Telecommunications Cooperative Network. He urges nonprofits to become more aggressive about producing and marketing information in order to demonstrate that noncommercial uses of the information infrastructure are economically viable.

Conclusion

Despite some progress in community-building and information access, democracy advocates must remain vigilant. Oregon Connects, that state's telecommunications strategy report, was dead once its legislative champion was voted out of office. And Maria Teresa Rojas, general manager of New York City's municipal cable TV network, Crosswalks, says that the city's Commission on Public Information and Communication expired due to lack of community or political support, despite being mandated in the 1989 revised City Charter.

One reason for limited political support is that new technologies may deepen democracy but also threaten the culture of incumbency. "Ultimately, we have serious political problems in how to structure new media in the best interest of participatory democracy," asserts Auburn's Becker.

Despite political foot-dragging, though, electronic democracy is here to stay. With 32 million people already on the Internet and a growth rate of 10 percent a month (according to the Internet Society), politicians are figuring out ways to make electronic contact with citizens online. But will citizens be able to connect with one another?

It is not by chance that communication and community come from the same Latin root. Any system that enhances or denies our ability to learn from and talk to one another necessarily affects our social fabric. But strong public support is necessary to educate politicians about the societal impact of the NII, not just its impact on specific industries. If the information infrastructure is to support our nation's democratic principles, a broad-based constituency must be educated and galvanized to tell the news media, public officials, and the telecommunications industry that the NII is about communication, not just consumption.

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Chapter 15: Freedom and Censorship in the Emerging Electronic Environment *

by Martin Fogelman

"Congress shall make no law abridging the freedom of speech." "No law" comes to be "almost no law," especially for explicit material sent electronically. Technologies are value-neutral, yet can policy values truly be technology-neutral? Today's jumble of regulation is increasingly hard to maintain as voice, image, data, and text coalesce into one massive "telematic" network, and as hybrid technologies like virtual reality blur the line dividing speech from action. Though a truly nondiscriminatory First Amendment policy may be unattainable, the challenges of today's (and tomorrow's) computer telecommunications environment demand a more proactive and consistent approach to the first freedom. How might—and how should—this right be applied in the era of the information superhighway?

Notable opinions on the First Amendment's future range from mild optimism to deep despair. Ithiel de Sola Pool claims the loss of liberty is not foreordained, while former British Film Institute director Anthony Smith observes that freedom of expression is now less than it was at the turn of the century.[1] James Martin, the techno-prophet who foresaw desktop publishing, electronic surveillance, and end-user computing, is uncharacteristically pessimistic: If Orwell had known about computers, he claims, his vision in 1984 might well have been worse![2] Journalist Haynes Johnson fears that the sparkle and glow of electronic escape will make real life seem drab and prosaic.[3]

Of the current challenge, Representative George Brown observes that the United States is developing policies for a completely new kind of society, as if Jefferson and his turn-of-the-century Congress were to guide the country from the Agricultural Age through the industrial era.[4] Is the United States producing a crop of founding mothers and fathers as enlightened as the leaders of the colonial period?

A brief review of how separate media are censored includes a discussion of First Amendment challenges of the current information era. The focus then moves to virtual reality, perhaps the most constitutionally challenging offspring of the marriage between computers and telecommunications. A final section outlines several technological, legal, and political aspects of the future of the first freedom.

Separation Doctrine

Three Models of Regulation. No modern technology has achieved the full freedom constitutional stature of the soapbox or the printing press; indeed, every breakthrough from the telegraph to fiber-optic video ignites a trench war between freedom fundamentalists and those seeking to regulate content "for the benefit of society." All three branches of government take part in this balancing act, with the courts often in the featured role.

Ithiel de Sola Pool’s extraordinary work on media and liberty, Technologies of Freedom, is an historical analysis of three communications policy structures: the sacrosanct, full-freedom "print model"; the "common carrier model," which supports natural monopolies while prohibiting content discrimination; and the restrictive licensing or "broadcast model" that permits private owners to act as regulated publishers of programming that is itself subject to government censorship.5

Some written content is not protected because it is seen to increase the incidence of sex crimes and offend those exposed to it against their wishes. By exciting the sexual fantasies of adults, it crosses the critical line between pornographic words and illegal action.6 Constitutional scholar Thomas Emerson points out, though, that the release from the use of erotic material may actually reduce the occurrence of illegal acts.7 Moderating this "permanent tension" between the constitution and the public interest has led to what law professor Harry Kalven terms a "proliferation of judicial views on obscenity."8 The current test is the Supreme Court’s 1967 Miller v. Califomia Court decision, which sets forth three rules for judging a work: whether (1) taken as a whole, it sexually arouses the average person, (2) it depicts sexual conduct in a patently offensive way, and (3) taken as a whole, it lacks serious literary, artistic, political, or scientific value.9

Though this decision has remained the accepted speech and print regulation standard for decades, Miller’s inconsistencies make successful prosecutions extremely rare. Justice Douglas derided any case based on either "patent offensiveness" or "community standards," observing that "every idea is capable of being obscene if the personality perceiving it so apprehends it....Definitions of obscenity," he pointed out, "...are as unique to the individual as his dreams."10 Moreover, evaluating a creation as "serious," "frivolous," or somewhere in between is a highly personal and idiosyncratic mental process. Even those who accept the legal concept of obscenity stumble on this shaky constitutional footing. An exasperated Justice Stewart said in essence of "hard-core" pornography, "I can’t tell you what it is, but I know it when I see it.." The test’s normative guidelines have been expanded in various "communities" to find material obscene for its actual or intended effect on a particular (sometimes manifestly "unaverage") audience, like sadomasochists, or for the "pandering" way in which it is marketed to the unsuspecting public.11

Telegraphy and telephony eventually became common carriers with an obligation, like postal or rail service, to offer equal rates in exchange for comparable service. With rare exceptions, notably refusals to carry 976 dial-a-porn audiotex, telcos have honored this commitment regarding explicit language. The restrictive broadcast model, however, bases the granting of transmission licenses on whether they serve the "public convenience, interest and necessity." The criminal code and the 1927 Radio Act enabled the government to control content by censoring material that is either "obscene" or "indecent," two terms that were used interchangeably for decades.12

Some background on how the separation doctrine has been applied to newer media is helpful in gauging how control of explicit content may affect merging computer/telecommunication technologies. Two relevant cases are the decoupling of "indecency" from "obscenity" in broadcast radio, and the on-again/off-again/on-again regulation of cable TV.

A guiding principle of First Amendment jurisprudence is that the limits of freedom of expression be suited to the special features and characteristics of each particular medium. The loudness of a sound truck, for example, is subject to control for its "high-volume" potential to confront citizens in their homes. Consequently many authorities assert that the "uniquely pervasive presence" of over-the-air broadcasting permits government to protect the rights of those who traverse the dial with no warnings of what they might encounter.13 Two other rationales accompany this "accessibility" criterion for broadcast regulation: "spectrum scarcity," rarely applied in obscenity cases; and "improper influence," the principle that broadcast technologies gain more direct and visceral access to the consciousness—particularly of children— demanding little of the deliberate intellectual participation of, say, going out to purchase and subsequently decode (read) printed matter.14

Indecency in the Air. In the landmark 1975 case against the FCC, the Pacifica Foundation sought to overturn an "indecent programming" sanction for a daytime airing of George Carlin's satire, "Seven Dirty Words You Can't Say on TV." After a Court of Appeals ruled that the nonarousing monologue could not be obscene, a High Court reversal found the "Filthy Words" performance was, in fact, "indecent." This term has since been applied to the use of sexual or excretory expletives, not just occasionally but repeatedly, and with the intention to shock a substantial segment of the public. The court reasoned that patently offensive material on the air "confronts the citizen, not only in public, but also in the privacy of the home, where the individual's right to be left alone clearly outweighs the First Amendment rights of an intruder."

Both time of day and community standards were referred to in the High Court's reversal, especially in regard to broadcasting's ability to enlarge the vocabulary of children (improper influence) and its impact on the unsuspecting and often unwilling public (accessibility). Dissenters criticized the majority's "fragile sensibilities" and their intolerance of diversity, yet the commission's indecency sanctions survive into today's "shock jock" era.15

Cable Regulation: A Continuing Saga. The "special features and characteristics" presumption notwithstanding, "the first treatment of an emerging medium is always based, at least in part, on the treatment traditionally applied to old technologies."16 Pool notes that the carrying over of unnecessary limits is rooted in frozen perceptions.17 Proactive interference, the hind-ering effect old habits exert on subsequent learning, is compounded by legislatures' tendency to reason by analogy and by the significance of precedent in Anglo-American jurisprudence. The volatility of cable television policy reflects the carrier's changing relationship with the more mature broadcast television industry.18 Communications scholar Patrick Parsons and others trace this progression through three distinct stages. Initially a means of improving TV reception, cable saw no regulation beyond that exerted on the core medium. Once increased spectrum (less scarcity) enabled it to originate its own programming, including adult humor and explicit images, the courts accepted a First Amendment shield. (The FCC still persisted for some time in trying to regulate it based on threats to privacy, the accessibility doctrine, and its perceived ancillarity to television—though by then it was more of a competitor.) In the third stage, each subscriber's ability to monitor program guides, decline overall service or specific shows, and technically prevent children from viewing certain channels was assumed.[19] This independence was inherently unstable, as cable became caught between the organizational and regulatory models of newspapers and telephones.[20] Operators' problematic pairing of a natural delivery system monopoly and absolute programming control gave rise to reregulation. Those pressing for continued "freedom," though, are mainly potential competitors and frustrated rate payers, hardly more protective than regulators of the right to offer and view explicit programming.

The magnitude of the coming content battle will transcend past and present policy skirmishes. Major new breakthroughs in electronic interaction materialize before Congress can collect testimony on the last generation's issues, let alone measure and respond to their effects. Neither judges, regulators, nor legislators can stay abreast of each scientific development and its social consequences, so new technologies will continue to be treated with obsolete judicial logic and regulatory equivocation.

Bulletin Boards: Today's First Amendment Battlefield. An especially relevant test case for this media policy web has existed for years in the world of computer bulletin board systems (BBS). While the medium's textual presence is less vivid than the images of cable, sexually oriented content generates considerable revenue for many on-line services. What BBS operators hope to establish is a division of services into open "public" areas and restricted sectors where traffic is limited to "private" messages. The precedent to date, paralleling the print model, suggests that operators may be held liable for content only in the public areas. Private messages may be confidential and not subject to censorship, as they are in a telephone system. The analogy is weakened by the fact that newspapers and telephones are two different things, while the line between "print" and "common carrier" functions of a bulletin board system is dynamic even within a single session. Users may "meet" in a public room, adjourn anonymously to private rooms for intimate conversations, and continue at will to alternate between the two "places." Court cases yet to be filed and future telecom research will help flesh out answers to two important questions: (1) Will this bifurcated regulatory model be judged viable for bulletin boards, and (2) Can it be generalized successfully to newer multisensory telecommunications environments?

Actions Speak Louder: The Peril and Promise of Virtual Reality

While today's vision of a multimedia thoroughfare strains this piecemeal approach to censorship, tomorrow's virtual reality (VR) technology could literally eliminate the legal distinction between protected telecommunication and criminal action. Scientists and leading-edge entrepreneurs are developing interactive technologies to immerse users in a totally convincing illusion, seeking to assemble a "real" and sharable environment within a cybernetic "teleplace," the synthetic equivalent of a fully "inhabitable" alternate world.

Some research and arcade VR implementations already enable the user/participant, masked (or wrapped) in sensory effectors, to walk through unconstructed buildings, feel the pull of molecular gravity, or engage in a high-tech shoot-out with a computer or a human opponent. VR peripherals are limited at this point to primitive step platforms, datagloves, and bulky head-mounted audio/video displays (HMDs), yet tactile effectors are already being tested. Such systems, which transcend current definitions of simulation, would become a convenient substitute for reality. Due to today's computing capacity and spectrum limits, these services will not be available right away over large networks. "Teledildonics," the "remote intimacy" dimension of the fledgling VR concept, is only a whimsical neologism, the brainchild of inventor and electronics visionary Theodor Nelson. Still, its ethical, legal, and policy ramifications should be modeled and investigated before they personally —even physically—touch our lives.

Newer and hotter controversies will supersede those surrounding "filthy" words and images, and alter forever the legal and social landscape. Truly persuasive, full-sensory depictions could give rise to a new epoch of high-technology crime and alienation. Now able only to violate system security by trashing files or spreading obscure viruses, network pirates could someday employ recorded or counterfeit bit streams to commit heinous acts of breaking and entering: virtual sexual harassment, cyberotic fraud, or even "remote statutory rape." With enough bandwidth, 1-900-TALKSEX might become 1-900-HAVESEX. Should such network sex for hire be punishable as a case of felony prostitution or heralded as a breakthrough in shop-at-home convenience— intimate human relations at their safest? Craig Brod's quotation from a six-year-old computer user gives cause for concern: "Sometimes I feel lonely, but I'd rather be with the computer than with my friends."21 Would this twenty-first century man ever go "home" from his personal cyberspace? Would he ever bother to distinguish real affection from "technosex"?

Many dismiss the idea of alternative virtual worlds as a macabre nightmare, as melodramatic as Stephen King's The Lawnmower Man or as outlandish as the "consensual hallucination" of Neuromancer, William Gibson's postindustrial depiction of a world of simulated sensation. Can such a notion be "real"? Is the computer-telecommunications industry crass enough, critics wonder, to market such an "unnatural" product? Are consumers carnal and vacuous enough to subscribe to it?

Such questions sound hypothetical—in the 1990s. The technology, though, is hardly farfetched. Nor are such Brave New World applications ridiculous—though they may be decades away. On the supply side, engineer Danilo De Rossi has closely modeled human skin, imbuing tactile effectors with warm and personal softness.22 Olfactory telecommunications may one day complete the illusion. A real-world laboratory to gauge demand for shared fantasy tools is the network version of Leisure Suit Larry, an "adult" computer game where remote users engage in telesex through cartoon surrogates. The initial "G-rated" release displays only the partner's face while allowing each user to control his or her own expressions. Despite this limitation, the game's producer can see real spouses getting jealous, and he guesses, "It is going to cause more than one divorce."23 Could some distant virtual partner be named as correspondent? Might the company itself end up in court? Or will a truly content-blind common carrier standard transcend the spoken or written word to encompass any telecommunication sensory data?

These questions are speculative, but some real instances will appear in the media — where permitted—in the coming months and years.

Will You Still Read Me Tomorrow? Aspects of Freedom in the Information Millennium

The Full Spectrum of Freedom. What should be the operational significance of this first freedom, as existing media merge with computing breakthroughs? The gifts of any invention —matches, the printing press—do not come free. Each has its price, in innocence if nothing else, and none will effectively police itself. "Self-regulation in the public interest" is a standard euphemism for the threat of censorship, variously exerted on the film, rock music, and now video game industries.24 Can the society preserve yesterday's libertarian values among tomorrow's seductive interfaces to such a spectrum of temptations?

The First Amendment and its proscriptions against almost all prior restraint set freedom of expression in the United States apart from what exists in other democracies. The constitutional imperative is to minimize regulation and apply the print model wherever possible to recent and newly blended media. Freedom should not be abridged unnecessarily through the content and structure controls that have saddled broadcast since the 1920s. Electronic content regulation, which trickled in through a narrow mandate to ensure signal integrity, can dampen—even saturate—the cultural fabric. To be truly effective at guaranteeing personal freedom, any approach to censorship of "telecomputed" information must address its technological, legal, and social aspects.

The Technological Dimension. Can technology solve the problems its progress helps create? To some extent, yes. Simply stated, no government or other outside authority should determine what adults may receive. Parents, though, do have a right to censor their minor children's reading, viewing, and listening. Pool points to electronic technology's "pliancy and profusion" as positive factors in the protection of freedom of speech, and there are obvious successes.25 Cable lock-outs have worked, as should applying various encryption principles to keep explicit material from the young or unwitting. Our ability to "grow more spectrum" supports freedom of communication.26 So may the coming commercialization of signal delivery alternatives like direct broadcast satellite (DBS), fiber optics, and multichannel multipoint distribution services (MMDS).

Still other solutions less restrictive than censorship will become technologically feasible. Segregating explicit imagery into the late evening hours is comparable to radio's de facto policy on indecent language. While this is hardly a comprehensive solution, it is an incremental advance over today's confused and oppressive patchwork of telecommunication censorship policies. Indecent or sexually explicit material might better be "zoned" to certain portions of the spectrum and decoders made available only to adults. This would enable parents to prevent their children from viewing erotic material, at least to the extent they can secure other pornography from curious young eyes. Such a limitation is completely analogous, claim several experts, to segregating "adult" books into separate bookstores or separate sections of bookstores. It also has a larger parallel in municipal zoning codes that limit some manifestations of the sex industry to specific geographic areas, like Boston's "Combat Zone" and New York City's Times Square.

The accessibility issue, already unconvincing for adults, could become completely irrelevant in the future. Carrying a recent computer network software advance a step further may open up a compromise between the freedom to transmit and the right to privacy. The "Knowbot" is a product from the Corporation for National Research Initiatives (CNRI). Given a theme by its user, a "knowledge robot" can search various networks and databases for relevant information, irrespective of the language or form in which it is stored. Why not enhance this development to produce a "Know-Not," a software genie coded instead to filter out incoming communications —words, images, and other signals—in contexts and combinations the user might construe as offensive? Enabling all recipients to prevent unwanted sensory data from raining on their virtual picnic could launch a whole industry for "do-it-yourself censorship." It would expand the concept of freedom of expression, giving rise to complete sensory and intellectual self-determination—universally acceptable content control.

Unfortunately, government tends to ignore the existence of workable technological solutions, contriving instead to protect children through dated precedents and heavy-handed legislation that prevent consenting and law-abiding adults from viewing otherwise legal matter. Policies struggling to keep up with today's telematic environment will prove wholly inadequate in a future where current media coalesce into a single and engrossing multisensory panorama. Each household could become a local originator of audio, text, and video over an integrated, switched, and networked marketplace of ideas. As the FCC conceded in a decision that repudiated the scarcity rationale, "The function of the electronic press in a free society is identical to that of the printed word."27 This is just as true for entertainment content across the various media, whose functional similarities also outweigh any physical differences.

Contrary to the persuasiveness finding in the "Filthy Words" case, the broadcast and on-line media consumer is not an unknowing captive randomly bombarded by sounds and pictures. Rather, he or she is a willing recipient of information. If unpalatability and shock value were just cause to censor content, many news stories—including some notable legislatlve and court hearings—would also be kept off the air. Given the wide array of content the modern communications environment can support, and in light of the United States' traditional utilitarian ideology, the government should afford all citizens the right to choose what they will view—or produce!

The Legal Dimension: Reconciling the Separation. The Supreme Court should rededicate itself to preserving the core values of the First Amendment and stop subjecting each new technology to a different standard of protection. Jonathan Emord and other experts see embracing a universal print standard in the next century as the only way to keep needless regulatory restraints from compromising liberty. A "full freedom" approach should recognize the fact that the general public is not a passive and undifferentiated mass; rather, it comprises an active segment of a bustling and diverse electronic information marketplace for voice, image, text, and eventually tactile content. Suppressing something as "offensive" not only allows an imperfect government to deprive communicators of their rights but prevents recipients from exercising their democratic freedom to decide what they will or will not find "of value" from among the full array of possibilities.

The Political Dimension. The natural lobby for free speech is small and shows no signs of growth. The strength and character of the newspaper and magazine industries, long champions of this liberty, continue to fall victim to liquidations, mergers, and acquisitions. So long as they can profit substantially under the current arrangement, broadcasters will "lack diligence in pressing for full First Amendment rights."28 Still, the right to send even the most unpopular and unsavory communications should not be suppressed—over any medium—so long as less constricting alternatives are available. Protection of freedom of expression for all Americans cannot safely be left to industry leaders, politicians, and the courts. The vigilance and activism of general citizen groups, and of telecommunications and information industry professionals in particular, are essential to the preservation of First Amendment rights in the next century. As John Berry writes, "Freedom is expensive, dangerous, unpredictable, and sometimes ugly and offensive. At such a high price, no wonder it is so sweet."29

Notes

1. Ithiel de Sola Pool, Technologies of Freedom (Cambridge, MA: Harvard University Press, 1983) p. 251; and Anthony Smith, "The Public Interest and Telecommunications," in Paula R. Newberry (ed.), New Directions in Telecommunications Policy, Volume 1: Regulatory Policy: Telephony and Mass Media (Durham, NC: Duke University Press, 1989), p. 358.

2. James Martin, Telematic Society: A Challenge for Tomorrow (Englewood Cliffs, NJ: Prentice Hall, 1981), p. 193.

3. Haynes Johnson, "Social and Human Factors," in R.L. Chartrand (ed.), Critical Issues in the Information Age (Metuchen, NJ: The Scarecrow Press, 1991), pp. 106-109.

4. George E. Brown, Jr., "Implications for the Role of Government in Information Age Policy," in Chartrand, p. 23.

5. Pool, pp. 81-90.

6. K. Greenawalt, Speech, Crime, and the Uses of Language (New York, NY: Oxford University Press, 1989), p.149.

7. Thomas I. Emerson, The System of Freedom of Expression (New York, NY: Random House, 1970), p. 498.

8. Harry Kalven, Jr., A Worthy Tradition: Freedom of Speech in America (New York, NY: Harper & Row, 1988), pp. 34, 41.

9. For a more complete discussion, see D.A. Downs, The New Politics of Pornography (Chicago, IL: University of Chicago Press, 1989).

10. H. Bosmajian (ed.), Justice Douglas and Freedom of Speech (Metuchen, NJ: The Scarecrow Press, 1980), p. 89.

11. Kalven, pp. 42-48.

12. F.J. Kahn (ed), Documents of American Broadcasting (Fourth Edition) (Englewood Cliffs, NJ: Prentice Hall, 1984), p. 53.

13. Pool, p. 134.

14. J. Lichtenberg, Democracy and the Mass Media: A Collection of Essays (New York, NY: Cambridge University Press, 1990), p. 6. See also M.L. Spitzer, Seven Dirty Words and Six Other Stories: Controlling the Content of Print and Broadcast (New Haven, CT: Yale University Press, 1986).

15. See Kahn, pp. 338-353, for a detailed, annotated review of "FCC v. Pacifica Foundation," 438 U.S. 726 (1978).

16. A.A. Bernstein, "Access to Cable, Natural Monopoly, and the First Amendment," Columbia Law Review (86:1986), p. 1663.

17. Pool, p. 150.

18. L.H. Winer, "The Signal Cable Sends: Why Can't Cable Be More Like Broadcasting?," Maryland Law Review (46:1987), p. 265.

19. P. Parsons, Cable Television and the First Amendment (Lexington, MA: Lexington Books, 1987).

20. M.L. Spitzer, "Broadcasting and the First Amendment," in Newberg, p. 189.

21. Craig Brod, Technostress: The Human Cost of the Computer Revolution (Reading, MA: Addison-Wesley Publishing Company, 1984), p. 121.

22. H. Rheingold, Virtual Reality (New York, NY: Simon K. Schuster, 1991), p. 347.

23. J. Markoff, "The Latest Technology Fuels the Oldest of Drives," New York Times: News of the Week in Review, March 22, 1992, p. E5.

24. Pool, p. 135.

25. Ibid., p. 251.

26. M.L. Spitzer, "DAB (Digital Audio Broadcasting): The Next Generation of Radio Broadcasting?," Broadcasting (62: June 4, 1990).

27. See Jonathan W. Emord, Freedom, Technology, and the First Amendment (San Francisco, CA: Pacific Research Institute for Public Policy, 1991), Chapter 18.

28. R.E. Labunski, The First Amendment Under Siege: The Politics of Broadcast Regulation (Westport, CT: Greenwood Press, 1981), p. 13.

29. John N. Berry, III, "If Words Will Never Hurt Me, Then...," Library Journal (January, 1992), p. 6.

Chapter 16: Cyberpower *

by Peter Huber

British Telecom timed its announcement perfectly—on the eve of the election. Think of British Telecom's 20 billion dollar merger with MCI as an antidote to bad government. By providing efficient, integrated global data connections, telecommunication companies now offer voters the ultimate shopping experience: shopping for better government.

Travel the wires and see what I mean. To a degree that may astound you, your computer and your telephone enable you to choose what you like in the way of Federal Reserve, FDIC, SEC, FDA, OSHA, EEOC, NLRB, or other cans in the alphabet soup aisles of modern regulation.

The idea of choosing government is not, of course, new. If you do not like California law on the subject, you drive to Reno for marriage, divorce, or gambling. To Mexico to buy cut-rate medicines unapproved in the U.S. To Florida to go bankrupt or to die. The urge to take a political hike has been there all along. What has changed is the ease and convenience.

In the past you had to vote with your feet. Now you can vote with your modem, too. The Web supplies an instant global storefront. While the U.S. market still dominates the Internet, 36 percent of servers are now outside this country. Virtual establishments on the Web already offer incorporation in Belize, bank accounts in Switzerland, currency trading in Germany, and brokerage accounts in New Zealand. International 800 numbers are proliferating.

Money, the most liquid of assets, has become the hardest to regulate. Rich people have always parked their money abroad when they did not trust the political climate at home. Today millions of ordinary investors can move their wealth between currencies and countries as fast as they can click icons on a screen.

For some this is just an opportunity to cheat on their taxes. A Hamburg currency trader promises "tax-free profits." A Swiss online banker emphasizes "banking secrecy" and "protecting the privacy of bank clients." Swiss safety deposit boxes, the bank assures you, "cannot be sealed by foreign authorities in case of civil offenses." Other online offshore entities brazenly tout "tax-free" advantages for U.S. depositors.

But evading tax collectors remains a sideshow in the vast business of international wire finance. The center of the action involves the completely legal evasion of inept central bankers. More than one trillion dollars in foreign exchange changes hands each day around the world. (By comparison, turnover of all stock on the New York Stock Exchange for an entire year is only around $4 trillion.) One in seven equity trades in today's world involves a foreigner as a counterparty. And even illiquid assets—real estate, for example—are increasingly being securitized and then traded on global markets.

As Walter Wriston, former Citicorp chief executive and author of The Twilight of Sovereignty (Charles Scribner's Sons, 1992), says: "Governments have lost control of the international value of their currency." A single integrated world market for tradable financial assets is taking shape. Lowell Bryan and Diana Farrell of McKinsey & Co. describe this evolution in Market Unbound: Unleashing Global Capitalism (John Wiley & Sons, 1996).

The upshot? The prudent investor can now select investments based on the central bankers standing behind them, just as he now chooses a stock based on his appraisal of the chief executive officer. Do you think the German central bank is wavering? Try Alan Greenspan. If you think he is on the wrong track, try New Zealand. Global mutual funds have limitless ability to move capital among local, state, national and international portfolios—equity, debt, currencies, futures, the lot. By far the most effective way to vote against new government spending is to buy some other government's bonds. This kind of balloting is in fact conducted continually—by banks, pension funds and mutual funds. These are the new, private treasuries.

By dispatching its capital elsewhere, the electorate can almost instantly depress the economy and thus the government's tax revenues. For any government that's seriously in debt, the globalization of financial markets puts a double squeeze on new discretionary spending. If global capitalists lose faith and drive up interest rates, it is not just new spending that costs more, it's also the refinancing of old debt. The modemization of finance explains the federal government's mass conversion to more balanced budgets.

As Bryan and Farrell discuss in their book, the tremendous new mobility of private capital sharply curtails government power over macro-economic policy. Budget planners and central bankers become little more than fancy bookkeepers. They do not orchestrate economic forces, they react to them.

Whether they talk left or right, governments worldwide have little choice but to abandon fiscally suicidal policies, most notably the practice of issuing long-term debt to finance current entitlements. Improvident governments that do not believe this end up like Mexico in 1995, with a collapsing peso and an overnight flight of capital. Even Washington's wisest understand the new reality. "I used to think if there was reincarnation I wanted to come back as the President, the Pope or a .400 baseball hitter," Clinton adviser James Carville quipped two years ago. "But now I want to come back as the bond market. You can intimidate everybody."

Including, of course, government regulators. Wires are imposing a strict new discipline on the regulators of private banks, too. At a recent Cato Institute conference on the future of money, University of Georgia economist Lawrence H. White described how new payment technologies have lowered the cost of wiring money from $20 to 2 cents per transaction. This opens up the world of offshore banking to small investors—and it's all perfectly legal, so long as you keep paying your income taxes. Offshore banks pay higher interest on deposits and charge lower rates on loans because they are not subject to the wide array of bank taxes, mandatory insurance premiums, and antiredlining decrees imposed by U.S. regulators. For the first time, small depositors can decide for themselves whether the Federal Deposit Insurance Corp. is really worth the price they pay in less favorable interest rates.

Securities regulation can now easily be circumvented in much the same way. With stock exchanges and brokerage accounts moving online, you can hold and trade U.S. equities completely outside U.S. jurisdiction. If the Securities and Exchange Commission goes over the edge of the regulatory Laffer Curve—by passing rules that stifle rather than protect —investors will easily be able to move to a Swiss broker, a London exchange, or a Canadian commodities trader. The value of regulation, positive or negative, becomes something you shop around for, just as you shop for a trusty broker or low trading fees.

Labor will never be as fluid as capital, but does follow it. The 1980s taught us that manufacturing jobs could escape U.S. unions, labor laws, tort lawyers, and environmental regulators much more easily than we had realized. The aluminum still comes from an Alcoa mill in the U.S., but some 20 percent of the Boeing 777 airframe structure is built by Japanese workers at a Kawasaki/Mitsubishi/Fuji consortium. The wings and the cockpit of McDonnell Douglas's MD-95 are being built in South Korea.

To be sure, most U.S. jobs, particularly the services that account for 54 percent of the U.S. economy, are still in nontradable sectors. If you live in Fresno, you can not easily get a haircut from a coiffeur in France. But services do already make up over 20 percent of global trade, and they represent the fastest growing component of both trade and foreign direct investment worldwide. American companies outsource data entry to countries in the Caribbean. Manufacturers outsource product design, logistics management R&D, and customer service across national borders, too. U.S. insurance, tax consulting, and accounting companies send claims and forms overseas for processing. Software, films, music, finance, advertising, and even health care and education all move as well. Haircuts? Not yet, but there's already serious talk of telemedicine.

The Boeing way of choosing labor is now embedded in the structure of some 39,000 large, transnational corporations, which collectively hold over 2.7 trillion dollars of assets outside their home-base countries. New foreign direct investment in the 26 nations in the Organization for Economic Cooperation and Development rose by 53 percent in 1995, while outflows from these countries increased by 42 percent. "The very phrase 'international trade' has begun to sound obsolete," Wriston says in an interview.

Again, information and communications technologies are the critical new lubricant. Many services, especially financial and anything involving software, consist of nothing but information and can be moved by wire alone. Moving solid goods still requires cheap transportation, too, but the cost of hauling things around keeps dropping, energy costs notwithstanding. And many of the products being hauled—everything from cameras to cars—keep getting smaller and lighter as they get electronically smarter.

Once a manager in Detroit learns how to use the telecom to outsource to Toledo, Ohio, she can outsource to Toledo, Spain; with cyberpower all physical distances are roughly the same. And with this kind of global production system in place, a manufacturing company can move jobs and capital around like pieces on a chessboard, shopping continually for the best-priced labor—and the best labor laws. As Norman Macrae, former deputy editor of The Economist, foresaw some years ago, corporations of the future are not going to be nationally based, and they "are not going to have long-lasting lines of production in settled places." Their managers will be able to move jobs almost as fast as governments can rewrite employment laws. At the margin, the managers of these transnational companies will adjust their portfolios of labor in much the same way as the manager of Templeton Growth Fund trades stocks.

So where does the globalization of labor markets leave the countless national regulators of employment and work? Whatever they address —parental leave, handicaps or the minimum wage—laws that deny economic reality cannot be enforced if the jobs can pick up and leave. Much as they hate the fact, government bureaucrats are beginning to accept it. Yes, Washington did recently raise the minimum wage, but the real story there was how little and how late. The long-term global political trend is away from all such dictates, not toward them.

When she thinks of herself as "labor" the average American citizen may not like this at all. But as a consumer she's collaborating enthusiastically. She buys Nikes and Nintendos made in Asian factories. She demands profit from her mutual fund and pension plan, not patriotic loss. Before long, she will shop for life insurance in London and health insurance in Geneva, and the offshore actuaries will discriminate fiercely in favor of the healthy. In the 1980s the chief executive of Chrysler might have decided to buy a few million car engines from Korea. Today millions of individual Americans are gaining the power to shop anywhere they please. No longer can consumers, any more than investors or corporate managers, be economically quarantined.

This means that consumer protection regulators face serious competition. An abortion comes in a pill; there's little to stop you from buying that from an online pharmacy in Monaco if you have to. For years the FDA blocked sales of kits that allowed home testing for the AIDS virus. So a South African company peddled a $100 kit on the Internet, with delivery by mail. And the owner boasted openly that he was in business to thwart the regulators overseas.

The daughter of a magazine editor I know needed a special asthma drug that the Food and Drug Administration has not yet seen fit to approve. Her dad e-mailed a contact in Paris, and the medicine arrived by air several days later. He would not have bought a drug from China or Belize, but he was willing to trust France. The world's drug regulators, in short, compete for his custom. A wide range of routine diagnostic services could easily be offered to U.S. citizens from laboratories in Bermuda. The Web would handle marketing and payment. Federal Express would deliver.

What holds for lab tests holds for morals and culture, too. Nevada can dispatch strip shows and blackjack tables to any computer in Utah. If we shut down Nevada, gaming houses farther afield will quickly fill the electronic void. A two-minute Web search turns up the Aruba Palms, off the coast of Venezuela. Download free software and link into the hotel's casino for real-time blackjack, poker and slots, as well as full sports-book action. Or try out any of a dozen online gaming alternatives in Argentina, Belize, Antigua, or the

U.K. Or play the national lottery of Liechtenstein. Use your credit card, or use E-cash if you want to make both gains and losses completely anonymous.

When it comes to pure content regulation—pornography the most vivid example—government authorities have lost their grip completely. If you do not like Utah's censors, three clicks of a mouse will put you under the unbuttoned authority of Utrecht. Canada has instructed its citizens not to watch too much U.S. television. But it's laughably easy now for Canadians to buy a small satellite dish and get subscription fees billed to a nominally U.S. address. Technology has rendered completely obsolete the very idea that government authorities can control morality and culture. Politicians may still give speeches about these things, but everyones know the talk is just reactionary twaddle.

All of this should be very reassuring. Most of us will not leave the country, not in person and not by wire. We will not have to. Competition improves the quality of everything else; it will improve the quality of government, too. Most politicians are pragmatists. They will grasp that they have to deliver a good service at an attractive price—or lose market share to the competition. Bill Clinton understands this. Like James Carville, he learned that the bond market runs the most powerful polls of all. Clinton ran as a budget conservative.

The trend is already clear in monetary and fiscal matters, where the competition for good government is the fiercest. Many of the abrupt currency swings of yesteryear (overnight devaluations, for example) just do not happen as much anymore. Wired financial markets are less volatile and much more honest. Nearly all industrial countries have brought their annual inflation rates under 3 percent. In The Death of Inflation: Surviving and Thriving in the Zero Era (Nicholas Brealey Publishing, 1996), Roger Bootle argues that the globalization of financial and labor markets left them no choice.

Within this country, large states like California seem to be learning the same lesson. They have to stay in line on tax rates, investment climate and so forth—or lose jobs, investment and residents to their better-governed neighbors. And while rigorous comparisons are difficult, it does appear that industrialized nations are gradually converging toward quite similar regulatory structures in monetary policy, banking, insurance, and securities trading. The overall price that competing governments charge citizens for service—the tax rate—seems to be converging, too. Take away health insurance, which some countries book as "private" rather than "public," and you find that the tax rates in industrialized countries are all quite close—much more so than they were in the 1960s. Governments that do not keep up with the competition can lose market share fast. Years ago Delaware developed a well-designed service called corporate law. Most big U.S. companies are Delaware corporations now. Other states tried to protect their consumers from high interest rates. So Citibank set up operations in South Dakota to issue credit cards nationally. In June the Supreme Court ruled that California residents may not challenge Citibank's late-payment fees as usurious under California law: The fees on Citibank cards are South Dakota's legal responsibility. The usury police in other states can all take a permanent vacation.

We, the people, are all shipping tycoons now, with mobile wealth and mobile labor. We can choose Liberia's flag, for its unmeddlesome bureaucracy, or London's insurance, for its trustworthy courts. As managers, workers, and consumers, we buy government in much the same way we buy shoes. Not through bribes or political action committees or anything like that—we buy it by paying taxes and complying with the laws. But when shopping in one government's mall gets too expensive or inconvenient, we shop in another's.

So the old political carnival, filled as it was with freaks and geeks, is over. The old game of big promises on election day, soon forgotten in the enjoyment of power, is over. Citizens now vote continually, with London, Bonn, and Tokyo on the ballot, too.

Chapter 17: Congress, Information Technology, and the Use of Force

by Jeffrey Record

Emerging information and communications technologies may indeed have a critical influence on certain elements of the U.S. national security decision-making process as it relates to the use of force. In so far as that process involves Congress, however, the new technologies are not likely to have a direct impact, though they could indirectly to the extent they influence public opinion. Unlike our highly capital-intensive armed forces, which are benefiting directly and immensely from such new technologies as digital transmission, advanced networking, fiber optics, and cellular communications, Congress is first and foremost a deliberative political body. This is especially true of the Senate, with its significant Constitutional role in the oversight of foreign policy. Congress, as it has since the founding of the Republic, is swayed by such non-technological influences as patriotism, money, organized lobbying, constituent opinion, and the search for political advantage.

Members of Congress and professional staff are already awash in information and the ability to communicate and analyze it evermore quickly; fiber optic cable has been installed in House and Senate office buildings; cellular phones are in common use; and every professional staff member has a television monitor which carries both C-SPAN channels and CNN. But the Constitutional responsibilities of Congress remain unchanged, and Congress will continue to do business according to established rules of procedure. Increased access to satellite communications may be revolutionizing the conduct of war, but such things as global positioning systems are irrelevant to what Congress is about.

Congressional Trends and the New Technologies

Even such a not-so-new information and communication technology as continuous live television coverage of overseas violence and human suffering may not have the dramatic effect on either congressional or public opinion that has commonly been ascribed to it. The evidence is mixed, at best. Dramatic CNN footage of the misnomered "Highway of Death" (the flight of Iraqi forces out of Kuwait) clearly influenced the Bush administration's decision to cease further coalition offensive operations against the Iraqis unilaterally. There is also little doubt that gut-wrenching pictures of starving children in Somalia contributed to initial public and congressional support for U.S. humanitarian intervention there in late 1992, and that the subsequent U.S. decision to vacate Somalia was driven significantly by pictures of a dead American soldier being dragged through the streets of Mogadishu by jubilant Somali gunmen.

Before the Dayton Accords on Bosnia, however, no less dramatic and outrageous footage of events in Bosnia, however, has created little sentiment for U.S. military intervention there, even though the United States clearly had more important interests in the former Yugoslavia than it did in Somalia. Polls suggested that the American public sensed that

Bosnia had quagmire written all over it, and congressional initiatives to lift the embargo of arms to Bosnia were essentially substitutes for any direct U.S. military action there, which the Defense Department opposed. Before Dayton, despite extensive media coverage, the Vietnam syndrome was alive and well in both the Pentagon and the country at large as regards Bosnia.

Nor did televised images of poverty and oppression in Haiti produce a groundswell of opinion for intervention in that country; the Clinton administration sent troops in the face of considerable congressional and public, if not Haitian, opposition. This is not to suggest that Congress will prove completely impervious to the influence of new information and communications technologies. Some of the technologies are likely to reinforce the continued increase in the relative power of professional staff on Capitol Hill. Over the past several decades, Congress has had to rely more and more on highly specialized professional committee staff (strongly reinforced by such congressional research and investigative arms as the General Accounting Office, Office of Technology Assessment, and the Library of Congress's Congressional Research Service), not only to remain competitive with the Executive Branch in terms of reaching informed judgments on a host of complex issues, but also to permit members of Congress the time to devote to fundraising in an era of skyrocketing costs of running for office. If knowledge is power, then a professional staff made ever more knowledgeable—if not wiser—via ready access to more information will become ever more powerful vis-a-vis 535 members of Congress who with few exceptions will remain amateurs. It should be noted that this trend would be accelerated by increased rates of congressional turnover—which is the declared objective of those who favor arbitrary term limits.

Other trends likely to be enhanced by the new technologies are the decline in power and influence based on seniority and absolute deference to that seniority. Before the explosive growth of professional staffs beginning in the late 1960s and early 1970s, there was in fact a distinct correlation between seniority and knowledge. Committee chairmen like Richard Russell and Wilbur Mills represented decades of experience and devotion to the details of their respective committee responsibilities, and junior members stood in awe of such men. Much has happened since then. The tradition of deference has declined, and the rising authority of professional committee and members' personal staff has provided opportunities for members without appreciable seniority to stake significant claims on one issue or another.

Congress and Post-Cold War Interventions

Does the relative imperviousness of Congress to direct or significant influence by new information and communications technologies mean that the long-standing issue of congressional assertiveness in foreign policy, especially on issues involving the use of force, should be ignored? Certainly not! What some would call congressional "meddling" in the conduct of foreign policy has been a feature of the Washington political landscape for a quarter of a century, and an increase in congressional assertiveness is already underway and likely to continue for reasons that lie beyond the realm of technology.

It is important to remember that congressional activism in foreign policy is hardly a new phenomenon. During the inter-war period, an isolationist-dominated Congress blocked U.S. accession to the League of Nations Treaty and passed a series of Neutrality Acts and other legislation that severely hobbled presidential flexibility in dealing with the threat posed to the United States and other democracies by the rise of German and Japanese fascism. President Franklin Roosevelt, seeking to retain as much flexibility as possible, was compelled to engage in a number of circuitous initiatives, including what amounted to an undeclared naval war against German submarines in the North Atlantic.

To be sure, congressional docility characterized the first two decades of the Cold War: few in Congress questioned the integrity or wisdom of the Executive Branch when it came to making foreign policy, including decisions on war and peace. One is still struck by the virtual silence on Capitol Hill which greeted President Harry Truman's momentous decision in June 1950 to commit U.S. troops to South Korea's defense without bothering to ask Congress for a formal declaration of war. Failure to do so not only came back to haunt the Truman administration, but also established a disastrous precedent for Southeast Asia in the following decade. Indeed, the Johnson administration interpreted the Tonkin Gulf Resolution of 1964, which after perfunctory debate passed the Senate with only two dissenting votes, as a functional substitute for a formal declaration of war.

Vietnam and Watergate, subsequently reinforced by the Iran-Contra Affair, sparked a resurrection of congressional activism against an "Imperial Presidency" which continues to this day. It is an activism rooted in a profound mistrust of the Executive Branch. With respect to the use of force, it is a largely negative activism that seeks to block or restrict the use of force on one ground or another. Examples of such congressional activism include the 1973 War Powers Act, the 1976 Clark Amendment (prohibiting any kind of U.S. assistance to Angola without congressional authorization), the 1993 Byrd Amendment (setting a deadline for withdrawal of U.S. forces from Somalia), the 1994 Helms Amendment (requiring prior congressional authorization for any use of force in Haiti), and the 1994 Dole Amendment (mandating a unilateral U.S. termination of the United Nations arms embargo of Bosnia).

With respect to using force, the most distinct fault line in Congress lies along the issue of purpose. On the one side is a vocal minority which contends that traditional U.S. national security interests are no longer seriously threatened, and that the United States now enjoys the luxury of placing its military power in the service of promoting democracy, human rights, humanitarian relief, and other American values overseas. This minority, inspired in part by the Clinton administration's initial embrace of such concepts as "assertive multilateralism" (on matters of war and peace) and "engagement and enlargement" (of market-based democracies), supports the use of force, when and where possible, to transform dictatorships into democracies, as in Haiti; to halt genocide, as in Bosnia; and to provide relief to the sick and starving, as in Somalia and Rwanda. It furthermore believes that the use of U.S. force overseas, to be legitimate, must be sanctioned by the United Nations, as indeed it was in the Persian Gulf in 1991, Somalia in 1992, and Haiti in 1994; it associates unsanctioned use of force with American "excesses" of the Cold War.

Opposite the supporters of value-motivated interventions stand those who believe that the United States should not use force except in defense of such traditional vital interests as protecting U.S. territory and American lives, preserving access to vital resources overseas, and maintaining balances of power in Europe and East Asia. They question the utility of military power as a means of promoting democracy and other American values abroad, and believe that investment in value-driven interventions like Somalia and Haiti degrades preparations for dealing with threats to truly vital interests, like another war on the Korean peninsula or another Iraqi invasion of Kuwait. They contend that the United States, especially in an era of rapidly shrinking defense resources, should be extremely careful about assuming new defense obligations, especially ones peripheral to core U.S. security interests. Bob Dole has written that, "American lives should not be risked—and lost—in places like Somalia, Haiti, and Rwanda with marginal or no American interests at stake. Such actions will make it more difficult to convince American mothers and fathers to send their sons and daughters to battle when vital interests are at stake. The American people will not tolerate American casualties for irresponsible internationalism."1

nlike proponents of value-driven uses of force, many "traditionalists" are also hostile to the United Nations as an instrument for the conduct of peace operations, and do not believe that U.N. approval is necessary to legitimize a U.S. decision to use force. Again, Senator Dole: "[The Clinton] administration has displayed a basic discomfort with American military power—unless that power is exercised pursuant to United Nations authorization. In Haiti, the 1823 Monroe Doctrine has been replaced with the [Morton] Halperin Doctrine—unilateral action only after multilateral approval. An unfortunate precedent has been set in seeking prior United Nations support for what an American president proclaimed was in America's interests—interests that should not be second-guessed, modified, or subject to the approval of international organizations."2

The majority of congressional opinion on the use of force falls somewhere in between the two positions just outlined. Most interventions themselves are propelled by some combination of interest and value motives. Even Desert Storm, which clearly would not have been undertaken on behalf of an oil-less Kuwait and Saudi Arabia, and against an Iraq having no nuclear or ballistic missile ambitions, was motivated in part by a desire to relieve the human tragedy of Kuwait and to bring down an exceptionally brutal regime. Conversely, the desire to restore democracy in Haiti did not completely eclipse the goal of staunching the uncontrolled flow of Haitian refugees to the United States.

Moreover, confusion, contradiction, and simple political posturing are as commonplace in the Congress on this issue as they are on most other issues. Party attitudes on the degree to which Congress can and should regulate presidential foreign policy initiatives vary widely depending on which party occupies the White House. For example, prominent Republicans who in 1990 argued that President Bush did not need congressional approval to initiate hostilities against Iraq—that UN authorization alone was sufficient—subsequently reversed position when it came to such Clinton administration initiatives as the dispatch of U.S. forces to Haiti. For another example, prominent Democrats who in 1983 condemned the U.S. use of force in Grenada as a violation of that country's sovereignty have applauded the Clinton administration's invasion of Haiti.

Many who wish to employ U.S. military power on behalf of humanitarian relief and who believe the issue is a simple matter of resolve and logistics fail to recognize that most humanitarian crises in the world today have political rather than natural origins, and therefore that intervention of the most benign intention risks being drawn into someone else's civil war. "The task of alleviating suffering inevitably involves political consequences when suffering has political causes," observes Michael Mandelbaum. "War was the cause of the breakdown of order in northern Iraq, Somalia, and Bosnia. Stopping a war requires settling the questions—political questions —over which it is being fought. As a result, in each case the noble humanitarian purpose of feeding people inevitably became caught up in the poisonous tangle of local politics."3

Many who find political legitimacy in UN resolutions do not grasp that the United Nations is constitutionally incapable of effectively employing force in circumstances involving war or the imminent risk of war. Again, Mandelbaum: "The UN can no more conduct military operations on a large scale on its own than a trade association of hospitals can perform heart surgery."4

Many who caution against assuming peripheral overseas defense commitments blithely endorse NATO's rapid extension of membership to east European states, thus commiting the United States to defending new territory never regarded as vital to U.S. security. (The Republicans' "Contract with America" called for the early admission of Poland, Hungary, the Czech Republic, and Slovakia.) Many who rail against the United Nations seem to forget that the United States is the dominant power in that organization, and can exercize its veto power as a Permanent Member of the Security Council in the post-Cold War era as forcefully as did the Soviet Union during the Cold War. And many who decry the alleged evils of multilateral applications of force, including the bugaboo of placing U.S. troops under foreign command, ignore the fact that the United States in this century has almost always fought in the presence of militarily and politically indispensible allies, and in many cases has placed its forces under foreign command.

Politics Over Technology

As confusing, contradictory, and politically motivated as congressional attitudes appear to be on many foreign policy issues in the post-Cold War era, attitudes on the use of force are shaped by several factors that are likely to be abiding features of the foreseeable domestic political landscape. And while several of these factors may be influenced by emerging information and communication technologies, none appears driven by these technologies.

The first is a preoccupation with domestic social and economic challenges—and concomitant aversion to involvement in any foreign crisis that might divert national resources away from their resolution. Foreign policy issues rarely dominate public and congressional concerns in peacetime; however, the present degree of preoccupation with national problems is unprecedented since the beginning of the Cold War, and is likely to remain so absent the emergence of another hostile world power capable of challenging U.S. interests on a global scale. While new information and communication technologies may make us more aware of distant events and connect U.S. financial markets more closely to overseas financial markets, they are not likely in the foreseeable future to overturn the preeminence of domestic social and economic challenges in congressional eyes.

The second factor is a strong preference for conventional forces and a concomitant aversion to injecting U.S. military power into situations where the effects of such traditional U.S. advantages as firepower and tactical mobility cannot be fully maximized. This preference mirrors Pentagon attitudes, and means a strong reluctance to intervene in places like Bosnia and Somalia, but a willingness, if necessary, to take on opponents like Iraq and North Korea, and to take lesser punitive military action against such pariah states for specific misdeeds. Congressional criticism of the Clinton administration's 1993 "Bottom-Up Review" of U.S. military requirements centered almost exclusively on the significant disparities between postulated requirements, and the current and planned resources to fulfill those requirements. Few questioned the realism of those requirements, which call for forces sufficient to wage two large-scale conventional wars simultaneously, with a North Korean invasion of South Korea and an Iraqi invasion of Kuwait and Saudi Arabia's Eastern Province serving as the basis for U.S. force planning. So while emerging information and communication technologies will undoubtedly enhance our ability to fight, it is not clear how these technologies might alter congressional positions on defense issues per se.

A third factor is an aversion to purely or predominantly value-driven uses of force, which by definition presume the absence of compelling or even modest national security interests. Support can be expected for such operations as the evacuation of endangered Western citizens in Third World countries (e.g., evacuation of American and European nationals from Algeria) and the provision of relief supplies in the wake of natural disasters and in other circumstances not involving significant risk of entanglement in local civil conflict (e.g., the Rwandan refugee relief operations of 1994). But a solid majority in both Houses of Congress can be expected to oppose, though perhaps not at the cost of crippling presidential flexibility in the middle of a crisis, interventions aimed at recreating failed states as viable societies (e.g., Haiti) and interventions likely to entangle the United States in local civil conflicts (e.g., Lebanon and Somalia). Emerging information and communication technologies are not likely to change this congressional calculus of what is in the American interest.

A fourth factor influencing congressional opinion on matters of war and peace is a widespread appreciation, born of the lessons of Vietnam and Operation Desert Storm as well as of Pentagon insistence, is that force, when used, should be ample to accomplish the task at hand in a timely fashion as well as command broad public support (or at a minimum a benign indifference). Meeting these and other desireable prerequisites for using force, such as having clearly defined political and military objectives and an effective means of measuring progress toward their accomplishment, may not always be possible, particularly in cases where the enemy has taken the initiative against established U.S. defense commitments. Sufficient resources and political support would seem imperative, however, when an administration is contemplating military action it is not obligated by treaty or other prior commitment to undertake, and even more so in circumstances where there are no apparent compelling U.S. security interests at stake. The shallowness of public and congressional support for U.S. intervention in Somalia was revealed by how few American dead and wounded it took to drive the United States out of that country; and arguably it has been the unexpected absence of American casualties in Haiti that has prevented a collapse of what little real support our intervention there has commanded.

This brings us to the fifth factor, which is the first which may indeed be significantly influenced by emerging information and communication technologies: public and congressional hyper-sensitivity to casualties, which may have been reinforced by Desert Storm's implication that even large-scale conventional warfare can henceforth be waged on the very cheap in terms of lives lost. Much has been written on this subject. Some observers have concluded that this hyper-sensitivity, which has come to include enemy civilian as well as American military dead and wounded, has effectively self-deterred the United States from using force in all cases other than self-defense and exceptional situations like that afforded the West by the strategically incompetent Saddam Hussein.5

This hyper-sensitivity is a relatively new phenomenon, and has often been attributed to the emergence of television's ability to project the death and destruction of combat into American living rooms. However, one should not move too rapidly to such a conclusion. During the opening stages of the Vietnam War, as casualties began to mount, the American public supported increased U.S. involvement in combat. Indeed, in the case of Vietnam, the primary source of that war's unpopularity through the Tet Offensive was the widespread conviction that the government was not prosecuting the war vigorously enough.6

In recent years, however, both the public and Congress displayed a disposition to abruptly abandon interventions in the face of even a small number of casualties, as in Somalia, and it is difficult to deny that the precipitous U.S. withdrawal from that unfortunate country was at least in part linked to televised scenes of a dead U.S. soldier being dragged through the streets of Mogadishu. However, we must remember that the withdrawal from Somalia was an executive decision. We can only speculate on what Congress might have done if the executive branch had not acted, but in this case, it was clearly the executive branch, not Congress, that in a policy sense responded to the media's message first. This is likely to be the case in the future as well.

A sixth factor influencing congressional attitudes on the use of force is a suspicion of multilateral frameworks for doing so, especially the United Nations. This too is not likely to change because of emerging information and communication technologies. Some of this suspicion is valid, and some of it is not. Much of it is motivated by the United Nations' feckless pre-Dayton performance in Bosnia and reckless performance in Somalia, by a distaste for so-called "peace operations" in general, and by strong opposition to placing U.S. troops under foreign command. To be sure, though the United Nations can provide effective genuine peacekeeping services, it is a demonstrably poor instrument for the conduct of even humanitarian relief-oriented military operations in places like Bosnia and Somalia where there is little peace to keep. In contrast, the multilateral NATO framework, with its integrated military command and decades of force-planning experience, is a true warfighting organization, though its ability to conduct effective military operations outside alliance territory requires a political consensus that is difficult to obtain, as NATO's original reluctance to become involved in Bosnia showed.

Last, but by no means least, congressional attitudes toward using force will be significantly influenced by military opinion that recently has become more forcefully and openly expressed than at any time during this century. For better or for worse, the influence of military advice on decisions made by civilians has steadily grown since the end the the Vietnam War, which, along with such other politically disastrous uses of force as the Lebanese misadventure of 1983-84, eroded military confidence in the capacity of civilian authority to employ force wisely. With this erosion of confidence has come an increasing outspokenness that has reflected the military establishment's congenital reluctance to use force, but greater willingness, once force is used, to raise the level of violence. (Traditionally, civilian authority has been quicker to resort to force but more hesitant to escalate.) Indeed, it was U.S. intervention in Lebanon, which the Joint Chiefs of Staff and the Secretary of Defense unanimously opposed, that prompted Caspar Weinberger to publicly proclaim six major political and military tests that should be applied when weighing the use of U.S. combat forces abroad:

- Forces should not be committed to combat except on behalf of vital interests;
- If force is used, it should be ample in scope and committed wholeheartedly with the clear intention of winning;
- We should have clearly defined political and military objectives;
- The relationship between objectives and the forces committed should be continually reassessed;
- There must be sufficient public and congressional support; and
- Use of force should be a last resort.[7]

Conclusions

In the real world, of course, few uses of force can satisfy all of these criteria, and Congress is certainly not in a position to compel their satisfaction on the part of the Executive Branch, short of rarely summoned courage to employ the power of the purse to stop U.S. participation in unpopular wars. However, in cases where there is evident division between military and civilian authorities within the Executive Branch, and these are usually situations where the latter are pressing for a resort to force, or having resorted to force, for restraint on escalation, Congress may be expected to side with military opinion.

To sum up, then, in the Information Age, congressional attitudes on matters of war and peace are being shaped by a number of factors, some of them new, but those factors are predictably political rather than technological—as befits an organization whose business is politics. Emerging information and communication technologies may well have an impact on the overall national security decision-making process, and they will clearly have an impact on our capabilities to conduct warfare, but when it comes to Congress' role in the national security decision-making process, it is difficult to argue that they will have much of an impact at all.

NOTES

1. Bob Dole, "Shaping America's Future," Foreign Policy (Spring 1995), p. 41.

2. Ibid., p. 39.

3. Michael Mandelbaum, "The Reluctance to Intervene," Foreign Policy (Summer 1994), p. 4.

4. Ibid., p. 11.

5. See, for example, Stanley R. Sloan, The United States and the Use of Force in the Post-Cold War World: Toward Self-Deterrence? CRS Report for the Congress 94-581-S (Washington, D.C.: Library of Congress: Congressional Resarch Service, July 20, 1994).

6. See Benjamin C. Schwarz, Casualties, Public Opinion and U.S. Military Intervention (Santa Monica, CA: RAND Corporation, 1994), pp. ix-xi.

7. Caspar W. Weinberger, "The Uses of Military Power," Defense '85 (January 1985), pp. 2-11.

Chapter 18: The Media's Impact on International Affairs, Then and Now *

by Johanna Neuman

In foreign policy circles these days one often hears that the advent of instantaneous and global technology has given the news media far greater influence in international relations than ever before, robbing diplomacy of its rightful place at the helm in the process. Observers of international affairs call it the CNN curve, and the term is not a compliment. It suggests that when CNN floods the airwaves with news of a foreign crisis, it evokes an emotional outcry from the public to "do something." Under the spell of the CNN curve, goes this refrain, policymakers have no choice but to redirect their attention to the crisis at hand or risk unpopularity, whether or not such revision is merited by policy considerations.

This paper argues, in contrast, that satellite television, and the coming clashes in cyberspace, are but the latest intrusions of media technology on the body politic. Throughout history, whenever the political world has intersected with a new media technology, the resulting clash has provoked a test of leadership before the lessons learned were absorbed into the mainstream of politics. Eventually, the turmoil caused by a new media technology's impact on diplomacy is absorbed and forgotten, until the next media invention begins the process anew. The marvel of real-time television is that it allows constituencies to watch history being made at the same time as their leaders. Yet the enormous power of images broadcast in real time—students rebelling in Beijing, bombs falling in Baghdad, Marines landing on the beaches of Mogadishu, a Russian parliament being shelled by troops loyal to President Yeltsin, paratroopers descending on Haiti—is only novel to a generation raised on television. To a generation accustomed to receiving news at the speed of a steam train or sailing ship, the telegraph conferred similar wonder. Similarly, to a generation experiencing the avalanche of information available on the Internet, watching the war in Bosnia via satellite television may soon seem a quaint throwback to a more innocent age—before cyberspace allowed the public to experience battle in virtual reality.

A pattern has emerged from the past clashes between new media technology and the political world, one that mitigates the power of the CNN curve. History shows that technology revolutionizes the way in which nations and peoples interact but without impacting the core of their relations. It is almost as if the media influence diplomacy and war at the margins while keeping intact the principles that guide both. The media, empowered with a new technology, can force the agenda but do not dictate the outcome. From the printing press to the photograph, from radio to cyberspace, media technology has challenged political leaders to rise above the immediate "do something" clamor of public opinion. The changes unleashed by satellite television are no different. With nearly every new invention, diplomats complained that they no longer had time to make rational decisions, while journalists boasted of new-found power to influence public opinion. The closest mirror to the upheaval felt by diplomats amid the CNN curve is that seen more than a century earlier with the invention of the telegraph. There was a revolution.

The Precedent

The telegraph was the first invention of communication technology in history to travel faster than the fastest form of transportation then available. Carried over electronic wires, the telegraph traveled at the speed of light, 186,000 miles per second,[1] while all the railroad train could muster was half a mile per minute, and pigeon carriers were clocked at around 35 miles per hour. The telegraph's impact was as revolutionary in the Industrial Age as that of satellite television or the computer in the Information Age. Even now, it is hard to comprehend the magnitude of the transition. In a world where communication had depended on the speed of a horse or a sailing ship or a train, messages could suddenly be received and answered almost instantly. This transition, from a leisurely pace of communication to almost instantaneous contact, most closely mirrors the changes in information technology that we are experiencing today. Looking at the telegraph as a later generation would view the computer, one early witness said, quite simply, "Time and space are now annihilated."[2]

Time and space, annihilated. No other phrase appears so frequently in the literature on the history of technology. It is as if conquering time and space is a human instinct as basic as hunger or thought. "Man may instantly converse with his fellow man in any part of the world," proclaimed one of the telegraph's devotees.[3] "Is it not a feat sublime? Intellect hath conquered time," trumpeted the masthead of the Telegrapher, the official publication of the National Telegraphic Union. Wrote one Rochester newspaper: "The actual realization of the astonishing fact that instantaneous personal conversation can be held between persons hundreds of miles apart can only be fully attained by witnessing the wonderful fact itself."[4] Even a congressional committee, investigating the telegraph in 1838, concluded that it meant "almost instantaneous communication of intelligence between the most distant points of the country, and simultaneously. Space will be, to all practical purposes of information, completely annihilated."[5] It is fashionable in the late years of the twentieth century to talk about "The Information Superhighway" and its promise for global interaction. But long before satellites circled the globe, the telegraph was proclaimed, "The Great Highway of Thought,"[6] its wires "slender bridges."[7]

To nineteenth century sensibilities, there could be nothing more instantaneous, nothing more immediate, nothing with more promise of the global village. "The chilling influences of time and distance are all gone," said Dr. George Loring, former congressman and chairman of the Massachusetts Republican Party, at a reception in inventor Samuel Morse's honor in 1871. "All mystery and doubt with regard to passing events and their influences are ended. The events occur, are received, weighed, set down in a moment, and in a moment we pass on to the next."[8] Even before Congress approved $30,000 to test the efficacy of the telegraph, Samuel Morse's brother Sidney hailed the invention. "Your invention, measuring it by the power which it will give to man to accomplish his plans, is not only the greatest invention of this age, but the greatest invention of any age," Sidney Morse wrote to his brother in 1838. "The surface of the earth will be networked with wire, and every wire will be a nerve. The earth will become a huge animal with 10 million hands, and in every hand a pen to record whatever the directing soul may dictate! No limit can be assigned to the value of the invention."[9] What is remarkable is that these claims to greatness were heard again in 1994, more than 150 years after Sidney praised his brother's invention. "Time in this age has been collapsed, there is no time any longer," said Marvin Kalb, director of the Joan Shorenstein Barone Center on the Press, Politics and Public Policy at Harvard University. "Another concept that has been collapsed is distance. Both are gone."10

From the beginning, the telegraph worried some intellectuals, who fretted that the faster dissemination of information by cable would somehow dilute the quality of public discourse, to say nothing of their own influence. Henry David Thoreau, in Walden, set the tone. "We are in great haste to construct a magnetic telegraph from Maine to Texas," he wrote, "but Maine and Texas, it may be, have nothing important to communicate." It is, he added, "as if the main object were to talk fast and not to talk sensibly. We are eager to tunnel under the Atlantic and bring the Old World some weeks nearer to the New; but perchance the first news that will leak through into the broad, flapping American ear will be that the Princess Adelaide has the whooping cough."11

Advances in communication technology inspired fears among nineteenth century leaders that they could no longer control public opinion. Even before Morse perfected the electric telegraph, France banned the visual telegraph, or Chappe system, based on flag signals. "Just imagine what could have happened if the passing success of the Lyons silk workers' insurrection had been known in all corners of the nation at once!" argued a horrified member of King Louis-Philippe's court. It is not surprising, therefore, that in 1837, a French law was enacted imposing jail sentences and stiff fines (up to 10,000 francs) on "anyone transmitting unauthorized signals from one place to another by means of the (Chappe) telegraph machine."12

Russian Czar Nicholas I was likewise terrified by the telegraph's potential to spread information. Fearing that the broad use of the telegraph would prove "subversive,"13 Nicholas turned down a contract with Morse, even though the details had already been worked out.14 It was a strategic blunder that cost Russia dearly.15 On the eve of World War I, Russian telegraph lines were still so rudimentary that Russian officers were forced to transmit marching orders by radio. As a result, during one of the first battles of the war, Germany learned from uncoded Russian radio broadcasts the exact location of two key Russian units. The information proved decisive in the German victory at Tannenberg.16 Nicholas I feared the democratizing potential of information so much that he was willing to risk victory in order to keep the new technology at bay. Years later, his Communist successors would act in a similar manner while trying to outlaw the telephone.

Even as Nicholas I saw in the new technology a recipe for war, others saw the prospect of peace. "Ambassadors can utter each day the voice of the government to which they belong, and communicate the reply from that to which they are sent," Loring said. "The boundaries of states and empires may remain the same, their tongues may differ, their social and civil conditions vary, but united as they are into an international community, intimate with each other's wants and necessities and interests, how can they long remain antagonistic?" Such optimism about the fruits of technology attests to a naive but endearing view that the knowledge relayed by the telegraph would make nations so conversant with the national interests of their one-time enemies that war would come no more. Sadly, that has been the case neither then nor now.

History provides other examples of new communications technologies influencing public opinion. Seventy years after the invention of the printing press, Martin Luther, the founder of the German Protestant tradition and the herald of the Reformation, challenged the papal authorities with a flood of pamphlets that exploited both a new technology and a growing role for public opinion. Luther, who described printing as "God's highest and extremist act of grace, whereby the business of the Gospel is driven forward," published 30 pamphlets between 1517 and 1520 that sold over 300,000 copies.17 Photography made a similar entry into the political scene. Mathew Brady's photographs of the bloodshed at Antietam appeared at his gallery in October 1862, only weeks after the smoke had cleared from the bloodiest battlefield in American military history. The exhibit was a sensation. "Mr. Brady has done something to bring home to us the terrible reality and earnestness of war," wrote a New York Times correspondent on October 20. "If he has not brought bodies and laid them in our dooryards and along the streets, he has done something very like it."18 Vicki Goldberg, author of The Power of Photography: How Photographs Change Our Lives, summed up the photograph's impact this way. "The first living-room war was not Vietnam but the American Civil War. [It] came into the front parlor in word and picture, even in photographs, as no war had before."19 To those who had only imagined the horrors of war, the photographs of corpses lining the battlefield at Antietam were a shock. Every new medium has this intoxicating effect. To those listening to Edward R. Murrow describe German bombing attacks on London, the radio was as instantaneous as any CNN broadcast. None of these innovations, however, changed the essentials of politics; power remained with political leaders who demonstrated both popular appeal and strong convictions.

Leadership

Policymakers feel rushed to comment by the immediacy of a crisis and the mess of microphones and cameras stuck in their faces by reporters who now tread on a 24-hour-a-day news cycle. Although aided by the improved speed of communications, diplomats despair over the shift away from substance that satellite television has produced. Henry Kissinger remarked recently that diplomats seeking his advice used to ask him what they should do. "Now," he droned, "they ask me what they should say."20 As former CIA Director Robert Gates puts it, "The aggressiveness of moment-by-moment commentary gets policy-makers in the frame of mind to answer an ambushing reporter, more than figuring out what to do."21 Any diplomat who resists the temptation, who declines the honor of rushing to judgment by issuing a "No comment," or a "We're studying the problem," risks an avalanche ot mean-spirited editorial opinion that the government in question is inept.

The truth is that diplomacy—the formal conversation between sovereign nations—has not so much been eliminated as driven underground. The meetings between the Israelis and the Palestine Liberation Organization in Norway, the visits of British government officials to Northern Ireland, the Mexican government's negotiations with Zapatista rebels from Chiapas, were all forced into seclusion by the glare of international media attention. Even the diplomatic missions of Robert Oakley to Somalia and Jimmy Carter to North Korea and Haiti, though widely covered, were largely conducted in private. When it is important, when it is necessary, trained diplomats and even political figures can still keep secrets. In fact, the posturing required in front of the cameras after private talks can actually benefit the negotiations inside by forcing diplomats to think about public implications as they negotiate. This has long been the role of the media: to convert private musings into public policy debates.

It is simply untrue that foreign relations have been replaced by public relations. Contrary to Marshall McLuhan's edict that the medium is the message, the message always mattered more than the medium: The Ayatollah Khomeini, living in exile in Paris, used audio cassettes to spread the message of his sermons back home to Iran. East Europeans, eager for the riches and freedom of capitalism, used radio to communicate their revolution. Corazon Aquino offered videotaped messages to anyone who contributed a blank cassette to her 1986 campaign. Students hoping to escape repression in China used the fax machine to relay information about their pro-democracy movement. With Red Army tanks poised to topple a nascent democracy, St. Petersburg Mayor Anatoly Sobchak called out the faithful by computer to surround Boris Yeltsin's White House in a sea of human guards. Subcomandante Marcos, leader of the Zapatistas guerrilla group challenging Mexican rule in the Chiapas region, is said to write his communiques on a laptop computer plugged into the lighter socket of an old pickup truck.[22]

Political leaders are responsible to both the professional diplomats and the public at large. History teaches that there are risks to ignoring either audience, and that these risks are exacerbated by the glare of media attention. In the face of new technology that speeds information and a sensationalist press that tries to sell it, leaders would be best served by ignoring their own press clippings. No one understood this better than Abraham Lincoln, who did not have to contend with television cameras, radio broadcasts, cellular telephones, or even home movies. Lincoln's only burdens were the telegraph and the photograph, and a mischievous, partisan press.

Upon being elected president in 1860 with 40 percent of the vote, most of it from the North and West, Lincoln was assailed with death threats from the South. Detective Allan Pinkerton insisted that on his way to Washington from Springfield, Illinois, Lincoln should avoid Baltimore, where an assassination plot was thought to be brewing. So Lincoln, against his instincts and initial wishes, was huddled onto a less prominent train and sneaked into Washington in the middle of the night. This concession to security was mocked mightily by the Northern papers, which published scathing articles and cartoons about "the flight of Abraham." Lincoln told friends that he was embarrassed by the manner of his arrival, that he regretted not making an entrance into the divided Capitol with head held tall, in broad daylight. But neither did he wallow in pity over the incident. The cloistered arrival in Washington "was the beginning of a relentless smear campaign against 'this backward president' and his 'boorish' wife, particularly on the part of Democratic papers," writes historian Stephen Oates. "Their taunts about his crudities and illiterate manner wounded Lincoln to the core, but he never replied to such journalistic abuse, [rather he] tried to accept it as one of the hazards of his job."[23] That is the forbearance required of political leaders amid a media onslaught.

If history brings a conviction about the primacy of leadership, so too does it leave a certainty that technology is often feared or praised beyond its deserved legacy. To this end, mastering a new technology is a fundamental prerequisite of strong leadership. For all the thresholds crossed by new technologies, individual skills of leadership in the selling of public policy matter most.

The Special Case of Satellite Television

In spite of these historic echoes, or perhaps because of them, some maintain that the current explosion of media technology is exponentially more of a burden than past inventions. The war in Bosnia and the relief effort in Somalia are widely claimed as proof that media technologv is driving world events. In assessing the impact of real-time television, it is important to separate impressions from realities.

For 3 years, a media drumbeat from Bosnia to "do something"—to stop the bloodshed and butchery—did not compel NATO to intervene. Horrific images of bread line massacres and concentration camp victims produced a response more like a palliative than a retaliation. The Serbs massacred, the West sent food to the Muslims. This pattern persisted for 3 years, despite the tug of heart-wrenching pictures. No better example exists of the inability of pictures to sway policy than the city of Gorazde. This Muslim town came under siege after a Serbian attack in April of 1994, and faced another devastating attack in September of 1994. In between, NATO threatened, the United Nations patrolled, the United States air-lifted food, peacekeepers abandoned their posts. If the media had dictated the outcome, Gorazde would have endured one massacre, not two. In 1995, a Serb assault on the marketplace in Sarajevo that killed 37 people, finally prompted NATO to pound Serb targets with air strikes. It is problematic to argue that television pictures produced this result, as they had not had that effect in all the bloodshed that came before. What is more likely is that it took years to build the political will to use muscle in the Balkans, despite the emotional pull of the pictures. Here again is confirmation that leadership is more telling than television.

In Somalia, too, the oft-heard chorus is that "pictures got us in, and pictures got us out." Those who hold this view argue that the vivid and wrenching images of starving Somali children forced President Bush to act, and that the equally horrible pictures of an American soldier's corpse being dragged through the streets of Mogadishu compelled President Clinton to announce a departure date for U.S. troops. The truth is more textured. If TV pictures alone compelled Bush to intervene in Somalia, then they should have had a similar impact in the Sudan, where the starvation was equaily devastating, the pictures equally horrific, and, at first, equally in evidence on CNN.[24] If Clinton had wanted to use political capital to explain to the American public why the United States was in Somalia, if he had used the bully pulpit of high office to make a case that the United States had an obligation to stay, he could have countered the weight of those pictures from Mogadishu. By choosing not to expend his political capital for a cause leftover from an earlier administration, Clinton allowed the pictures to dominate. It is not inevitable, or even desirable, that leaders cede this power to television. It is also not the fault of television.

George Kennan, the esteemed diplomat who was one of the key proponents of the containment policy of the Cold War, criticized U.S. intervention in Somalia because he believed emotions evoked by television pictures were driving American diplomacy. "If American policy from here on out, particularly policy involving the uses of our armed forces abroad, is to be controlled by popular emotional impulses, and particularly ones provoked by the commercial television industry, then there is no place—not only for myself, but for what have traditionally been regarded as the responsible deliberative" voices in government, he wrote in an article written just before U.S. Marines landed on the beaches of Mogadishu. It is a fitting coda to Kennan's lament that when the Marines landed, they encountered only one hostile group—a pack of journalists whose bright camera lights mitigated the strategic effect of the soldiers' night-vision goggles.25 To Kennan, these cameras looked like the enemy.

The old warrior of diplomacy, who had been so prescient in predicting Moscow's aggressions during the period of superpower rivalry, was trying to warn a new generation of the dangers of television and its impact on diplomacy. But Kennan's real quarrel is not with television pictures that hit viewers in the gut but with leaders who too easily yielded to their pull. Scolding the emotionalism of the 1990s, this grand man of foreign policy may have forgotten that he was equally incensed by Franklin Delano Roosevelt's decision in the 1930s to grant concessions to the Soviet Union during negotiations over diplomatic recognition. Chiding FDR in his Memoirs for "showmanship and prestidigitation," Kennan attributes the move to "neurotic self-consciousness and introversion, the tendency to make statements and take actions with regard not to their effect on the international scene...but rather to their effect on...American opinion."26 Then and now, politicians tend to make decisions for political reasons, with public opinion and emotion much on their radar.

Each generation is mesmerized by the innovations of its times, sure that no other generation has experienced the emotional upheaval that comes of technological change. We are in the throes of such self-indulgence now. In the most extreme example, a diplomat at the United Nations recently quipped that CNN had become "the sixth vote on the Security Council."27 Similarly, there are already predictions that the World Wide Web will erase national borders, making governments impotent and sovereignty just a memory. What history shows, instead, is that despite the vanity of each age, journalists have always had the power to sway public opinion, and politicians have always blamed the news media for souring public opinion when they failed to win favor. What changes as one invention gives way to the next is the way in which the message hits home.

Conclusion

As traumatic as satellite television has been for world events, cyberspace could be even more tumultuous. Those who fear the impact on international affairs of Ted Turner's CNN might have more to worry about from Bill Gates' Microsoft. H.L. Mencken once said that the power of the press belongs to the person who owns one. In the coming era of cyberspace, everyone is a publisher, everyone is a journalist, a possibility that blurs the line of professional status.28 If information is the currency of the Internet, then newspapers will have to compete with government offices, business interests, humanitarian groups, and outraged citizens for the public's attention. Readers who prefer to get their information from specialists will have little need for general news, or much appetite for reporters who pretend to be objective while pushing a deliberate if subtle ideological line. Eventually, the audience may be able to ignore the "professional" journalists completely. Online chat rooms already form at the drop of a crisis, as readers reach out to one another for information instead of the traditional sources of news.

For diplomacy and international relations, the medium of cyberspace, like journalism, is a mixed blessing. With this new technology, the potential is enormous for global interaction, and with it common understanding—or at least more information. Already, sophisticated governments and savvy political figures are making use of the Internet's global component, the World Wide Web, to reach former adversaries and attract new investors. Quick to seize the new medium's advantages, the Israeli Foreign Ministry is one of the many political agencies around the world to have set up an Internet address. Computer users can call up a news service that includes selected newspaper articles translated from Hebrew to English, speeches by Israeli politicians, and reports on the Tel Aviv Stock Exchange. "It's a very large discussion group in the global village," said Martin Peled-Flax, a ministry official, who estimated that 700 people browse through the service daily. "In the new realities of this world, information travels at the speed of light. And it doesn't need a passport."29

Soon governments will no longer have the stage to themselves but will be competing against interest groups and non-governmental organizations, against newspapers, local cultural groups and corporate advertisers. One potential pitfall for leaders dealing with cyberspace, a place that does not exist except for the lines of communication between people, is that this type of communication makes unified national experiences rare occurrences. An assassination, a famine, an earthquake, or a terrorist attack may bring people to their screens to peruse the latest news, but marshaling public opinion for national purposes like war or economic sacrifice will likely be even more difficult than it is now. Already television networks are ignoring a president's request for air time and newspapers relegate the comments of top leaders to their back pages. These are tacit acknowledgments that information is decentralizing, that national governments are less relevant, that we are, as Walt Wriston, the former chairman of Citicorp, puts it, in "the twilight of sovereignty."

Perhaps that is why the O.J. Simpson trial riveted national and even international attention, becoming one of the few unifying experiences of 1995. Or perhaps the murder trial of an ex-football star accused of slaying his ex-wife and her friend was the ultimate paean to cultural icons made in America. The Americanization of international culture began long before the O.J. Simpson trial: blue jeans and rock music were in some sense at the heart of Eastern Europe's revolution in 1989, a flight from the rigid bore of communism to the liberation of travel and dance. Madonna and Big Mac are to this day the best-known exports of American culture. O.J. Simpson was only the latest. The problem with real-time television is not that it Americanizes the international agenda or makes celebrities of questionable characters, but that it encourages no feeling for context or for background; in a word, for history.

It is this legacy of ahistoricism, this depicting of a double-murder case in a rich neighborhood in California as "the trial of the century"—as if Nuremberg were just a city in southeast Germany rather than the site of court proceedings against Nazi war criminals—that poses the greatest danger for policymakers, in the field of international as well as domestic affairs. Whether broadcast on real-time television or discussed in virtually real chat rooms, events without history are merely "photo ops." The antidote to mindless or sensational journalism is not to blame the messenger but to influence the message. Whether the subject is ethnic rivalry in Bosnia or murder trials in Los Angeles, satellite television requires a voice of authority to set the record straight. Communication has long been at the heart of leadership. Nothing in technology's charter changes that equation.

NOTES

1. Tom Lewis, Empire of the Air, The Men Who Made Radio (New York, NY: Harper Collins, 1991), p. 32.

2. Carleton Mabee, The American Leonardo: A Life of Samuel F.B. Morse (New York, NY: Alfred A. Knopf, 1943), p. 207.

3. James D. Reid, The Telegraph in America (New York, NY: Arno Press, 1974), p. 92.

4. Daniel J. Czitrom, Media and the American Mind from Morse to McLuhan (Chapel Hill, NC: University of North Carolina Press, 1982), p. 7.

5. House Commerce Committee Report #753, April 6, 1838.

6. Harold A. Williams, The Baltimore Sun 1837- 1987 (Baltimore, MD: Johns Hopkins University Press, 1987), p. 23.

7. Menahem Blondheim, News Over the Wires, The Telegraph and the Flow of Public Information in America, 1844-1897 (Cambridge, MA: Harvard University Press, 1994), p. 34.

8. Reid, p. 736.

9. Reid, p. 889.

10. Author's interview with Marvin Kalb, 1994.

11. Henry David Thoreau, Walden (New York, NY: Collier Books, 1962), p. 48.

12. Ithiel de Sola Pool (ed.), The Social Impacts of the Telephone (Cambridge, MA: MIT Press, 1977), p. 99.

13. Mabee, p. 225.

14. Robert Luther Thompson, Wiring a Continent, The History of the Telegraph Industry in the United States, 1832-1866 (Princeton, NJ: Princeton University Press, 1947), p. 15.

15. Russian scientists had actually preceded Morse, laying the world's first practical electrical telegraph line from St. Petersburg to Kronstadt in 1835. But their military advance was wiped out by the Czar's politics.

16. Anthony Livesey, Great Battles of World War I (New York, NY: Macmillan, 1989), pp. 26-37.

17. For Luther's use of the printing press, see Elizabeth Eisentstein, The Printing Revolution in Early Modern Europe (Cambridge, MA: Cambridge University Press, 1983); and Charles Mee, Jr., White Robe, Black Robe (New York, NY: G.P. Putnam's, 1972).

18. Vicki Goldberg, The Power of Photography, How Photographs Change Our Lives (New York, NY: Abbeville Press, 1991).

19. Goldberg, p. 251.

20. Henry Kissinger's remarks to Everette Dennis.

21. Author's interview with Bob Gates.

22. Tod Robberson, "Mexicans Using a High-Tech Weapon: Internet Helps Rally Support," Washington Post (February 20, 1995), p. 1.

23. Stephen B. Oates, With Malice Toward None, The Life of Abraham Lincoln (New York, NY: Harper & Row, 1977), p. 231.

24. CNN Library shows that CNN did 14 stories in 1991 on the drought and refugee situation in Sudan. As world attention shifted to Somalia, CNN's coverage of the Sudan dropped to 4 stories in 1992, then jumped back to 10 stories in 1993. CNN Library.

25. George Kennan, "Somalia, Through a Glass Darkly," New York Times (September 30, 1993), p. A23.

26. George Kennan, Memoirs, 1925-1950 (Boston, MA: Little Brown & Co., 1967), pp. 53-54.

27. Interview with official at U.S. embassy to the United Nations.

28. See James J. Cramer, "We're All 'Journalists' Now," Washington Post (April 7, 1995), p. A27.

29. The Associated Press, dateline Jerusalem, 11:15 AM EDT, April 22, 1995, V0767.

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Chapter 19: Warfare in the Information Age *

by Bruce Berkowitz

Pentagon officials and defense analysts have a new topic to add to their list of post-Cold War concerns: information warfare, or IW, in the usual manner of military-speak. The term refers to the use of information systems—computers, communications networks, databases—for military advantage, either by the United States or by a variety of unfriendly parties.

IW is drawing increasing attention for at least two reasons. First, the United States is potentially vulnerable to IW attack. The United States, in civilian as well as military matters, is more dependent on electronic information systems than is anyone else in the world. In addition to the possibility that computer and communications systems might prove to be a vulnerable weak link for military forces, there is also a danger that hostile parties—countries, terrorist groups, religious sects, multinational corporations, and so on—could attack civilian information systems directly. Attacking these systems could be easier, less expensive, and certainly less risky than, say, sabotage, assassination, hijacking, or hostage-taking, and a quick cost-effectiveness calculation may make IW an aggressor's strategy of choice.

The second reason why the defense community is so intrigued with IW is that it may be as much an opportunity as it is a threat. The United States may be able to develop new military strategies using IW that are perfectly tailored to world conditions following the Cold War. Information technology is a U.S. strong suit, and military forces could use this know-how to improve our defense capabilities, perhaps dramatically, against hostile attack and to defeat any aggressors—and to accomplish both missions at the lowest possible cost. Indeed, U.S. military planners are already taking the first steps in this direction.

Yet, despite all of the attention that IW is receiving, several basic questions about information warfare remain to be resolved. These include:

- What is the actual IW threat, and how much should the United States worry about it? IW aficionados have suggested a number of scenarios in which IW might be used against us, but other observers think at least some of them are far-fetched.

- If the IW threat is real, what does the United States need to do in order to protect itself? Conversely, what must we do in order to make the most of the IW opportunity?

- As a practical matter, how should information warfare be integrated into overall U.S. defense planning? Will IW replace some military capabilities or merely supplement them? Should IW be considered "special," like atomic weapons or chemical weapons, and kept separate from other military forces, or should IW be part of the military's overall organization and planning process?

- What are the implications of IW for current concepts of offense, defense, coercion, and deterrence? For example, is it more difficult to deter an IW attack? Does information warfare automatically escalate to conventional warfare, or vice versa?

- What is the relationship between the military and civilian society in preparing for information warfare? Also, how can the nation protect democratic values—namely, freedom of expression and personal privacy—while taking the measures necessary to defend against an IW threat?

These are very basic issues. We have experience in dealing with similar questions in other areas of defense policy, but information warfare is in many ways quite different. So, if the world is indeed entering an Information Age and IW has the potential to improve, undermine, or just generally complicate U.S. military planning, we need to address such issues now.

Origins of the Threat

Military weapons and military strategy usually reflect the politics, economy, and—most especially—the technology of any given society. Even the writers of scripture understood the technological relationship between plowshares and swords, and we take for granted the two-sided nature of nuclear power, long-range jet aircraft, and rockets. Thus, today's improvements in computers, communications, and other electronic data-processing systems that are driving economic growth and changing society are also changing military thinking and planning.

Armies have always used information technology —smoke signals in ancient days, telegraphs at the turn of the century, precision-guided munitions today—but until recently information systems were second in importance to "real" weapons, such as tanks, aircraft, and missiles. Today, information systems are so critical to military operations that it is often more effective to attack an opponent's information systems than to concentrate on destroying its military forces directly.

Also, because modern societies are themselves so dependent on information systems, often the most effective way to attack an opponent is to attack its civilian information infrastructure —commercial communications and broadcasting networks, financial data systems, transportation control systems, and so on. Not only is this strategy more effective in crippling or hurting an opponent, but it often has some special advantages of its own, as will be seen.

Some recent books and films have raised the issue of information mayhem, although they may have exaggerated the dangers. High school students cannot phone into the U.S. military command-and-control system and launch a global thermonuclear strike (a la the 1984 movie "War Games"), and it would be hard for a band of international cyber-terrorists to totally eradicate a woman's identity in the nation's computer systems (as in 1995's screen thriller "The Net"). But consider some of the scenarios that the Department of Defense has studied:

Approximately 95 percent of all military communications are routed through commercial lines. U.S. troops depend on these communications; in some cases, even highly sensitive intelligence data is transmitted in encrypted form through commercial systems. Although hostile countries may not be able to intercept and decipher the signals, they might be able to jam the civilian links, cutting off U.S. forces or rendering useless numerous intelligence systems costing hundreds of millions of dollars.

The United States buys most of the microchips used in military systems from commercial vendors, many of which are located in foreign countries. The chips are dispersed throughout a variety of weapons and perform a range of functions. Some experts are concerned that someone might tamper with these chips, causing the weapons to fail to perform when needed.

One lesson of Operation Desert Storm is that it is unwise to provoke a full-scale conventional military conflict with the United States and its allies. A more subtle alternative might be to send several hundred promising students to school to become computer experts and covert hackers. Such a cadre could develop the training and tactics to systematically tamper with U.S. government and civilian computer systems. But unlike pranksters, they would play for keeps, maximizing the damage they cause and maintaining a low profile so that the damage is hard to detect.

Some strategic thinkers believe that "economic warfare" between countries is the next area of international competition. This may or may not be so, but it is possible for government experts, skilled in covert action, to assist their countries' industries by well-designed dirty tricks. For example, a bogus "beta tester" could sabotage the market for a new software product by alleging on an Internet bulletin board that the pre-release version of the program has major problems.

Modern military aircraft, such as the B-2 bomber and F-22 fighter, are designed without a single blueprint or drawing. Rather, they use computer-assisted design/computer-assisted manufacturing (CAD/CAM), in which all records and manufacturing instructions are maintained on electronic media and shared on a closed network. This makes it possible for plants across the country to share databases and to manufacture components that fit together with incredible precision. But it also makes these programs dependent on the reliability and security of the network, which might be compromised by an insider with access.

Like many large-scale industrial operations today, the military uses "just-in-time" methods for mobilization. That is, to cut costs and improve efficiency, the military services trim stockpiles of spare parts and reserve equipment to the minimum, and they use computers to make sure that the right part or equipment is delivered precisely when needed to the specific user. If the computers go down, everything freezes.

The problem is that it will be hard to integrate IW into U.S. defense planning without building public support. Citizens will need to understand why the government is undertaking IW programs and how the programs may permit other military programs to be phased out. Without public discussion and understanding of how IW capabilities might replace some conventional military systems, the nation may needlessly spend money for both conventional and IW programs. Secrecy also tends to increase costs.

DOD and think tanks have in recent years been actively studying the national security threats that these and other IW scenarios present to U.S. security. But it is also important to remember that, in addition to the threat to military forces, many of these same vulnerabilities apply to commercial industry and the civilian infrastructure. Virtually all communications systems are computer-controlled. Virtually all aircraft and land vehicles have computer-based components. Most transportation systems—aircraft, railroads, urban transit—are directed by remote communications and computers. Thus, virtually all of these civilian systems are also vulnerable to IW attack and could become targets to unfriendly parties.

The Changing Face of War

One way to understand the impact of IW on military thinking is to recall the evolution of mechanized warfare. Beginning in the mid-1800s, the Industrial Revolution made it possible to develop new weapons that were much more capable than anything produced before: mass-produced machine guns, steam-powered armored warships, long-range artillery capable of hitting targets from several miles away, and so on. The military also benefited from technology that had been developed mainly for civilian purposes, such as railroads and telegraphs, which vastly improved the ability of military forces to mobilize and to maneuver once they arrived at the battlefield. War became faster, longer ranged, and more deadly. Just as important, new technology also created new targets. Military forces became critically dependent on their nation's industrial base—no factories, no mass-produced weapons, and no mass-produced weapons meant no victory. So, destroying a nation's industrial base became as important as destroying its army, if not more so.

The result was not just an adjustment in military thinking but a complete rethinking of how to wage war. Military planners began to understand that the faster, longer range weapons offered the opportunity of leapfrogging the front lines on a battlefield in order to destroy an enemy's factories, railroads, and telegraph lines directly. A classic case in point is the progression from the invention of the airplane to the development of the entirely new doctrine of strategic bombing. Moreover, these military planners realized that such an expanded warfare plan was not only a possibility; in many cases, it was likely to be the dominant strategy.

Today's information revolution presents a similar situation. And just as new theories and doctrines were developed for industrial-age warfare, so have thinkers begun to develop a theory and doctrine for IW. As with mechanized warfare and strategic bombing, where it took awhile for military thinking to catch up with the technology, IW concepts have required a few years to mature. In fact, just as aircraft had been in use for almost three decades before the doctrine of strategic bombing was invented, the roots of IW also go back many years. For example, most of the tactics envisioned for attacking an opponent through its information systems—destruction, denial, exploitation, and deception—can be traced to classical military and intelligence fields, such as signals intelligence and cryptography, electronic countermeasures and jamming, "black" propaganda and disinformation, and measures for concealment and camouflage.

What stands clear today is that information technology has reached critical mass. Information systems are so vital to the military and civilian society that they can be the main targets in war, and they can also serve as the main means for conducting offensive operations. In effect, IW is really the dark side of the Information Age. The vulnerability of the military and society to IW attack is a direct result of the spread of information technology. Conversely, IW's potential as a weapon is a direct result of U.S. prowess in information technology.

Indeed, many of the problems of dealing with IW are linked to the nature of information technology itself. The most important feature may simply be the falling cost of information processing; since the 1950s, costs have declined at a rate of about 90 percent every 5 years, and most experts expect this trend to continue for the foreseeable future. One result is that information technology—and, with it, the ability to play in the IW game—is constantly becoming more available, and quite rapidly. Unlike nuclear weapons technology or aerospace weapons technology, which have been spreading steadily but slowly, the diffusion of IW technology is likely to accelerate. If a party cannot afford some form of information technology and IW capability today, it probably will be able to afford the technology tomorrow. This is evidenced in the spread of dedicated military electronic systems, but even more in the availability of commercial information technology such as computer networks, satellite and fiber-optic communications, cellular telephone systems, and so on. All of these can be used for hostile purposes, and all can be attacked by a hostile power.

A second feature of information technology that affects IW is that as the technology becomes cheaper and cheaper, it becomes less and less efficient to control information from a central authority. Indeed, one reason for the current increasing pressure in society to decentralize government, corporations, and other organizations is that low-cost information technology makes it affordable and feasible to decentralize. The demand and incentives for decentralization are following the technological opportunity.

This trend runs counter to several centuries of military tradition and experience, which are based on hierarchical command structures, rank, and centralized control. The new technology does not support the traditional military model. Also, the trend toward decentralized information systems changes the government's ability to interact with the commercial sector. As a result, national security officials and military planners must find new ways of issuing instructions and implementing policies.

Dealing with Infowar

With these characteristics in mind, it is possible to discuss some specific issues and problems that the United States will face in dealing with information warfare.

The IW threat will grow because entry costs are low. As the cost of information technology falls, a greater number of foreign governments and nongovernment organizations will present a potential IW threat to the United States. Countries that could not match the United States and its Western allies in expensive modern weapons systems, such as tanks, aircraft, and warships, will be able to buy the computers and communications systems necessary to carry out IW.

One defining feature of the post-Cold War era has been that the single, large threat of the Soviet Union has been replaced by a greater number of lesser threats. The declining cost of information technology has facilitated this trend, and many of the new threats will take the form of IW. As a result, the U.S. military will need to think about IW threats coming from a number of different directions.

To complicate matters further, each threat will probably be somewhat different. One terrorist group might like to fiddle with transportation control systems; another might be dedicated to compromising DOD databases. In the past, the United States has tailored its forces and plans to deal with the single Soviet threat, and has assumed that, if it could defeat the Soviet Union militarily, it could also deal with what the Pentagon calls "lesser included threats." In the IW world, threats are likely to be as varied as tailored software, and U.S. military forces will need to deal with each on its own terms.

There will be an international learning curve. Not only will more players engage in IW, they will steadily get better at it. Because information is so easily transferred, everyone can quickly learn from the IW mistakes that others make. For example, Desert Storm was essentially a situation in which one side fought a classical twentieth century conventional war while the other side fought a classical twenty-first century IW war. The Iraqi army was not outgunned; indeed, it had a numerical edge, as well as the advantages of fighting from prepared defensive positions and its experience in battle gained during Iraq's decade-long war with Iran. The US. advantage was in information technology—intelligence, communications, precision-guided munitions, night vision equipment, stealth technology, and electronic countermeasures. As a result, the United States and its coalition partners were well-coordinated and could adjust their operations in real time, whereas Iraqi forces were isolated, disorganized, and blind.

It's unlikely future foes will repeat Iraq's mistakes and permit opponents such a free hand in the contest for what DOD has taken to calling "information superiority" on the battlefield. Indeed, a country or organization with even a rudimentary knowledge of IW could take countermeasures that can greatly reduce the U.S. advantage. The upshot is that the United States will have to work hard and persistently in order to maintain its present IW advantage. Also, because the U.S. advantage could potentially be tenuous and fleeting, it will be necessary to monitor the changing IW threat and develop the systems and expertise necessary to deal with it.

The Changing Face of Deterrence

The problem is that it will be hard to integrate IW into U.S. defense planning without building public support. Citizens will need to understand why the government is undertaking IW programs and how the programs may permit other military programs to be phased out. Without public discussion and understanding of how IW capabilities might replace some conventional military systems, the nation may needlessly spend money for both conventional and IW programs. Secrecy also tends to increase costs by limiting competition and reducing the ability of DOD to draw on unclassified and commercial programs.

One of the greatest difficulties in deterring a would-be IW threat is that an attacker may be anonymous. A country or nongovernmental group could tamper with U.S. communications and computer systems just enough to cause damage, but not enough so the perpetrator can be identified. To paraphrase a metaphor offered by Thomas Rona, a long-time IW thinker, we will be unlikely to find a smoking gun because our opponents will likely use smokeless powder. With no "attacker ID," it would be hard to determine who deserves retaliation, and without the threat of retaliation, deterrence usually fails. Indeed, a truly diabolical enemy would most likely adopt the strategy of an unseen parasite, quietly causing problems that would be attributed to normal glitches we routinely accept with software and information systems. (Have you tried installing OS-2 Warp or Windows 95 on your computer? Many people simply expect electronics to be difficult.)

Another problem for deterrence is that, even if an IW attack is identified, it may be difficult to develop an effective option for retaliation. As one DOD official has said, "What are we going to do, nuke them for turning off our TVs?" An IW attack may be just crippling and expensive, rather than lethal, so conventional retaliation (say, an airstrike) may be unpopular. On the other hand, because the United States is so dependent on information technology, we would likely come out on the losing end of a game of IW tit for tat. And mere diplomatic responses are likely to be ineffective.

Who will be responsible for IW? In the past, the usual response of the military to a new technology has been to assign responsibility for it to a new organization; for example, the Strategic Air Command (now simply Strategic Command) was created to assume responsibility for long-range bombers and missiles. Indeed, within DOD responsibility for information technologies has historically been assigned to specific organizations—the National Security Agency (NSA) in the case of signals intelligence and information systems security, the Central Intelligence Agency (CIA) in the case of covert operations such as black propaganda and covert political action, the National Reconnaissance Office (NRO) in the case of surveillance satellites, and so on.

Currently, each of the military services is developing an IW strategy to assist it in developing new weapons and doctrine, and commanders of U.S. military units deployed in the field are developing plans for IW in their theater of operation. DOD officials have mused—briefly— whether to consolidate responsibilities for IW in a single organization. Most have quickly concluded that this would not make sense. Not only would there be turf battles among existing organizations; such an organization would be inconsistent with the trend in which information systems are, in fact, becoming more decentralized.

Indeed, the more appropriate question may be why we need large operating organizations such as NSA and NRO when information systems are becoming cheaper, networked, and decentralized. It may soon be more efficient for military units to operate their own signals intelligence and even reconnaissance systems. There already is some movement in that direction; for example, Army and Navy units operate their own reconnaissance drone aircraft.

The objective should be to permit IW technology to spread throughout the DOD organization while ensuring that IW operations are coordinated so that they are consistent with national policy and the strategy of military commanders. At the same time, DOD needs to ensure that IW systems in the military can operate with each other and with those in the civilian world, without creating an unwieldy bureaucracy or body of specifications.

Planning for IW "Civil Defense"

Planning for IW requires cooperation between the defense sector and the commercial sector. Civilian information systems are prime candidates for attack. So just as cities are targeted in strategic bombing, in future wars we can expect civilian information systems to be hacked, tapped, penetrated, bugged, and infected with computer viruses.

Another reason for cooperation is that DOD itself depends heavily on the civilian information infrastructure. As noted earlier, not only does the military use civilian information systems for "routine" activities such as mobilization; sometimes even the transmission of sensitive intelligence data is routed through commercial links. Obviously, it would be impossibly expensive for DOD to make the entire civilian information infrastructure secure to military standards. And even if it were affordable, the passwords, encryption systems, and other security measures would make it incredibly inconvenient for public use.

Moreover, the government's ability to control or influence the civilian information industry is limited. DOD lacks the leverage it has enjoyed in other situations. For example, the Air Force can influence the design of spacecraft because it is the largest operator of space systems, but DOD's share of the total computing and communications market is quite small compared with commercial users. Also, today's commercial information industry is often ahead of the defense industry in developing new technology. So, whereas DOD once could effectively create industry standards in order to enhance security though its leading-edge role in research and development and its buying power, standards are now being set by companies in the market. Add to this the burgeoning information industry worldwide and DOD's influence is diminished further.

The upshot is that DOD cannot use traditional-style directives or specifications to improve the ability to defend the nation against the IW threat. If it tries, no matter how well intentioned, it will likely fail. As evidence, consider the recent Clipper Chip episode, in which the federal government tried to cajole and coerce the information industry to adopt a NSA-developed encryption system. The Clipper Chip was supposedly indecipherable, but critics claimed that any system designed by the government would permit the government to read messages using the code (in cryptography parlance, this is called "back door access"). According to the critics, the government's objective was to preserve the ability of NSA and law enforcement agencies to read encrypted communications that they intercepted.

Not only did the industry reject the Clipper Chip, but the government was unable to prevent private computer programmers from developing and illegally distributing their own encryption systems that the government supposedly could not crack or systems (such as SATAN) that can detect "back doors." The lesson of the Clipper Chip is that DOD must use a more sophisticated, less heavy-handed approach to get the civilian sector to take measures to protect itself against the IW threat. Because directives and standards usually will not work, DOD officials need to learn how to use incentive systems instead.

For example, simply informing industry and individuals that they could be IW targets will often lead them to adopt "street smart" information behavior to protect themselves from both foreign and domestic attack. DOD officials themselves have suggested that the government could encourage insurance companies to charge appropriately higher rates to corporations that did not take reasonable steps to protect their data or information systems (again, on the assumption that making the insurance companies aware of the damage an IW attack could cause will generally suffice). In cases in which DOD is critically dependent on a civilian information link, it may even make sense for the government to subsidize the civilian operators so that they adopt protective measures.

In other cases, the government may need to face the fact that some of its traditional activities will simply no longer be possible—for example, easily reading most transmissions that it intercepts. Instead, the government could concentrate on providing industry with the means to protect its information system. Indeed, in at least some cases it would seem that using the government's technical expertise to give U.S. industry an edge in the IW wars may do more for national security than collecting and decoding signals.

Ensuring Democratic Control of IW Policy

Reconciling information security obviously collides with allowing easy access to information systems and freedom of expression. However, IW presents another problem for American democracy.

It is possible to imagine ways in which offensive IW tactics might cost less or be more effective than conventional military options; suffice it to say that almost all the tactics ascribed to our opponents could, at least potentially, be considered for adoption by the United States. Yet the defense community rarely discusses the offensive use of information warfare. The reason for this reticence is that, like intelligence plans and systems, IW options are easily compromised once the opponent learns about them. Even in the case of defensive IW, some government officials are reluctant to discuss the threat, thinking that raising attention to U.S vulnerabilities will encourage new groups to target the United States.

The problem is that it will be hard to integrate IW into U.S. defense planning without building public support. Citizens will need to understand why the government is undertaking IW programs and how the programs may permit other military programs to be phased out. Without public discussion and understanding of how IW capabilities might replace some conventional military systems, the nation may needlessly spend money for both conventional and IW programs. Secrecy also tends to increase costs by limiting competition and reducing the ability of DOD to draw on unclassified and commercial programs. One reason why commercial information technology is usually equal or superior to its military counterparts, and almost always less expensive, is that greater competition in the private sector forces innovation and pushes down prices.

Unless U.S. leaders deal with the problem of reconciling secrecy and democracy, IW will likely remain a marginal asset. In fact, the political system has considerable experience in dealing with such issues; nuclear weapons, intelligence operations, and covert action are all routinely reviewed by Congress and, at a more general level, are discussed in the public media. It seems reasonable that the nation can also have a public debate over the place of IW in U.S. defense policy without compromising the policy itself.

Prescriptions for Preparedness

Dealing with the IW threat and especially with aggressive attackers who use IW as their main weapon against the United States will require new approaches. In most cases, it will probably be impossible to build a foolproof defense for the civilian information infrastructure. But it should be possible to prevent "cheap kills" by informing the general public and industry of the threat though formal and informal networks for government-civilian cooperation.

In the case of vital military communications links and computer systems, it may be possible to build hardened "point defenses," taking extra steps to thwart attackers. These could include, for example, building dedicated transmission lines for communications, isolating critical computers from all outside networks, and using hardware and software security systems that might be excessively expensive or inconvenient for commercial use but which are necessary for vital DOD systems. These measures would also need to be repeated in the production of hardware and software, and in some cases dedicated production lines might be necessary for the most sensitive systems.

Yet, because defense and deterrence are both so difficult to achieve in IW, the best strategy to protect the most vital information systems may be stealth—keeping the very existence of such an information system a secret so that it does not become a target. Of course, "secret information system" is the ultimate oxymoron, which is another way of saying that such systems will also likely be among the most expensive, inefficient, and difficult to use.

The most challenging measures, though, are likely to be political, economic, and cultural. IW requires new concepts within DOD because traditional approaches to military planning and military command and control will not work for it. And the same is true across society, where the measures for countering the IW threat will often collide with the essential features of the democratic, free-market system that an IW policy is intended to protect.

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Part Four: International Affairs

Introduction

Inevitably, the impacts of the Information Age will affect international affairs as well as commerce and culture, business and the services, and the government and military. Indeed, according to James Robinson in his article, "Technology, Change, and the Emerging International Order," the technologies of the Information Age have already had a significant impact on international affairs and the structure of the international system. In Robinson's view, the inability of the Soviet Union to apply the advanced information and communication technologies of the "third industrial revolution" to economic development and economic competitiveness played a significant role in the collapse of the U.S.S.R. Further, Soviet General Secretary Mikhail Gorbachev's efforts to loosen the reigns of state control to permit the Soviet Union to accommodate the new technologies accelerated the collapse of the world's first communist state and led directly to the demise of the old bipolar international system.

But where do we go from here? To Robinson, the answer is straightforward: a globalized system of "international markets now function[s] as essentially one where buying and selling never stops." This has led to the increased mobility of capital, goods, and services, with multinational corporations providing much of the impetus behind the march toward globalization. However, Robinson recognizes there is a downside to the new technologies for some states, especially those that have neither the managerial expertise, technical know-how, or financial capabilities to take advantage of the capabilities the technologies afford. Nevertheless, because they redefine "the basis of power and economic competitiveness," Robinson argues, the new technologies are "forcing increasing numbers of states to become democratic and adopt market-based economies."

Barney Warf uses a different approach to reach many similar conclusions in his "Telecommunications and the Changing Geographics of Knowledge Transmission in the Late 20th Century." Basing his analysis on geography and spatial dynamics, Warf concentrates on the impact of transborder flows of data and services made possible by teleports and the Internet, concluding that at least in the early phases of the Information Age, "uneven development and spatial inequality" are the result. The author points to three different features that he believes are central features of this trend: (1) the emergence of "world cities" such as London, New York, and Tokyo, where much of the international traffic in information and finance is centered; (2) the development of "offshore banking" centers in locations such as Bahrain, the Cayman Islands, Liechtenstein, and Vanuatu, that permit individuals, groups, and corporations to conduct financial affairs "outside the regulation of their national authorities"; and (3) the globalization of "back offices" that perform routinized clerical functions in locations where there is cheap labor far distant from a business's primary location.

At the same time, Warf stresses, "the emergence of global digitalized networks" has "generated growth in a number of unanticipated places" such as Singapore, Hungary, and the Dominican Republic. Since it was unexpected as recently as a decade ago that economic growth would result in these and other locations that have benefited from the new information and communication technologies, Warf predicts that "the future will hold an equally unexpected, even bizarre, set of outcomes."

But economic development resulting from the technologies of the Information Age does not necessarily have to be random or unexpected, or so Jean-Francois Rischard argues in the third article, "Connecting Developing Countries to the Information Technology Revolution." Rischard concurs that a tidal shift is taking place in the way the world works, on a visible basis in business (as demonstrated by "accelerated, more standardized business processes"; "increasingly complex trans-national business alliances"; "hypercompetitive purchasing worldwide"; "borderless capital flows"; and "soaring international trade in services") and on a not-yet-visible social basis (in "teleworking on a large scale"; "education as a universally tradable commodity"; "teleshopping"; "the advent of paperless electronic money systems"; and a "revolution in human organizations").

This, Rischard posits, lays the groundwork for the use of information technologies in economic development on a global basis, especially in areas such as education and training, better health systems, improved environmental monitoring and management, reduced isolation, improved connectivity between small and large businesses, and better government. Developing countries have a responsibility in making this happen, Rischard says, and must undertake several tasks: raise awareness that change is happening and that it is inevitable, invest heavily in information infrastructure development, and mobilize additional resources to increase demand in areas such as education, technical literacy, and computer literacy. But developed countries have a responsibility too, Rischard concludes, and that is to help reduce the "knowledge gap" between the have's and the have not's. This, Rischard believes, will accelerate development and alleviate poverty.

Despite the need to apply information and communication technologies in efforts to combat poverty in developing countries, the benefits of the Information Age to date have not been restricted to large rich countries. Some small countries both rich and poor have also benefited, as was already pointed out in Barney Warf's article. However, in their article "Little Engines That Could: Computing in Small Energetic Countries," J.L. Dedrick, S.E. Goodman, and K.L. Kraemer use Singapore, Hong Kong, Ireland, New Zealand, Israel, and several Nordic states to point out that in small countries, having at least a modicum of wealth seems to abet entry into the Information Age. At the same time, they maintain that government policy toward trade, investment, information technology production and use, and defense are also critical factors in information technology adoption and use. Although "a laissez-faire policy approach is adequate for the diffusion of IT use," they continue, "some forms of active government support seem necessary for a country to become a major [information technology] producer."

The authors also delve into the desire of some states to control internal flows of information for political reasons. However, they do not pursue the point very far; indeed, they close with a crucial question that they do not answer: "Can such countries participate in the global information economy while maintaining domestic control over access to information, or will their political and social cultures have to change to deal with a potential flood of uncontrolled information?"

Daniel S. Papp and David Alberts close the anthology with a far-ranging chapter that offers several observations about the impacts of emerging information and communication technologies on international actors and the international system. Basing their assessments on conclusions developed in earlier chapters in this anthology, Papp and Alberts believe that their first four observations are applicable not only at the international actor and system levels of analysis, but also at levels below the international actor and system, that is, within individual states, corporations, organizations, and institutions.

To Papp and Alberts, their first conclusion is straightforward: As the cost of information goes down and the accessibility and flow of information increase, there will be more and more locations at which information will be available, and a greater and greater proliferation of ability to communicate it and analyze it. Their second conclusion is that at all levels of analysis, decision-making authority will be increasingly decentralized as a result of this, although efforts will be made by some individual actors, institutions, and organizations to maintain centralized control. The authors also conclude that the Information Age will bring with it greater permeability of actor, institutional, and organizational boundaries, although some will again seek to curtail such permeability. Fourth, new forms and types of actors, institutions, and organizations will also emerge, including "virtual" entities, some of which will be ephemeral and others of which will be amorphous.

The authors next explore the impact of the Information Age on the primary types of actors at the international level, including states, international governmental organizations (IGOs), multinational corporations (MNCs), and non-governmental organizations (NGOs). They raise questions about the future role of the state, posit that IGOs will remain hostage to state objectives even in the Information Age, and speculate that MNCs, NGOs, and other related international actors may attain even greater prominence in the Information Age.

Papp and Albert's last four conclusions apply primarily to the international system level of analysis. First, they argue, traditional power relationships among individual actors and types of actors will be disrupted. Second, as the Information Age progresses, regionalization and globalization will accelerate, sometimes in competition with one another, and sometimes local and national reaction to both will set in. Third, to the extent that new information and communication technologies create new wealth and are adopted at different rates by different international actors, the Information Age has potential to lead to increasingly skewed patterns of distribution of wealth within and between international actors. And finally, as a result of the above impacts, the international system that accompanies the Information Age will be more diffuse than those which existed earlier in the twentieth century.

The Information Age, then, promises to usher in a brave new world that will contain many uncertainties. But one certainty that will exist is that of change. However, as it was observed earlier, we are in a certain sense fortunate, for we are now only at the dawn of the Information Age. Thus, we have a window of time during which we can look for answers before the full impact of the Information Age is upon us.

Nevertheless, the full impacts of the Information Age are fast approaching, so our window of opportunity is a small one. The time to begin examining the questions and issues raised here is now. And the answers that we develop will in turn play a role in determining what the Information Age becomes, for as Peter Drucker once observed, albeit somewhat paraphrased, assessing the future impacts of information and communication technologies on human affairs is not an effort to assess the future, but to assess the future of present decisions.

Chapter 20: Telecommunications and the Changing Geographics of Knowledge Transmission in the Late 20th Century *

by Barney Warf

This paper constitutes an ambitious overview of the development, spatial dynamics, and economic consequences of international telecommunications in the late twentieth century as they arise from and contribute to the expansion of a global service economy. It opens with a broad perspective of recent changes in trade in producer services, particularly international finance, as the propelling force behind a large and rapidly expanding telecommunications infrastructure. Secondly, it explores the political economy of one of the largest and most renowned electronic systems, the Internet. Thirdly, it dwells upon the spatial dimensions of the mode of information, including the flowering of a select group of global cities, offshore banking centres, and the globalisation of clerical functions. Fourthly, it traces the emergence of what is called here "new informational spaces," nations and regions reliant upon information services at the core of their economic development strategies. The conclusion summarizes several themes that arise persistently in this discussion.

The Global Service Economy and Telecommunications Infrastructure

There can be little doubt that trade in services has expanded rapidly on an international basis,1 comprising roughly one-quarter of total international trade. Internationally, the U.S. is a net exporter of services (but runs major trade deficits in manufactured goods), which is one reason why services employment has expanded domestically. Indeed, it could be said that as the U.S. has lost its comparative advantage in manufacturing, it has gained a new one in financial and business services.2 The data on global services trade are poor, but some estimates are that services comprise roughly one-third of total U.S. exports, including tourism, fees and royalties, sales of business services, and profits from bank loans.

The increasing reliance of financial and business services as well as numerous multinational manufacturing firms upon telecommunications to relay massive volumes of information through international networks has made electronic data collection and transmission capabilities a fundamental part of regional and national attempts to generate a comparative advantage.3 The rapid deployment of such technologies reflects a conjunction of factors, including: the increasingly information-intensive nature of commodity production in general (necessitating ever larger volumes of technical data and related inputs on financing, design and engineering, marketing, and so forth); the spatial separation of production activities in different nations through globalised sub-contracting networks; decreases in price and the elastic demand for communications; the birth of new electronic information services (e.g., online databases, teletext and electronic mail); and the high levels of uncertainty that accompany the international markets of the late twentieth century, to which the analysis of large volumes of data is a strategic response.4 The computer networks that have made such systems technologically and commercially feasible offer users scale and scope economies, allowing spatially isolated establishments to share centralised information resources such as research, marketing and advertising, and management.5 Inevitably, such systems have profound spatial repercussions, reducing uncertainty for firms and lowering the marginal cost of existing plants, especially when they are separated from one another and their headquarters over long distances, as is increasingly the case.

Central to the explosion of information services has been the deployment of new telecommunications systems and their merger with computerised database management.6 This phenomenon can be seen in no small part as an aftershock of the microelectronics revolution and the concomitant switch from analogue to digital information formats: the digital format suffers less degradation over time and space, is much more compatible with the binary constraints of computers, and allows greater privacy.7 As data have been converted from analog to digital forms, computer services have merged with telecommunications. When the cost of computing capacity dropped rapidly, communications became the largest bottleneck for information-intensive firms such as banks, securities brokers, and insurance companies. Numerous corporations, especially in financial services, invested in new communications technologies such as microwave and fibre optics. To meet the growing demand for high-volume telecommunications, telephone companies upgraded their copper-cable systems to include fibre-optics lines, which allow large quantities of data to be transmitted rapidly, securely, and virtually error-free. By the early 1990s, the U.S. fibre-optic network was already well in place. In response to the growing demand for international digital data flows beginning in the 1970s, the United Nation's International Telecommunications Union introduced Integrated Service Digital Network (ISDN) to harmonise technological constraints to data flow among its members.8 ISDN has since become the standard model of telecommunications in Europe, North America, and elsewhere.

The international expansion of telecommunications networks has raised several predicaments for state policy at the global and local levels. This topic is particularly important because, as we shall see, state policy both affects and is affected by the telecommunications industry. At the international level, issues of transborder data flow, intellectual property rights, copyright laws, etc., which have remained beyond the purview of traditional trade agreements, have become central to GATT and its successor, the International Trade Organization. At the national level, the lifting of state controls in telecommunications had significant impacts on the profitability, industrial organisation, and spatial structure of information services. In the U.S., for example, telecommunications underwent a profound reorganisation following the dissolution of AT&T's monopoly in 1984, leading to secular declines in the price of long-distance telephone calls. Likewise, the Thatcher government privatised British Telecom, and even the Japanese began the deregulation of Nippon Telegraph and Telephone.

Telecommunications allowed not only new volumes of inter-regional trade in data services, but also in capital services. Banks and securities firms have been at the forefront of the construction of extensive leased telephone networks, giving rise to electronic funds transfer systems that have come to form the nerve centre of the international financial economy, allowing banks to move capital around a moment's notice, arbitraging interest rate differentials, taking advantage of favourable exchange rates, and avoiding political unrest.9 Citicorp, for example, erected its Global Telecommunications Network to allow it to trade $200 billion daily in foreign exchange markets around the world. Such networks give banks an ability to move money—by some estimates, more than $1.5 trillion daily10—around the globe at stupendous rates. Subject to the process of digitisation, information and capital become two sides of the same coin. In the securities markets, global telecommunications systems have also facilitated the emergence of the 24-hour trading day, linking stock markets through the computerised trading of stocks. Reuters and the Chicago Mercantile Exchange announced the formation of Globex, an automated commodities trading system, while in 1993 the New York Stock Exchange began the move to a 24-hour day automated trading system. The world's major financial centres are easily connected even with an 8-hour trading day. The volatility of stock markets has increased markedly as hair-trigger computer trading programmes allow fortunes to be made (and lost) by staying microseconds ahead of (or behind) other markets, as exemplified by the famous crashes of 19 October 1987. It is vital to note that heightened volatility, or the ability to switch vast quantities of funds over enormous distances, is fundamental to these capital markets: speculation is no fun when there are no wild swings in prices.11

Within the context of an expanding and ever more integrated global communications network, a central role in the formation of local competitive advantage has been attained by teleports, which are essentially office parks equipped with satellite earth stations and usually linked to local fibre-optics lines.12 The World Teleport Association defines a teleport as:

An access facility to a satellite or other long-haul telecommunications medium, incorporating a distribution network serving the greater regional community and associated with, including, or within a comprehensive real estate or other economic development.13

Just as ports facilitate the transshipment of cargo and airports are necessary for the movement of people, so too do teleports serve as vital information transmission facilities in the age of global capital. Because telecommunications exhibit high fixed costs and low marginal costs, teleports offer significant economies of scale to small users unable to afford private systems.14 Teleports apparently offer a continually declining average cost curve for the provision of telecommunications services. Such a cost curve raises important issues of pricing and regulation, including the tendency of industries with such cost structures to form natural monopolies. Government regulation is thus necessary to minimise inefficiencies, and the pricing of telecommunications services becomes complex (i.e., marginal revenues do not equal marginal costs, as in non-monopolistic, non-regulated sectors).15

In the late 1980s there were 54 teleports in the world, including 36 in the U.S.16 Most of these are concentrated in the industrialised world, particularly in cities in which data-intensive financial and business services play a major economic role. In Europe, London's new teleport in the Docklands will ensure that city's status as the centre of the

Euromarket for the near future; Hamburg, Cologne, Amsterdam, and Rotterdam are extending telematic control across Europe.

Tokyo is currently building the world's largest teleport. In the 1980s, the Japanese government initiated a series of high-technology "technopolises" that form part of a long-term "teletopia" plan to encourage decentralisation of firms out of the Tokyo region to other parts of the nation.17 In 1993 the city initiated the Tokyo Teleport on 98 ha of reclaimed land in Tokyo harbour.18 The teleport's "intelligent buildings" (those designed to accommodate fibre optics and advanced computational capacity), particularly its Telecom Centre, are designed to accommodate ISDN requirements. Wide Area Networks (WANs) provide local telecommunications services via microwave channels, as do Value Added Networks on fibre-optic routes. The site was originally projected to expand to 340 ha, including office, waterfront, and recreational functions, and employ 100,000 people, but may be scaled back in the light of the recent recessionary climate there.

The world's first teleport is named, simply, The Teleport, located on Staten Island, New York, a project jointly operated by Merrill Lynch and the Port Authority of New York and New Jersey. Built in 1981, The Teleport consists of an 11 acre office site and 16 satellite earth stations, and is connected to 170 miles of fibre-optic cables throughout the New York region, which are, in turn, connected to the expanding national fibre-optic network. Japanese firms have taken a particularly strong interest in The Teleport, comprising 18 of its 21 tenants. For example, Recruit USA, a financial services firm, uses it to sell excess computer capacity between New York and Tokyo, taking advantage of differential day and night rates for supercomputers in each city by transmitting data via satellite and retrieving the results almost instantaneously.19

In addition to the U.S., European, and Japanese teleports, some Third World nations have invested in them in order to secure a niche in the global information services economy. Jamaica, for example, built one at Montego Bay to attract American "back office" functions there. Other examples include Hong Kong, Singapore, Bahrain, and Lagos, Nigeria.20

The Internet: Political Economy and Spatiality of the Information Highway

Of all the telecommunications systems that have emerged since the 1970s, none has received more public adulation than the Internet. The unfortunate tendency in the popular media to engage in technocratic utopianism, including hyperbole about the birth of cyberspace and virtual reality, has obscured the very real effects of the Internet. The Internet is the largest electronic network on the planet, connecting an estimated 20 million people in 40 countries.21 Further, the Internet has grown at rapid rates, doubling in networks and users every year; by mid-1992, it connected more than 12,000 individual networks worldwide. Originating as a series of public networks, it now includes a variety of private systems of access, in the U.S. including services such as Prodigy, CompuServe, or America On-Line, which allow any individual with a microcomputer and modem to "plug in," generating a variety of "virtual communities." By 1994, such services connected almost 5 million people in the U.S. alone.22

The origins of the Internet can be traced back to 1969, when the U.S. Department of Defense founded ARPANET, a series of electronically connected computers whose transmission lines were designed to withstand a nuclear onslaught.23 Indeed, the very durability and high quality of much of today’s network owes its existence to its military origins. In 1984, ARPANET was expanded and opened to the scientific community when it was taken over by the National Science Foundation, becoming NSFNET, which linked five super-computers around the U.S. The Internet, which emerged on a global scale via its integration with existing telephone, fibre-optic, and satellite systems, was made possible by the technological innovation of packet switching, in which individual messages may be decomposed, the constituent parts transmitted by various channels (i.e., fibre optics, telephone lines, satellite), and then reassembled, seamlessly and instantaneously, at the destination. In the 1990s such systems have received new scrutiny as central elements in the Clinton administration’s emphasis on "information superhighways."

The Internet has become the world’s single most important mechanism for the transmission of scientific and academic knowledge. Roughly one-half of all of its traffic is electronic mail, while the remainder consists of scientific documents, data, bibliographies, electronic journals, and bulletin boards.24 Newer additions include electronic versions of newspapers, such as the Chicago Tribune and the San Jose Mercury News, as well as an electronic library, the World Wide Web. In contrast to the relatively slow and bureaucratically monitored systems of knowledge production and transmission found in most of the world, the Internet and related systems permit a thoroughly unfiltered, non-hierarchical flow of information best noted for its lack of overlords. Indeed, the Internet has spawned its own unregulated counterculture of "hackers."25 However, the system finds itself facing the continuous threat of commercialization as cyberspace is progressively encroached upon by corporations, giving rise, for example, to new forms of electronic shopping and "junk mail."26 The combination of popular, scientific, and commercial uses has led to an enormous surge in demand for Internet capacities, so much so that they frequently generate "traffic jams on the information highway" as the transmission circuits become overloaded.27

Despite the mythology of equal access for everyone, there are also vast discrepancies in access to the Internet at the global level.28 As measured by the number of access nodes in each country, it is evident that the greatest Internet access remains in the most economically developed parts of the world, notably North Ameirca, Europe, and Japan. The hegemony of the U.S. is particularly notable given that 90 percent of Internet traffic is destined for or originates in that nation. Most of Africa, the Middle East, and Asia (with the exceptions of India, Thailand, and Malaysia), in contrast, have little or no access. There is clearly a reflection here of the long-standing bifurcation between the First and Third Worlds. To this extent, it is apparent that the geography of the Internet reflects previous rounds of capital accumulation—i.e., it exhibits a spatiality largely preconditioned by the legacy of colonialism.

There remains a further dimension to be explored here, however—the bifurcation between the super-powers following World War II. Marxist regimes favoured investments in television rather than telephone systems: televisions, allowing only a one-way flow of information (i.e., government propaganda), are far more conducive to centralised control than are telephones, which allow multiple parties to circumvent government lines of communication.29 Because access to the Internet relies heavily upon existing telephone networks, this policy has hampered the emerging post-Soviet "Glasnet." Super-imposed on top of the landscapes of colonialism, therefore, is the landscape of the Cold War.

A rather curious yet revealing by-product of the Internet's expansion concerns the international transmission of computer viruses, programmes written deliberately to interfere with the operations of other software systems. Although viruses are not new to users of computers, the rapid growth of electronic systems in the 1980s has markedly accelerated their capacity to travel internationally, indicating both the extent and speed with which knowledge circulates through such networks as well as the vulnerability of these systems to unwanted intrusions. In 1992, for example, the Michelangelo virus disrupted software systems of users ranging from South African pharmacists to the San Francisco police department. More ominous is the "Bulgarian virus machine."30 In the 1980s, Bulgaria was the designated computer producer for the Soviet bloc, and Sofia University produced large numbers of skilled engineers and programmers to serve it. As communism collapsed in the late 1980s, many of such individuals, including bored young men who comprise the vast bulk of hackers, took to writing viruses and releasing them on international networks, including those of the UN. Simultaneously, Sofia University began to export its anti-virus software on the world market. Although some of the worst excesses of Bulgarian hackers have been curtailed, some indications are that they are being joined by Russian, Thai, and other counterparts.

Geographical Consequences of the Mode of Information

As might be expected, the emergence of a global economy hinging upon producer services and telecommunications systems has led to new rounds of uneven development and spatial inequality. Three aspects of this phenomenon are worth noting here, including the growth of world cities, the expansion of offshore banking centres, and the globalisation of back offices.

World Cities. The most readily evident geographical repercussions of this process have been the growth of "world cities," notably London, New York, and Tokyo, each of which seems to be more closely attuned to the rhythms of the international economy than the nation-state in which it is located.31 In each metropolitan area, a large agglomeration of banks and ancillary firms generates pools of well-paying administrative and white-collar professional jobs; in each, the incomes of a wealthy stratum of traders and professionals have sent real estate prices soaring, unleashing rounds of gentrification and a corresponding impoverishment for disadvantaged populations. While such predicaments are not new historically—Amsterdam was the Wall Street of the seventeenth century32—the magnitude and rapidity of change that global telecommunications have unleashed in such cities is without precedent. London, for example, boomed under the impetus of the Euromarket in the 1980s, and has become detached from the rest of Britain.33 Long the centre of banking for the British Empire, and more recently the capital of the unregulated Euromarket, London seems to have severed its moorings to the rest of the UK and drifted off into the hyperspaces of global finance. State regulation in the City—always loose when compared to New York or Tokyo—was further diminished by the "Big Bang" of 1986. Accordingly, the City's landscape has been reshaped by the growth of offices, most notably Canary Wharf and the Docklands. Still the premier financial centre of Europe, and one of the world's major centres of foreign banking, publishing, and advertising, London finds its status challenged by the growth of Continental financial centres such as Amsterdam, Paris, and Frankfurt.

Similarly, New York rebounded from the crisis of the mid-1970s with a massive influx of petrodollars and new investment funds (i.e., pension and mutual funds) that sustained a prolonged bull market on Wall Street in the 1980s.34 Today, 20 percent of New York's banking employment is in foreign-owned firms, notably Japanese giants such as Dai Ichi Kangyo. Driven by the entrance of foreign firms and increasing international linkages, trade on the New York Stock Exchange exploded from 12 million shares per day in the 1970s to l50 million in the early 1990s.35 New York also boasts of being the communications centre of the world, including one-half million jobs that involve the collection, production, processing, transmission or consumption of information in one capacity or another.35 This complex, including 60 of the largest advertising and legal services firms in the U.S., is fueled by more word-processing systems than in all of Europe combined. The demand for space in such a context has driven an enormous surge of office construction, housing 60 headquarters of U.S. Fortune 500 firms. Currently, 20 percent of New York's office space is foreign-owned, testimony to the need of large foreign financial firms to establish a presence there.

Tokyo, the epicentre of the gargantuan Japanese financial market, is likely the world's largest centre of capital accumulation, with one-third of the world's stocks by volume and 12 of its largest banks by assets.36 The Tokyo region accounts for 25 percent of Japan's population, but a disproportionate share of its economic activity, including 60 percent of the nation's headquarters, 65 percent of its stock transactions, 89 percent of its foreign corporations, and 65 percent of its foreign banks. Tokyo's growth is clearly tied to its international linkages to the world economy, particularly in finance, a reflection of Japan's growth as a major world economic power.37 In the 1980s, Japan's status in the global financial markets was unparalleled as the world's largest creditor nation.38 Tokyo's role as a centre of information-intensive activities includes a state-of-the-art telecommunications infrastructure, including the CAPTAIN (Character and Pattern Telephone Access Information Network) system.39

Offshore Banking. A second geographical manifestation of the new, hypermobile capital markets has been the growth of offshore banking, financial services outside the regulation of their national authorities. Traditionally, "offshore" was synonymous with the Euromarket which arose in the 1960s as trade in U.S. dollars outside the U.S. Given the collapse of Bretton Woods and the instability of world financial markets, the Euromarket has since expanded to include other currencies as well as other parts of the world. The recent growth of offshore banking centres reflects the broader shift from traditional banking services (loans and deposits) to lucrative, fee-based non-traditional functions, including debt repackaging, foreign exchange transactions, and cash management.40

Today, the growth of offshore banking has occurred in response to favourable tax laws in hitherto marginal places that have attempted to take advantage of the world's uneven topography of regulation. As the technological barriers to capital have declined, the importance of political ones has thus risen concomitantly. Several distinct clusters of offshore banking may be noted, including, in the Caribbean, the Bahamas and Cayman Islands; in Europe, Switzerland, Luxembourg, and Liechtenstein; in the Mid East, Cyprus and Bahrain; in southeast Asia, Singapore and Hong Kong; and in the Pacific Ocean, Vanuatu, Nauru, and Western Samoa. Roberts notes that such places "are all part of a worldwide network of essentially marginal places which have come to assume a critical position in the global circuits of fungible, fast-moving, furtive money and fictitious capital."41 Given the extreme mobility of finance capital and its increasing separation from the geography of employment, offshore banking can be expected to yield relatively little for the nations in which it occurs; Roberts, for example, illustrates the case of the Cayman Islands, now the world's fifth largest banking centre in terms of gross assets, where 538 foreign banks employ only 1,000 people (less than two apiece). She also notes that such centres are often places in which "hot money" from illegal drug sales or undeclared businesses may be laundered.

Offshore markets have also penetrated the global stock market, where telecommunications may threaten the agglomerative advantages of world cities even as they reinforce them. For example, the National Associated Automated Dealers Quotation System (NASDAQ) has emerged as the world's fourth largest stock market; unlike the New York, London, or Tokyo exchanges, NASDAQ lacks a trading floor, connecting half a million traders worldwide through telephone and fiber-optic lines. Similarly, Paris, Belgium, Spain, Vancouver, and Toronto all recently abolished their trading floors in favour of screen-based trading.

Global Back Offices. A third manifestation of telecommunications in the world service economy concerns the globalisation of clerical services, in particular back offices. Back offices perform many routinised clerical functions such as data entry of office records, telephone books or library catalogues, stock transfers, processing of payroll or billing information, bank cheques, insurance claims, magazine subscriptions, and airline frequent-flyer coupons. These tasks involve unskilled or semi-skilled labour, primarily women, and frequently operate on a 24-hour-per-day basis.42 By the mid 1980s, with the conversion of office systems from analog to digital form largely complete, many firms began to integrate their computer systems with telecommunications.

Historically, back offices have located adjacent to headquarters activities in downtown areas to ensure close management supervision and rapid turnaround of information. However, under the impetus of rising central-city rents and shortages of sufficiently qualified (i.e., computer-literate) labour, many service firms began to uncouple their headquarters and back office functions, moving the latter out of the downtown to cheaper locations on the urban periphery. Most back office relocations, therefore, have been to suburbs.43 Recently, given the increasing locational flexibility afforded by satellites and a growing web of inter-urban fibre-optics systems, back offices have begun to relocate on a much broader, continental scale. Under the impetus of new telecommunications systems, many clerical tasks have become increasingly footloose and susceptible to spatial variations in production costs. For example, several firms fled New York City in the 1980s: American Express moved its back offices to Salt Lake City, UT, and Phoenix, AZ; Citicorp shifted its Mastercard and Visa divisions to Tampa, FL, and Sioux Falls, SD, and moved its data processing functions to Las Vegas, NV, Buffalo, NY, Hagerstown, MD, and Santa Monica, CA; Citibank moved its cash management services to New Castle, DE; Chase Manhattan housed its credit card operations in Wilmington; Hertz relocated its data entry division to Oklahoma City; and Avis went to Tulsa. Dean Witter moved its data processing facilities to Dallas, TX; Metropolitan Life repositioned its back offices to Greenville, SC, Scranton, PA, and Wichita, KS; Deloitte Haskins Sells relocated its back offices to Nashville, TN; and Eastern Airlines chose Miami, FL.

Internationally, this trend has taken the form of the offshore office.44 The primary motivation for offshore relocation is low labour costs, although other considerations include worker productivity, skills, turnover, and benefits. Offshore offices are established not to serve foreign markets, but to generate cost savings for U.S. firms by tapping cheap Third World labour pools. Notably, many firms with offshore back offices are in industries facing strong competitive pressures to enhance productivity, including insurance, publishing, and airlines. Offshore back office operations remained insignificant until the 1980s, when advances in telecommunications such as trans-oceanic fibre-optics lines made possible greater locational flexibility just when the demand for clerical and information processing services grew rapidly.45 Several New York based life insurance companies, for example, have erected back office facilities in Ireland, with the active encouragement of the Irish government.46 Often situated near Shannon Airport, they move documents in by Federal Express and the final product back via satellite or the TAT-8 fibre-optics line that connected New York and London in 1989. Despite the fact that back offices have been there only a few years, Irish development officials already fret, with good reason, about potential competition from Greece and Portugal. Likewise, the Caribbean has become a particularly important locus for American back offices, partly due to the Caribbean Basin Initiative instituted by the Reagan administration and the guaranteed access to the U.S. market that it provides. Most back offices in the Caribbean have chosen Anglophonic nations, particularly Jamaica and Barbados. American Airlines has paved the way in the Caribbean through its subsidiary Caribbean Data Services (CDS), which began when a data processing centre moved from Tulsa to Barbados in 1981. In 1987. CDS opened a second office near Santo Domingo, Dominican Republic, where wages are one-half as high as Barbados.47 Thus, the same flexibility that allowed back offices to move out of the U.S. can be used against the nations to which they relocate.

New Information Spaces

The emergence of global digital networks has generated growth in a number of unanticipated places. These are definitely not the new industrial spaces celebrated in the literature on post-Fordist production complexes,48 but constitute new "information spaces" reflective of the related, yet distinct, mode of information. Three examples — Singapore, Hungary, and the Dominican Republic—illustrate the ways in which contemporary telecommunications generate repercussions in the least expected of places.

Singapore. Known best perhaps as a member of the East Asian newly industrialised countries (NlCs), Singapore today illustrates what may be the most advanced telecommunications infrastructure in the world, creating an "intelligent island" with high-speed leased circuits, a dense telephone and fibre-optic network, household teleboxes for electronic mail, and ubiquitous remote computer access.49 Singapore's government has led the way in this programme through its National Computer Board and Telecommunications Authority. This transformation has occurred as part of a sustained shift in the island's role from unskilled, low-wage assembly functions to exporter of high value-added business services and as the financial hub of southeast Asia, a process hastened by the flight of capital from Hong Kong.50

Exports of services have now become Singapore's largest industry in terms of employment and foreign revenues. Reuters, for example, uses Singapore as its news hub in southeast Asia. In part, this transformation reflects the island's relatively high wages and fears of competition from its larger neighbours. Today, more than one-third of Singapore's labour force is engaged in skilled, white-collar employment. In addition, Singapore uses its telecommunications network for advanced Electronic Data Interchange (EDI) services to faciltate maritime shipping, in congruence with its status as the world's largest port.

Hungary. Before the collapse of the Soviet Union, Hungary suffered many of the same telecommunications problems as other underdeveloped nations: outdated technology, unsatisfied demand, and few advanced services. Today, largely due to deregulation and foreign investment, the Hungarian telecommunications system is the most advanced in the former Soviet bloc, subsuming 10 percent of the nation's total investment capital. The leader in this process has been the postal service, Magyar Posta, and its successor, the Hungarian Telecommunications Company (Matav), which introduced innovative pricing based on market, not political criteria, fees for telephone connections, time-differentiated and distance-sensitive pricing, and bond financing. Concomitantly, an administrative reorganisation decentralised control of the firm, breaking the inefficient stranglehold of the bureaucratic Communist apparatchik.51 The birth of the new Hungarian telecommunications network was invaluable to the nation's emerging financial system, centred in Budapest, which has expanded beyond simple loans and stocks to include database management and stock transfers.52 Thus, in this respect, Hungary serves as a model for other nations making the transition from state socialism to market economies.

The Dominican Republic. In the 1980s, the Dominican government introduced a policy designed to develop nontraditional exports, particularly tourism and information services, as part of a strategy to reduce the country's reliance upon agricultural exports. For a small, relatively impoverished nation, the nation possesses a well-endowed information services infrastructure.53 The national telephone company Codetel (Compania Dominicana de Telecommunicaciones), for example, has provided the Dominican Republic with near-universal telephone access, high-speed data transmission services on fibre-optics lines, digital switching equipment, cellular telephones, and microwave service to all neighbouring nations except Cuba. Codetel also sells a variety of high value-added services such as electronic mail and databases, telex, remote terminals, facsimile services, Spanish-English translations, and leased lines. This infrastructure has made the Dominican Republic the most advanced nation in telecommunications in Latin America and has attracted numerous foreign firms. IBM-Santo Domingo, for example, engages in a complex, worldwide system of sub-contracting with its subsidiaries, purchasing, for example, printers from Argentina, disk drives from Brazil, CPUs from the U.S. or Brazil and software, written in Canada, the U.S. and Denmark, through its distributor in Mexico. A similar firm is Infotel, which performs a variety of computer-related functions for both domestic and international clients, including compilation of telephone directories, photo-composition, data conversion, computerised, online sale of advertising images, desktop publishing, and map digitising. Infotel serves a variety of domestic and foreign clients, including Dominican utilities and municipal governments, the GTE telephone-operating companies, the U.S. Geological Survey, and the Spanish telephone network. Another service attracted to the Dominican Republic is back offices. American Airlines, and its subsidiary Caribbean Data Services, processes medical and dental insurance claims, credit card applications, retail sales inventories, market surveys, and name and address listings at a Free Trade Zone near the capital.

Concluding Comments

What lessons can be drawn from these observations about the emergence of a globalised service economy and the telecommunications networks that underpin it? As part of the broad sea-change from Fordist production regimes to the globalised world of flexible accumulation, about which so much has already been said, it is clear that capital as data or cash, electrons or investments in the context of global services has acquired a qualitatively increased level of fluidity, a mobility enhanced by the worldwide wave of deregulation unleashed in the 1980s and the introduction of telecommunication networks. Such systems give banks, securities, insurance firms, and back offices markedly greater freedom over their locational choices. In dramatically reducing the circulation time of capital, telecommunications have linked far-flung places together through networks in which billions of dollars move instantaneously across the globe, creating a geography without transport costs. There can be no doubt that this process has real consequences for places, as attested by the current status of cities such as London, New York, Tokyo, Singapore, and the Cayman Islands. Generally, such processes tend to concentrate skilled, high value-added services, e.g., in global cities, while dispersing unskilled, low value-added services such as back offices to Third World locations.

In short, it is vital to note that, contrary to early, simplistic expectations that telecommunications would "eliminate space," rendering geography meaningless through the effortless conquest of distance, such systems in fact produce new rounds of unevenness, forming new geographies that are imposed upon the relics of the past. Telecommunications simultaneously reflect and transform the topologies of capitalism, creating and rapidly recreating nested hierarchies of spaces technically articulated in the architecture of computer networks. Indeed, far from eliminating variations among places, such systems permit the exploitation of differences between areas with renewed ferocity. As Swyngedouw noted, the emergence of hyperspaces does not entail the obliteration of local uniqueness, only its reconfiguration.[54] That the geography engendered by this process was unforeseen a decade ago hardly needs restating; that the future will hold an equally unexpected, even bizarre, set of outcomes is equally likely.

Notes

1. M. Kakabadse, International Trade in Services: Prospects for Liberalization in the 1990s (London: Croon Helm, 1987).

2. T. Noyelle and A. Dutka, International Trade in Business Services (Cambridge, MA: Ballinger, 1988); and I. Walter, Global Competition in Financial Services: Market Structure, Protection, and Trade Liberalization (Cambridge, MA: Ballinger, 1988).

3. A. Gillespie and H. Williams, "Telecommunications and the Reconstruction of Comparative Advantage," Environment and Planning A (20: 1988), pp. 1311-1321.

4. M. Moss, "Telecommunications and International Financial Centers," in J. Brotchie, P. Hall, and P. Newton (eds.), The Spatial Impact of Technological Change (London: Croom Helm, 1987); and R. Akwule, Global Telecommunications: The Technology, Administration, and Policies (Boston, MA: Focal Press, 1992).

5. M. Hepworth, "The Geography of Technological Change in the Information Economy," Regional Studies (20:1986), pp. 407-424; and M. Hepworth, Geography of the Information Economy (London: Guildford Press, 1990).

6. L. Nicol, "Communications Technology: Economic and Spatial Impacts," in M. Castells (ed.), High Technology, Space and Society (Beverly Hill, CA: Sage, 1985).

7. Akwule, passim.

8. Ibid.

9. J. Langdale, "Electronic Funds Transfer and the Internationalization of the Banking and Finance Industry," Geoforum (16:1985), pp. 1-13; J. Langdale, "The Geography of International Business Telecommunications: The Role of Leased Networks," Annals of the Association of American Geographers (79: 1989), pp. 501-522; and B. Warf, "Telecommunications and the Globalization of Financial Services," Professional Geographer (41:1989), pp. 257-271.

10. "Juggling Trillions on a Wire: Is Electronic Money Safe?," Insight (February 15, 1988), pp. 38-40.

11. S. Strange, Casino Capitalism (Oxford, England: Basil Blackwell, 1986).

12. A. Lipman, A. Sugarman, and R. Cushman, Teleports and the Intelligent City (Homewood, IL: Dow Jones, 1986); G. Hanneman, "The Development of Teleports," Satellite Communications (March 1987), pp. 14-22; G. Hanneman, "Teleport Business," Satellite Communications (April 1987), pp. 23-26; and G. Hanneman, "Teleports: The Global Outlook," Satellite Communications (May 1987), pp. 29-33.

13. Hanneman, "The Development of Teleports," p. 15.

14. G. Stephens, "What Can Business Get From Teleports?," Satellite Communications (March 1987), pp. 18-19; and H. Burstyn, "Teleports: At the Crossroads," High Technology (6:5, 1986), pp. 28-31.

15. J. Rohlfs, "A Theory of Interdependent Demand for a Communications Service," Bell Journal of Economics and Management Science (5: 1974), pp. 13-37; R. Saunders, J. Warford, and B. Wellenius, Telecommunications and Economic Development (Baltimore, MD: Johns Hopkins University Press, 1983); and J. Guldmann, "Economics of Scale and Density in Local Telephone Networks," Regional Science and Urban Economics (20: 1990), pp. 521-533.

16. Hanneman, "The Development of Teleports," pp. 14-22.

17. P. Rimmer, "Exporting Cities to the Western Pacific Rim: The Art of the Japanese Package ," in J. Brotchie, et al. (eds.), Cities of the 21st Century (Melbourne, Australia: Longman Cheshire, 1991).

18. Tokyo Metropolitan Government Planning Department, Tokyo Teleport (Tokyo, Japan: Tokyo Metropolitan Government Information Center, 1993).

19. Warf, "Telecommunications and the Globalization of Financial Services," passim.

20. Ibid. See also M. Wilson, "Offshore Relocation of Producers Services: The Irish Back Office," paper presented at the Annual Meeting of the Association of American Geographers, Miami, Florida, 1991.

21. W. Broad, "Doing Science on the Network: A Long Way from Gutenberg," New York Times (May 18, 1993), p. B5.

22. P. Lewis, "A Boom for On-Line Services," New York Times (July 12, 1994), p. C1.

23. H. Schiller, "‘The Information Highway’: Public Way or Private Road?," The Nation (257: 1993), pp. 64-65.

24. Broad, passim.

25. P. Mungo and B. Clough, Approaching Zero: The Extraordinary Underworld of Hackers, Phreakers, Virus Writers, and Keyboard Criminals (New York, NY: Random House, 1993).

26. A. Weis, "Commercialization of the Internet," Electronic Networking (2:3, 1992), pp. 7-16.

27. J. Markoff, "Traffic Jams Already on the Information Highway," New York Times (November 3, 1993), pp. 1, C7.

28. Schiller, pp. 64-65; and K. Cooks and D.Lehrer, "The Internet: The Whole World is Talking," The Nation (257:1993), pp. 60-63.

29. B. Buchner, "Social Control and the Diffusion of Modern Telecommunications Technologies: A Cross National Study," American Sociological Review (53:1988), pp. 446-453.

30. See Mungo and Clough.

31. M. Moss, "Telecommunications, World Cities, and Urban Policy," Urban Studies (24:1987), pp. 534-546; and S. Sasson, The Global City: New York, London, Tokyo (Princeton, NJ: Princeton University Press, 1991).

32. N. Rodriguez and J. Feagin, "Urban Specialization in the World System," Urban Affairs Quarterly (22:1986), pp. 187-219.

33. N. Thrift, "The Fixers: The Urban Geography of International Commercial Capital," in J. Henderson and M. Castells (eds.), Global Restructuring and Territorial Development (Beverly Hills, CA: Sage, 1987); and L. Budd and S, Whimster (eds.), Global Finance and Urban Living: A Study of Metropolitan Change (London: Pergamon, 1992).

34. R. Scanlon, "New York City as Global Capital in the 1980s," in R. Knight and G. Gappert (eds.), Cities in a Global Society (Newburg Park, CA: Sage, 1989); J. Mollenkopf and M. Castells (eds.), Dual City: Restructuring New York (New York, NY: Russell Sage Foundation, 1992); and M. Shefter, Capital of the American Century: The National and International Influence of New York City (New York, NY: Russell Sage Foundation, 1993).

35. B. Warf, "The Internationalization of New York Services," in P. Daniels (ed.), Services and Metropolitan Development: International Perspectives (London: Routledge, 1991).

36. Y. Masai, "Greater Tokyo as a Global City," in Knight and Gappert.

37. Ibid.; and R. Cybriwsky, Tokyo: The Changing Profile of an Urban Giant (Boston, MA: G.K. Hall and Co., 1991).

38. E. Vogel, "Pax Nipponica?," Foreign Affairs (64:1986), pp. 752-767; and "Japan Banking and Finance," Far Eastern Economic Review (April 9, 1987), pp. 47-110.

39. H. Nakamura and J. White, "Tokyo," in M. Dogan and J. Kasarda (eds.), The Metropolitan Era, Volume 2: Mega-Cities (Newbury Park, CA: Sage, 1988).

40. I. Walter, Secret Money (London: Unwin Hyman, 1989).

41. S. Roberts, "Fictitious Capital, Fictitious Spaces: The Geography of Offshore Financial Flaws," in S. Corbridge, R. Martin, and N. Thrift (eds.), Money Power Space (Oxford, England: Basil Blackwell, 1994).

42. M. Moses and A. Duncan, "Offices, Information Technology, and Locational Trends," in J. Black, K. Roark, and L. Schwartz (eds.), The Changing Office Workplace (Washington, D.C.: Urban Land Institute, 1986), pp. 171-182.

43. Ibid.; and K. Nelson, "Labor Demand, Labor Supply, and the Suburbanization of Low Wage Office Work," in A. Scott and M. Storper (eds.), Production, Work, Territory (Boston, MA: Allen Univin, 1986).

44. Wilson, passim.

45. B. Warf, "Back Office Dispersal: Implications for Urban Development," Economic Development Commentary (16:1993), pp. 11-16.

46. S. Lohr, "The Growth of the Global Office," New York Times (October 18, 1988), p. D1.

47. B. Warf, "Information Services in the Dominican Republic," Yearbook of the Association of Latin American Geographers (forthcoming).

48. A.J. Scott, New Industrial Space (London: Pion, 1988).

49. P. Dicken, "A Tale of Two NICs: Hong Kong and Singapore at the Crosswords," Geoforum (18:1987), pp. 161-164; and K. Corey, "The Role of Information Technology in the Planning and Development of Singapore," in B. Brunn and T. Leinbach (eds.), Collapsing Space and Time (London: Harper-Collins, 1991), pp. 217-213.

50. M. Jussawalla and C. Cheah, "Towards an Information Economy: The Case of Singapore," Information Economics and Policy (1:1983), pp. 161-176.

51. E. Whitlock and E. Nyevrikel, "The Evolution of Hungarian Telecommunications," Telecommunications Policy (1992), pp. 249-259.

52. A. Tardos, "Problems of the Financial Information System in Hungary," Acta Oeconomica (43:1991), pp. 149-166.

53. Warf, forthcoming.

54. E. Swyngedouw, "The Heart of the Place: The Resurrection of Locality in an Age of Hyperspace," Geografiska Annaler (71:1989), pp. 31-42.

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Chapter 21: Technology, Change, and the Emerging International Order *

by James Robinson

It is always difficult to recognize fundamental change in the dynamics of international relations, and it is usually only with hindsight that such changes come into focus. This appears to be the case with the sudden and unexpected end of the Cold War, for the role of technology in helping to bring this conflict to a conclusion has remained largely unnoticed.1 But with the end of the Cold War, something fundamental has changed in the nature of international competition. As Robert Tucker has noted, "there does not appear to be an instructive modern historical parallel of a hegemonic conflict simply being terminated by the default in time of peace of one side."2 Indeed, the Soviet Union's behavior in the last years of the Cold War was so extraordinary because it entailed the complete abandonment by a "Great Power" of its position in the international system without being forced to do so through coercion or war. Soviet policy defied conventional wisdom and understanding of statecraft, which claims that "...[n]ormally, the threat of war, tacit or overt seems a necessary condition of important political changes in the international sphere."3 However, as Seweryn Bialer emphasized in 1988, "Never in their history have the Russians been as secure from external danger as they are now and will remain in the foreseeable future."4 Nevertheless, in spite of—or because of?—their security, the Russians chose to end the Cold War. This apparent anomaly suggests that the basic dynamics of international competition have altered. Moreover, such changes may well portend the emergence of a fundamentally new international order.

The technological changes that undermined the position of the Soviet Union and ended the Cold War have already been recognized as transforming industry to such an extent as to constitute the "third industrial revolution."5 New revolutionary technologies began to redefine industry several decades ago, but are only now beginning to change international relations as well through their effects on economic power, the structure of production, and the organization of political authority. Such changes cannot help but have a very profound influence on the behavior of states and the nature of the international system. Consequently, the purpose of this essay is to assess more closely the impact of these technologies on states and the emerging international order. Nowhere has the impact of the "third industrial revolution" for international relations been more dramatically demonstrated than in the collapse of the Soviet Union. Therefore, it is well worth beginning this assessment by first unravelling the anomaly of the Cold War's end.

The End of the Cold War

The end of the Cold War challenges the conventional wisdom and understanding of international relations because the Soviet Union gave up its international position without being forced to do so. By retreating from its "sphere of influence" in Eastern Europe and tolerating anticommunist elections, then holding relatively free elections, dissolving the Warsaw Pact, permitting its republics to secede from the Soviet Union, and accepting the reunification of Germany within NATO, Moscow called into question the very integrity of the Soviet empire. According to the traditional view of state behavior: "It is doubtful whether there is any instance in history of a power disarming unilaterally and voluntarily."6 But this is precisely what the Soviet Union's actions entailed.

This anomaly has been dismissed by arguments that the Soviet Union collapsed economically as a result of four long decades of military spending in an increasingly costly and ever-escalating armaments race.7 It is an established truth that "if too large a proportion of the state's resources is diverted from wealth creation and allocated instead to military purposes...that is likely to lead to a weakening of national power over the long term."8 According to Central Intelligence Agency estimates, by 1985 the Soviet Union was putting roughly 15 percent to 17 percent of its Gross National Product (GNP) into defense-related expenditures, and by 1990, as Eduard Shevardnadze declared to the 28th Party Congress, 25 percent of the country's GNP was being spent on defense.9 These large military expenditures must have been a heavy burden on the Soviet economy, but devoting considerable resources to defense was not new to the Soviet Union. This was, afterall, a country that had been able to rebuild its economy and infrastructure after World War II and then achieved military and strategic parity with the United States by the 1970s. Despite its economic limitations and military spending, during the Cold War the Soviet Union had been able to build an atomic bomb, pioneer an earth satellite program, develop a long-range rocket delivery system, and, by the late 1950s and early 1960s, was completely outpacing many western states in rate of industralization. Until the 1970s, the Soviet economy had grown at rates of 5 percent or better. Cold War expenditures on defense had not prevented the Soviet Union from developing into a modern industrial state with a GNP second only to the United States.10 For over three decades, the Soviet Union's allocations for defense did not appear to have crippled the economy.11 However, by the 1970s the Soviet economy's growth rate had begun to decline and by 1984 had slowed to only 2.5 percent.12

The economic decline of the Soviet Union has generally been attributed to the cumulative effects of the Cold War armaments race. It is worth noting, however, that George Kennan argued that the transformation of the U.S.-Soviet rivalry into a military conflict simply served to prolong the Cold War.13 Even if Kennan's argument is correct, however, that does not mean the Soviet Union's economic collapse was not the result of the armaments race. It merely suggests that a less militaristic strategy would have been more effective and expeditious in bringing this protracted conflict to an end.14 As debates over the causes of Soviet decline have proven inconclusive, it is worth considering the efforts by Soviet leaders to correct their country's economic decline.

By the early 1970s, Brezhnev sought to correct the economic inefficiencies of the Soviet Union by instituting reforms aimed at "rationalizing" planning and investment. Ironically, this strategy had the immediate effect of reducing investment over previous 5-year plans.15 More significantly, Brezhnev promoted detente in the hope of gaining greater access to Western technology, and, not surprisingly, Soviet foreign trade increased by 21 percent between 1974 and 1980.16 Brezhnev recognized the Soviet Union's dependence on foreign technology and, therefore, sought to improve the Soviet economy by developing domestic science and technology. This meant increasing Western imports, in addition to more direct investments, licensing agreements, and joint ventures into the

Soviet bloc.[17] While the Soviet Union was successful in obtaining some advanced technologies during detente, these "new" technologies were usually already obsolete by Western standards, so the quality of Western technology continued to stay far ahead of that in the Soviet Union. Soviet access to relatively obsolete technology was, of course, not an accident. U.S. objectives during detente included providing limited aid to the Soviet Union in an effort to bind the Soviet economy more closely to the world economy. But the United States, through CoCom, attempted to make sure that access to valuable new technologies was denied.[18]

The outdated technologies that the Soviet Union obtained were not nearly as useful in helping to develop Soviet technology as Brezhnev had hoped. This was because Brezhnev's basic strategy for improving Soviet technology was misguided in that he did not fully appreciate the extent to which technology is a product of specific political, social, and economic forces.[19] Because of industrial espionage and the help of third parties, getting new technologies from the West was less of a problem for Moscow than "sustaining the application of technology in the economy and constantly improving that technology." In other words, "technology is not something, once obtained, develops on its own. It requires a culture and an economy that are receptive and stimulating."[20] The need for an appropriate culture and economy had become even more essential in the development and use of new technologies because of the nature of the technologies of the "third industrial revolution."

The "Third Industrial Revolution"

The "third industrial revolution" has been so important for international relations because it has led to a dismantling of command economies and a decentralization of political power. It was precisely because the Soviet Union was built upon a centrally organized command economy, an authoritarian regime, and a "closed" society that it was unable to integrate modern information-based technologies into its production processes. As it could not adapt these new technologies to its economy, the Soviet Union continued to fall farther behind the much more advanced and technologically sophisticated industrialized democracies of the West and Far East.

The "third industrial revolution" refers to the development and application of advanced information technologies to economic competitiveness. With the rapid advancement of knowledge-based technologies in areas such as semiconductors, robotics, computers, industrial control systems, fiberoptic communications, globally integrated financial trading systems, and "smart weapons," the most important source of power in the contemporary international system has become information.[21] These technological innovations have had their most profound effect in the world economy, as is evident from the growing shift away from traditional heavy industrial production to more value-added and knowledge-based manufactures.

For the Soviet Union, these innovations meant it was unable to compete economically against states that had integrated knowledge-based technologies into their market-driven economies. The limits of Soviet economic competitiveness and its technological weaknesses were clearly apparent in the fact that by 1978 the Soviet Union had roughly

18,000 to 28,000 computers in operation, whereas the United States had over 250,000.22 By 1985, there were only about 50,000 personal computers in the Soviet Union, as compared to more than 33 million in the United States.23 By 1988, the Soviet Union was able to increase to about 100,000 to 150,000 computers, but by then the United States had over 40 million.24 The relationship of these figures to economic competitiveness can be surmised from Soviet estimates that only 8 percent of national production was up to world-class standards by the late 1980s.25 This specific weakness in new technology was also significant in that it hindered the development of modern military hardware, which has increasingly come to depend on command, control, and communication components that together make up technological information systems.26 It was not merely the absence of the new technologies that hindered Soviet economic competitiveness and modernization of its military. A more fundamental problem had to do with the nature of Soviet society and the organizational structure of its economy.

As Eugene Skolnikoff has explained, "the Soviet Union, with its command economy proved to be ill-equipped to make rapid and effective use of sophisticated technology even when it could obtain it on the open market or through other legitimate means."27 Even if the Soviet Union had been able to obtain the new technologies, it would have still been unable to develop a competitive position in the international economy. The inability to integrate the new technologies into the Soviet economy was due to the rigidity of its centralized planned structure and the authoritarian nature of its society. This closed society could not tolerate a free-flow of information among groups or individuals, for the legitimacy of the Communist Party depended upon the state maintaining tight control over all social classes. But in order for any economy to remain highly competitive on an international scale, it must be able to adapt to continuous innovations and incorporate new technologies into its production processes.28 As the Soviet economist Oleg Bogomolov pointed out: "The greatest relative advantages in international trade today are connected with the ability to make efficient use of the new information technologies, rapid innovation and continuous upgrading of technologies."29 The Soviet command economy has been unable to meet these requirements, because broad dissemination of information threatens the state’s dominant control over civil society.30 The price of such control has been extremely high, for "vertical" command structures (or centralized planning) over the economy tends to discourage innovation and change.31 "Horizontal communication" of ideas or information is virtually eliminated. Economically this helps to protect against foreign competition, but it also leads to a lack of quality control so that technology and equivalent skills lag far behind those developed in market economies. Such tendencies were all too apparent in the Soviet computer industry. As Skolnikoff elaborates:

Effective use of computers...requires that they be widely available and connected to interactive networks at the working level. That implies a willingness to accept unsupervised horizontal communication linkages—anathema to authoritarian societies...—and also open the door to independent ties to international communication networks. The unwillingness of Soviet authorities to accept that degree of interaction was, in fact, one of the reasons for the absence of a creative computer culture in the Soviet Union.32

Without being able to adapt to a world economy that increasingly relied upon information as the foundation for transactions, it was inevitable that the Soviet economy would be increasingly uncompetitive against advanced industrialized democracies. Only by "opening" its domestic society, allowing for a completely free flow or "horizontal" communication of information and ideas, and by adopting a market economy could the Soviets have hoped to regain their position in the international system. However, such changes would have been tantamount to completely abandoning communism.

"New Thinking" in Soviet Policies

Far more than his predecessors, Gorbachev recognized the dire need for sweeping economic and political reform within the Soviet Union.33 From the beginning, Gorbachev used his power as General Secretary to emphasize "new thinking" about Soviet security and foreign policy.34 As Gorbachev acknowledged, "Like many others, I had known that our society needed radical change...If I had not understood that, I would not have accepted the position of General Secretary."35 Gorbachev realized that Soviet development had to occur in conjunction with technological modernization, and both were tied to broad economic and political reforms that seriously threatened entrenched interests. Thus, Gorbachev's "new thinking" had to overcome the deeply ingrained "dysfunctional effects of the Stalinist system...inert interest groups defending conservatism, orthodoxy, entrenched bureaucratic privileges, corruption, and sloth."36 Launching a program of change did not, however, mean Gorbachev was prepared to fully embrace laissez-faire capitalism. Institutionalizing private property or complete market reforms were too radical even for Gorbachev. He favored a gradual adoption of reforms aimed at creating something closer to the social democratic welfare state.37 Even so, anything less than liberalization and modernization of the economy and political system would exacerbate the problems and contradictions of the Soviet state.

Historically, "late industrialisers," like the Soviet Union, have needed highly centralized states in order to oversee economic development.38 Certainly the Soviet state had been able to drive peasants off the land and into factories, and for more than three decades the command economy had been highly effective in building a powerful industrial economy. Over time, however, the command economy had become less efficient in allocating capital, providing labor incentives, and stimulating innovation. The initial problem was that with the development of Soviet industry and the adoption of more sophisticated technological production processes, workers began to demand political and economic reforms. Growing political consciousness among workers was an inevitable consequence of the growing complexity of industrial production. That is, effective management of an industrial economy (not to mention an information-based economy) requires greater worker education.39 As industrial production becomes more advanced, the role for information in the process becomes more significant.40 The growing specialization and complexity of advanced production processes means that centralized control tends to be very inefficient. Thus, to ensure efficiencey, organizational control over processess has to be broken down into a network of more autonomous organizations. As workers assume more responsibilities they become better informed and more politically conscious. Consequently, economic development and modernization eventually requires a lessening of centralized controls, which, in turn, leads to worker demands for greater political representation. Economic modernization transforms "subjects" into "citizens," and, in the case of the Soviet Union, this meant that a "civil society" was beginning to emerge. It also meant there were pressures from "below" to adopt meaningful economic and political reforms.41

Domestic pressure alone, however, would have been insufficient to compel Gorbachev or Yeltsin to launch sweeping reforms. Much more critical was the stark reality that market-based reforms and decentralization of political authority had to occur if the Soviet Union was to reverse its economic decline by drawing upon the new information technologies. By the early 1970s, Soviet industrial development had reached a technological "ceiling" because of the contradictory nature of its centralized system and the environment required to develop and use knowledge-based technologies. If the Soviet state did not move toward open democracy and a market-based economy, its decline was inevitable and probably irreversible.

It is important to note that the reform effort and the events leading up to the collapse of Soviet Union occurred long "after it was obvious that U.S. resolve to apply global pressure had already passed its peak and begun to diminish."42 By the late 1980s, the Soviets had very little reason to be worried about their military security, yet every reason to be concerned about their economic capability.43 Consequently, it was this understanding of the need to create a political and economic environment conducive to both technological absorption and innovation that drove Russian policies as the Cold War came to an end.

Technology and the Changing Nature of Competitiveness

The unexpected collapse of the Soviet Union and peaceful end of the Cold War provide clear evidence that international politics in the late twentieth century are now guided by very different principles than in previous periods. By redefining the nature of power and economic security, information technologies are forcing states, such as the former Soviet Union, to adopt market economies, reorganize structures of production, and move towards democracy. Technologically induced changes are not, however, limited just to the political and economic structures of the state. New technology is also contributing to fundamental changes in the global economy. The growing "globalization of production and exchange" has occurred as a result of recent technological innovations in communications and transportation. International markets for goods and services have become far more integrated, which, in turn, has forced states to redefine their strategies for growth and development. Thus, technologically driven change at the international and domestic level have become mutually reinforcing.

The growing importance of the new technologies has occurred for several reasons. Due to technological advances in weaponry, as well as improvements in communications and transportation, time and space have become "compressed," and thereby changed the character of military strategy. With the development of nuclear weapons, inter-state competition has been transfromed as military security is no longer a "scarce commodity," especially among great powers.44 International competition has become more economic in nature. That does not mean military conflict has become obsolete, but, as the increasing importance of "smart weapons" demonstrates, even the use of force has become far more technologically sophisticated. Modern weapons now utilize information-based technologies, particularly integrated command, control, and communications systems, which help to increase capacity and effectiveness. As John von Neumann noted, "technology has largely replaced geography as the main element in national power."45

The utility of information technologies is also apparent in the growth of "dual-use" technologies for military and commercial production alike. However, in the past decade, states have become much more dependent on commercial (rather than military) technology in the development of "smart weapons" and of a "defense industrial base."46 That is, there are now less technological "spin-offs" from military to industrial production than "spin-ons" from commercial technology to military weaponry.47 The increased importance of commercial technology is because new information technologies have become essential to industrial competitiveness as well as the basis for the integrated electronic systems used in military production. Furthermore, modern commercial technology tends to be cheaper, more efficient, reliable, and is developed more quickly than military technology. Firms and states that compete in the market, whether domestic or international, must continuously innovate in order to remain competitive. Innovation helps to not only ensure control over markets, but lowers costs and improves efficiency. If a state gains even a modest technological advantage over its competitors, this can result in increased control and a greater share of foreign markets, which further lowers the costs of innovation and improves efficiency. If a state falls behind competitors in technological development, this can lead to diminished industrial competitiveness and market control, which heightens the costs of technological innovation and may increase economic vulnerability. Therefore, even small gaps in technology capability among the most advanced industrialized democracies can have a significant impact on their relative international competitiveness. The role of domestic and international markets in decreasing costs, stimulating innovation, and improving efficiency is a major reason commercial technology has become more important than military technology. Because both military capability and economic strength are tied more than ever to technology, it is vital for the state to maintain a high level of technological capacity to ensure international competitiveness.

While continued commercial competitiveness and technological innovation require that the state compete in international markets, paradoxically this may contribute to a loss of state autonomy or to vulnerability interdependence. The tradeoff is between enhancing commercial competitiveness, and thus the capacity for technological development, and creating the possibility of greater dependence, if not vulnerability, on foreign resources. Increased reliance upon international markets to generate wealth and increase efficiency is a consequence of modern technology and the globalization of markets and production. However, reliance on international markets makes the state more susceptible to the vicissitudes of the market, which may mean loss of autonomy and control over its policies.48 States that choose autarkic policies or concentrate their research and development (R&D) in the military sector may be able to protect themselves against the possiblility of dependence or vulnerability. Yet, such policies weaken the state's access to markets, which also means cutting itself off from the latest and most sophisticated technologies in the international sphere.49 That is, commercial and technological interests require expanding trade and production abroad even at the cost of diminished state autonomy and heightened vulnerability. Given the choice between increased technological capacity or greater state autonomy, it is clear that gaining access to global markets and new technologies should take precedence over other policy objectives. Without the appropriate technologies and economic strength to compete, state autonomy is of little use.

While this would appear to resolve the dilemma, it should be noted that the recent technological decline of the United States is the result of two policies that seemed appropriate in the context of the Cold War.50 First, during the Cold War the United States concentrated R&D in the military sector even though this served to undermine the United States' long-term commercial competitiveness. Secondly, the United States attempted to limit commercial exchange between the West and the Soviet bloc during the Cold War in the belief that by denying access to modern technologies to the Soviet Union its economy would be severely handicapped in international competition. While this strategy undoubtedly hastened the Soviet Union's demise, by imposing limits on many commercial activities in international markets the United States inadvertently weakened its competitive economic position in the international system by ceding control of these markets to European and Asian competitors.51 Thus the strategy of denying new information technologies to the Soviet Union may have helped to "win" the Cold War, but it appears to have been achieved at a cost of U.S. economic and technological decline.

If new information-based technologies had not been developed, economic competitiveness would still depend upon the production of heavy industries, areas in which the United States and the Soviet Union both excelled. Their economic success was due in no small part to concentrating R&D and investments into military technology, which tended to complement production of heavy industry. Clearly the military armaments race that drove the Cold War also aided the United States and Soviet Union in economic expansion for several decades. But just as the knowledge-based technologies undermined the economic capabilities of the Soviet Union, so too have they greatly weakened the economic position of the United States because of its long-term investment in military technologies at the expense of the development of commercial technology. The decline in the 1970s of the steel industry, manufacturing, and capital equipment sectors in the United States were all highly symptomatic of a clear loss of technological competitiveness due to its concentration on military technology.52 Yet, the United States cannot immediately overcome its present technological deficiencies even if it does begin to concentrate investment and R&D in commercial technologies. This is because the development of the new technologies is not simply a question of acquiring appropriate technical knowledge, as the Soviet Union has discovered. The capacity for technological innovation, absorption, and integration cannot be separated from the state's political and economic organization.

If technological capacity were simply a matter of adopting a market-based economy and democracy, it might be expected that the advanced industrialized democracies would all have equal or fairly comparable levels of technological development. While the rest of the world is still far behind, the technological gap between the industrialized democracies is relatively small. But, although this gap is small, it is quite significant and reflects very different "technological trajectories." Traditionally it has been argued, following from Joseph Schumpeter, that technological innovation is "exogeneous," in that it is based upon the advancement of science and technology and therefore occurs outside of economic processes. Yet more recent views have claimed technological innovations are "endogeneous" and explained by economic factors.53 The endogenous nature of technological innovation means that its development is largely "path-dependent." As Michael Borrus and John Zysman have explained: "Technology is a path-dependent process of learning in which tomorrow's opportunities grow out of product, process, and applications activities undertaken today."54 By concentrating for several decades on military technology, the United States created a technological development trajectory, or "path-dependence," that was based upon "products, processes, and applications" that were very useful for the production of heavy industry, but which became uncompetitive with the introduction of information technologies. Moreover, the historical trajectory of U.S. technological development has hindered its absorption and utilization of the new knowledge-based technologies, as Japan and the Asian NICs take the lead. Although the United States, or any country, can gain access to technological knowledge through international markets, this in itself is insufficent to ensure technological absorption, greater competitiveness, or future innovation. Specific forms of technical knowledge cannot be immediately absorbed and adapted to production processes within a particular state unless there is an appropriate environment, or technological trajectory, for integration. This is because recent "technical knowledge involves additional, often more subtle insights that coalesce only in conjunction with experience in development and production. The process is simultaneously cyclical and incremental...advances are driven through iteration and cumulative learning by doing in production."55 As Borrus and Zysman elaborate, cumulative learning creates a skilled workforce as well as proprietary technology and techniques. This constitutes a specific "path dependence" which makes it more difficult to copy or apply the new technologies to areas that lack the appropriate infrastructure, skilled labor force, or organization of production. In order for the new information technologies to be effectively absorbed and utilized by a state, it must at the least have highly educated workers and production processes that are organized around horizontal communication networks. In sum, while new information technologies can indeed be acquired through international markets, the ability to integrate them efficiently into a state's production processes depends on a range of political and economic factors, not the least of which are the state's past "technological trajectory."

The "Globalization of Production and Exchange"

New information-based technologies are not only forcing states to reorganize their domestic political and economic structures, they are also transforming the character of international markets. Because of the power of modern computers, computer software, fiber-optic cables, and satellites, a new global communications system has been created so that international markets now function as essentially one where buying and selling never stops. With vastly improved communications networks and the decline in transportation costs, it is now highly profitable to produce and market goods on a global scale. But as conditons in the global market can rapidly shift, the international economic competitiveness of states and firms depend primarily upon having up-to-date information on such changes. For that reason, it is hardly an exaggeration to claim "[i]nformation has become the key to modern economic activity—a basic resource as important today as capital, land and labor [was] in the past."56 Information has become so important because the world economy is highly integrated, although it was the development of knowledge-based technologies that made the integration possible.

The growing recognition of the importance of information as the basis of competitve advantage has led the advanced capitalist states to utilize new technologies to shift production away from material goods to information processing activities. That is, the underlying structure of modern production is now being reorganized and enhanced by concentrating on economic activities that utilize information and communications technologies. This has meant that advanced economic activity has changed radically from standardized mass production to adjustable customized production, which is vital to maintaining competitive efficiency and flexibility in the ever-changing environment of the global economy. The restructuring and reorganizing of production is apparent in the use of "horizontal networks" between economic units, rather than traditional large-scale "vertical integration." Greater "horizontal reorganization" is evident in management, production, investment, markets, labor, and technologies, so that production now extends across national frontiers.57 That is, until the development of the new information technologies, "horizontal reorganization" of production had to be "primarily organized within national economies..."58 But the new technologies have made it possible to organize production "outside" of national economies. This has led to the "internationalization of production," where capital, technology, and other factors of production are extremely mobile. But the "internationalization of production" also means the location of natural resources, cheap and abundant labor, or capital stock are no longer primary determinants of where production occurs. It is more important for the economic development of a state to be able to incorporate new knowledge and apply it quickly to a broad range of activities through information processing and telecommunications.59 Consequently, "...a country's comparative advantage lies in its ability to utilize effectively the new information technology, in the speed of its absorption into the productive process, and in the relative efficiency with which it is applied. Less and less it is other factor endowments..."60 States using old organizational structures, whether hierarchical structures or assembly-line production, will inevitably remain at a competitive disadvantage because they will not be able to adapt new technologies to their production processes or to quickly adjust to changing international market conditions.

Advanced industrial democracies with flexible market economies and access to these new technologies have increasingly been able to "globalize" their production processes throughout the international system, and their most effective "tool" for doing so has been the multinational corporation (MNC).61 In the expanding global market, MNCs are extremely well-suited to produce and market goods on an international scale.62 In addition to MNCs being able to mobilize investment capital, conduct research and development on products and their applications, as well as process and utilize information throughout the globe, MNCs have become the primary creators and controllers of modern technology. With the growing diffusion of technology from economy to economy, rapid shifts in comparative advantage between countries have become more frequent, which leads to changes in location of international production. Thus trade and investment are more dynamic, but MNCs are able to take advantage of such shifts because of their innate technical expertise, managerial skills, and economies of scale. Trade now quickly adjusts to new opportunities because MNCs have immediate knowledge of foreign markets and access to global distribution channels.[63] The power of some contemporary MNCs is now greater than that of many states.

MNCs are helping to further integrate the global economy by moving vast amounts of capital, technology, factories and equipment across national boundaries.[64] It is hardly surprising then that international trade is now expanding faster than world production. While much of this trade continues to be in merchandise goods, the proportion of services traded across borders is increasing.[65] The growth in trade of merchandise and services is due largely to the developments in communications, data-processing, and information technologies. Such services as transportation, telecommunications and computer services, data processing, financial services, cross-border consulting, and professional services have all become much more important in the global economy.[66] A related trend is the growth of trade in merchandise goods and services occurring between advanced developed countries. That is, over three-quarters of the developed countries' exports go to other developed countries.[67] In addition, most of the trade in merchandise goods, and much of it in services, is not between industries in different states, but between industries of MNCs whose plants are increasingly located in different countries.[68] This growth in "intra-industry" trade, along with increasing trade between industralized countries and the rise in services, reflect the importance of information-based technology on economic behavior. However, as these recent trends also clearly indicate, having new technologies and being able to effectively use them remain largely the privilege of the advanced industrialized democracies.

The Emerging Economic Order and International Relations

Although the internationalization of production and exchange continues to expand, information-based technologies have also begun to generate contradictory effects throughout the global economy. The advanced industrialized democracies, and their multinationals, have a considerable stake in the stability and development of the global economy. The expansion of production, exchange, and new technologies in the global economy have created very strong ties of mutual interests among the developed states, which are helping to mitigate the harmful effects of the inevitable unequal gains from trade. Certainly, industrialized democracies recognize the gains to be had by ensuring the stability and efficiency of the global economy, but this does not mean that international order precludes competitive trade strategies and increased friction among the most advanced countries.

Because of the growing importance of technology as the basis of comparative advantage, rapid shifts occur as innovations are introduced into production processes and markets. Moreover, the increasing mobility of capital and other factors of production tend to intensify the competition for foreign investments and control of markets. As a result, the underlying importance of technologies for economic competitiveness are causing advanced industrialized democracies to adopt increasingly mercantilist and protectionist trade policies. Under the guise of "strategic trade theory,"69 states now utilise managed trade arrangements, sector subsidies, "nontariff barriers," and other tactical devices in an effort to gain unilateral or competitive advantage in particular sectors or industries.70 Because many of the new technologies have "spin-on" applications from commercial to military uses, strategic trade policies attempt to grasp key technologies and markets before others do. The effectiveness of such strategies frequently depends on a state taking "a first mover advantage" as a preemptive measure.71 Japan has been extremely successful over the last 40 years in using such strategies of "international mercantilism." Through its strong bureaucracy, the Japanese state and zaibatsu (industrial conglomerates) have guided the country's development in the world economy by effectively adapting to the dynamic and changing nature of comparative advantage.72

As other industrialized democracies adopt similar strategies, it remains unclear how the global economy will evolve. It may well reflect "liberal protectionism" or "benign mercantilism" between "loose regional blocs."73 But more pessimistic scenarios envision regional blocs becoming increasingly aggressive to gain favorable "technological balances of power."74 Certainly, because of their vast financial resources, well-developed markets, and relatively independent industrial and technological bases, Europe, Asia, and North America are all capable of emerging as autonomous regional actors in the new global economy. Whether technological needs will induce greater cooperation or preemptive trade strategies to gain technological advantage will contribute to mercantilist competition remains to be seen.75

While economic growth and international competitiveness depend upon advanced information technologies, the new technologies have been developed and are controlled by the industrialized democracies of the First World. However, in 1987, W.W. Rostow argued that the new technologies were contributing to a "diffusion of power away from Washington and Moscow...," much to the advantage of the less developed countries of the Third World.76 According to this view, education and the spreading of the new technologies are the great equalizers among states. Certainly the Asian NICs, Mexico, Brazil, India, and China have demonstrated that with correct development strategies and self-discipline it is possible to achieve remarkable levels of growth. The question for these countries is whether they can sustain long-term growth and development without becoming full-fledged democracies, which is virtually a prerequisite for the use of the new technologies. If they fail to become democratic with market-based economies and open societies, the technological gap between them and the advanced industrialized democracies will only continue to get wider.

Most threatening to the global economy and the stability of the international order are those countries confronted with their increasing marginalization because of a total lack of access or ability to use the new technologies. In effect, the development of the knowledge-based technologies has served to further handicap those Third World countries that lack the political and economic prerequisites, including the appropriate technological trajectory, to adapt and integrate the technologies into their economies.77 Many of these states have become totally marginalized or excluded from the global economy, despite having cheap and abundant labor and considerable natural resources that formerly attracted foreign investment. Because the information technologies require a well-educated workforce, an entrepreneurial or professional class, adequate capital, extensive knowledge resources, as well as an efficient financial structure supported by a stable and functional national infrastructure,78 the absence and unattainability of these resources have caused MNCs and the advanced industrial states to investment elsewhere.79 But as foreign investment in Third World states declines, the resources necessary to improve "human capital" and make the great technological leap forward to development are absent.80

Those Third World countries that have suffered the most from recent technological changes, and the integration of the global economy, are being relegated to what is now characterized as the "Fourth World." For the several hundred million people that occupy this world, their economies "fail to provide even bare subsistence on a reliable basis, so that economic collapse is avoided only through resource transfers from the advanced nations."81 They are truly the newest "wards of the international community." As the new technologies contribute to the increasing marginalization of the Third and Fourth Worlds, their situations are only likely to get worse. As a result, it is just a matter of time before the growing ecological and environmental disasters of the Fourth World spill over and affect the stability and order of the First World.82

Conclusions

By redefining the basis of power and international economic competitiveness, the new information technologies of the "third industrial revolution" are forcing increasing numbers of states to become democratic and adopt market-based economies, if only to ensure their economic and political survival. These changes cannot help but have a profound influence on the interstate competition and the nature of the international relations. The impact of new technologies on the industrialized democracies and international system will be no less profound than they have been on the former Soviet bloc. The emerging international order will undoubtedly reflect the spreading of democracy and the growth of market-based economies, and both should contribute to greater stability and cooperation in the system, albeit still within a highly competitive environment. But many potential and actual international problems remain even after the "third industrial revolution," particularly with regard to the Third and Fourth Worlds. As Eugene Staley presciently noted in 1939: "A conflict rages between technology and politics...Stability and peace will reign in the world economy only when, somehow, the forces on the side of technology and the forces on the side of politics have once more been accommodated to each other."83 The difficult transitions to democracy and free market economy in the former Soviet Union and in parts of the Third and Fourth World, along with the increasingly competitive nature of relations between the advanced industrialized democracies, indicate that technology and politics are still a long way from reaching accommodation. This will, however, be far easier to achieve if it is based upon an understanding of the critical role information-based technologies played in ending the Cold War and helping to define the emerging global order.

Notes

1. John Lewis Gaddis, "International Relations Theory and the End of the Cold War," International Security 17, 3 (Winter 1992/1993), pp. 5-58.

2. Robert W. Tucker, "1989 and All That," Foreign Affairs 69, 4 (Fall 1990), p. 95.

3. E.H. Carr, The Twenty Years' Crisis, 1919-1939 (New York: Harper, 1964), p. 216.

4. Seweryn Bialer, "Gorbachev's Program of Change: Sources, Significance, Prospects," Political Science Quarterly 103, 3 (Fall 1988), p. 459.

5. On the concept of the "third industrial revolution," see Daniel Bell, "The Third Technological Revolution," Dissent (Spring 1989), pp. 164-76; and on the role of technology in international relations, see Eugene B. Skolnikoff, The Elusive Transformation (Princeton: Princeton University Press, 1994).

6. Martin Wight, Power Politics (New York: Penguin, 1986), p. 262.

7. John Lewis Gaddis, "Hanging Tough Paid Off," Bulletin of Atomic Scientists 45 (January 1989), pp. 11-14; and Valery Giscard d'Estaing, Henry Kissinger, and Yasuhiro Nakasone, "East-West Relations," Foreign Affairs 68 (Summer 1989), pp. 1-21. See also, Seweryn Bialer and Joan Afferica, "Reagan and Russia," Foreign Afairs 61 (Winter 1982/83), pp. 261-67; Richard Pipes, "Can the Soviet Union Reform?" Foreign Affairs 63, 1 (1984), pp. 47-61; and Barry Posen and Stephen Van Evera, "Defense Policy and the Reagan Administration," International Security 8 (Summer 1983), pp. 3-45.

8. Paul Kennedy, The Rise and Fall of the Great Powers (New York: Random House, 1987), p. xvi.

9. Joint Economic Committee, U.S. Congress, Allocation of Resources in the Soviet Union and China - 1986 (Washington, D.C.: Goverment Printing Office, 1988), p. 15; and Eduard Shevardnadze, Atlantic Council Bulletin 1, 19 (August 1, 1990), p. 1. On the problematic nature of these estimates, see Franklin D. Holzman, "Politics and Guesswork: CIA and DIA Estimates of Soviet Military Spending," International Security 14, 2 (Fall 1989), pp. 101-31.

10. Gur Ofer, "Soviet Economic Growth: 1928- 1985," Journal of Economic Literature 25, 4 (December 1987), pp. 1767-1833.

11. Aaron L. Friedberg, "The Political Economy of American Strategy," World Politics 41, 3 (April 1989), pp. 381-406.

12. Ofer, pp. 1814-26; and Paul Kennedy, Preparing for the Twenty-first Century (New York: HarperCollins, 1993), p. 231.

13. George Kennan, "The G.O.P. Won the Cold War? Ridiculous," The New York Times (October 28, 1992), p. A21. See also, Thomas Risse-Kappen, "Did `Peace Through

Strength' End the Cold War? Lesson from INF," International Security 16, 1 (Summer 1991), pp. 162-88.

14. See for example, George F. Kennan, "America and the Russian Future," Foreign Affairs 29, 3 (April 1951), pp. 351-70.

15. Ofer, pp. 1818-1819; and Myron Rush, "Guns over Growth in Soviet Policy," International Security 7, 3 (Winter 1982/83), pp. 167-79.

16. Joint Economic Committee, U.S. Congress, East-West Trade: The Prospect of 1985 (Washington, D.C.: Government Printing Office, 1982), p. 367. On Soviet objectives during detente, see Harry Gelman, The Brezhnev Politburo and the Decline of Detente (Ithaca, NY: Cornell University Press, 1984), pp. 124-31; and Bruce Parrott, "Theory and Praxis of Soviet Economic Modernization," Problems of Communism 33 (September-October 1984), pp. 104-08.

17. Joint Economic Committee, East-West Trade: The Prospect to 1985, p. 278; and Timothy W. Luke, "Technology and Soviet Foreign Trade," International Studies Quarterly 29, 3 (September 1985), pp. 346-47.

18. Michael Mastanduno, "Strategies of Economic Containment: United States Trade Relations with the Soviet Union," World Politics 37, 4 (July 1985), pp. 503-31. Also, Michael Mastanduno, Economic Containment: The Western Politics of East-West Trade (Ithaca, NY: Cornell University Press, 1992); and Beverly Crawford, Economic Vulnerability in International Relations (New York: Columbia University Press, 1993). CoCom was the Coordinating Committee for Multilateral Export Controls, a multilateral regime to restrict Western exports to the Soviet bloc.

19. Paul R. Josephson, "Science and Technology as Panacea in Gorbachev's Russia," in Technology, Culture, and Development, edited by James P. Scalan (London: M.E. Sharpe, 1992), p. 26.

20. Loren R. Graham, "The Fits and Starts of Russian and Soviet Technology," in Technology, Culture, and Development, p. 3, pp. 17-22.

21. Melvin Kranzberg, "The Information Age: Evolution or Revolution?" in Information Technologies and Social Transformation, edited by Bruce Guile (Washington, D.C.: National Academy Press, 1985), pp. 35-53.

22. Luke, "Technology and Soviet Foreign Trade," p. 350 note #5.

23. Joseph S. Nye. Jr., "Is There a New World Order?" in The New World Order, edited by Carol Rae Hansen (Flagstaff, AZ: Arizona Honors Academy Press, 1992), p. 8. See also, Loren R. Graham, "Science and Computers in Soviet Society," in The Soviet Union in the 1980s, edited by Erik Hoffmann (New York: Academy of Political Science, 1984), pp. 124-34; and S.E. Goodman and W.K. McHenry, "Computing in the USSR: Recent Progress and Policies," Soviet Economy 2, 4 (1986), pp. 327-54.

24. Seymour Goodman, "Information Technologies and the Citizen; Toward a `Soviet-Style Information Society'?" in Science and the Soviet Social Order, edited by Loren R. Graham (Cambridge: Harvard University Press, 1990), p. 373 note #13.

25. Joseph S. Nye, Jr., Bound to Lead (New York: Basic Books, 1990), p. 122.

26. S.E. Goodman, "Technology Transfer and the Development of the Soviet Computer Industry," in Trade, Technology, and Soviet-American Relations, edited by Bruce Parrott (Bloomington, IN: Indiana University Press, 1985), pp. 117-40. See also Bell, "The Third Technological Revolution," pp. 165-66; and Beverly Crawford, "The Security Dilemma Under International Economic Interdependence," Millennium 23, 1 (Spring 1994), pp. 25-55.

27. Skolnikoff, p. 58.

28. Nathan Rosenberg, Inside the Black Box: Technology and Economics (New York: Cambridge University Press, 1988); and "A Background Review of the Relationships Between Technological Innovation and the Economy," in Technology, Trade and the U.S. Economy (Washington, D.C.: National Academy of Sciences, 1978), pp. 18-48.

29. Oleg Bogomolov, "The World Economy Faces a Technological Challenge," in Science, War, and Peace, edited by Jean Jacques Salomon (Paris: Economica, 1990), p. 158.

30. Loren R. Graham, "Introduction: The Impact of Science and Technology on Soviet Politics and Society," in Science and the Soviet Social Order, pp. 12-13. See also, Goodman, "Information Technologies and the Citizen: Toward a `Soviet-Style Information Society'?" pp. 51-67.

31. Skolnikoff, pp. 128-32. "Vertical communication" refers to communication from authorities to citizens/workers (top down), but it may also be from from citizens/workers to authorities (bottom up). "Horizontal communication" is across social classes.

32. Skolnikoff, p. 130.

33. Loren Graham, "Gorbachnev's Great Experiment," Issues in Science and Technology 4 (Winter 1988), pp. 23-32; and Robert Legvold, "The Revolution in Soviet Foreign Policy," Foreign Affairs 68, 1 (1989), pp. 82-98.

34. Bruce Parrott, "Soviet National Security Under Gorbachev," Problems of Communism 37 (November-December 1988), pp. 1-36; Matthew Evangelista, "Sources of Moderation in Soviet Security Policy," in Behavior, Society, and Nuclear War, edited by Philip E. Tetlock et al., Vol.2 (New York: Oxford University Press, 1990), pp. 254-354; David Holloway, "State, Society, and the Military Under Gorbachev," International Security 14, 3 (Winter 1989/90), pp. 5-24; and David Holloway, "Gorbachev's New Thinking," Foreign Affairs 68, 1 (1989), pp. 66-81.

35. Interview with Gorbachev on April 1, 1993, cited in Janice Gross Stein, "Political learning by doing: Gorbachev as uncommitted thinker and motivated learner," International Organization 48, 2 (Spring 1994), p. 158.

36. Marshall Shulman, "The Superpowers: Dance of the Dinosaurs," Foreign Affairs 66, 3 (1988), p. 495. See also Matthew Evangelista, "Economic Reform and Military Technology in Soviet Security Policy," The Harriman Institute Forum 2, 1 (Janauary 1989), pp. 1-8.

37. Daniel Deudney and G. John Ikenberry, "Soviet reform and the end of the Cold War," Review of International Studies 17 (1991), p. 136.

38. Alexander Gerschenkron, Economic Backwardness in Historical Perspective (Cambridge: Harvard University Press, 1962), Chapter 1.

39. Alaine Touraine, The Post-Industrial Society (New York: Random House, 1971); Daniel Bell, The Coming of the Post-Industrial Society (New York: Basic Books, 1973); and John A. Hall and G. John Ikenberry, The State (Minneapolis, MN: University of Minnesota Press, 1989), pp. 80-83.

40. Deudney and Ikenberry, "Soviet Reform and the End of the Cold War," pp. 235-39, 241-44.

41. S. Frederick Starr, "New Communications Technologies and Civil Society," in Science and the Soviet Social Order, edited by Loren R. Graham (Cambridge: Harvard University Press, 1990), pp. 19-50; and S. Frederick Starr, "Soviet Union: A Civil Society," Foreign Policy 70 (Spring 1988), pp. 26-41.

42. Fred Chernoff, "Ending the Cold War: The Soviet Retreat and the U.S. Military Buildup," International Affairs 67, 1 (January 1991), p. 124.

43. Bialer, "Gorbachev's Program of Change," p. 459.

44. Steve Weber, "Cooperation and Interdependence," Daedalus 120 (Winter 1991), pp. 183-201.

45. Robert Gilpin, "The Computer and World Affairs," in The Computer Age, edited by Michael L. Dertouzos and Joel Moses (Cambridge: MIT Press, 1980), p. 230; and John Von Neumann, "Can We Survive Technology?" Fortune (June 1955), p. 152.

46. Stephen S. Cohen and John Zysman, Manufacturing Matters (New York: Basic Books, 1987), pp. 24-27; and Ethan Kapstein, The Political Economy of National Security (New York: McGraw Hill, 1992), pp. 91-112.

47. Michael Borrus et al., "Mercantilism and Global Security," The National Interest 29 (Fall 1992), pp. 26-27; Charles Herzfeld, "Technology and National Security," The Washington Quarterly, 12 (Summer 1989), pp. 171-72, 180-83; and D. Weston and P.

Gummett, "The Economic Impact of Military R&D: Hypotheses, Evidence, and Verification," Defense Analysis 3, 1 (1987), pp. 63-76.

48. Barry Buzan, People, States, and Fear (Boulder, CO: Lynne Reiner, 1991), especially pp. 124-31; and Karl Polanyi, The Great Transformation (Boston: Beacon Press, 1944).

49. Crawford, "The New Security Dilemma Under International Economic Interdependence," p. 26.

50. Charles H. Ferguson, "America's High-Tech Decline," Foreign Policy 74 (Spring 1989), pp. 130-39; and John Zysman, "U.S. power, trade, and technology," International Affairs 67, 1 (1991), pp. 81-106.

51. See Jay Stowsky, "From Spin-Off to Spin-On: Redefining the Military's Role in American Technology Development," in Wayne Sandholtz et al., The Highest Stakes (New York: Oxford University Press, 1992) pp. 114-40.

52. Stephen Cohen and John Zysman, Manufacturing Matters: The Myth of the Post-Industrial Economy (New York: Basic Books, 1987); and Michael L. Dertouzos, Richard K. Lester, and Robert M. Solow, Made in America: Regaining the Productive Edge (Cambridge, MA: MIT Press, 1989).

53. See, for example, Jacob Schmookler, Invention and Economic Growth (Cambridge, MA: Harvard University Press, 1966); and Robert Gilpin, "Trade, Investment, and Technology Policy," in Emerging Technologies, edited by Herbert Giersch (Tubingen: J.C.B. Mohr, 1982), pp. 390-92.

54. Michael Borrus and John Zysman, "Industrial Competitiveness and American National Security," in The Highest Stakes, p. 26, pp. 30-31.

55. Ibid., p.27.

56. W. Michael Blumenthal, "The World Economy and Technological Change," Foreign Affairs 66, 3 (1988), p. 534.

57. Martin Carnoy, et al., "Introduction," The New Global Economy in the Information Age (University Park, PA: Pennsylvania State University Press, 1992), pp. 5-6; and Manuel Castells, "The Information Economy and the New International Division of Labor," in ibid., pp. 15-20.

58. E.J. Hobsbawm, "The Development of the World Economy," Cambridge Journal of Economics 3 (1979), p. 313.

59. Manuel Castells and Laura D'Andrea Tyson, "High Technology Choices Ahead: Restructuring Interdependence," in Growth, Exports, and Jobs in a Changing World Economy, edited by John Sewell and Stuart Tucker (Washington, D.C.: Transaction Books, 1988), pp. 55-95.

60. Blumenthal, p. 536, pp. 537, 542.

61. Raymond Vernon, Sovereignty At Bay (New York: Basic Books, 1971); Helen Milner, Resisting Protectionism: Global Industries and the Politics of International Trade (Princeton: Princeton University Press, 1988); and Lorraine Eden, "Bringing the Firm Back In: Multinationals in International Political Economy," Millennium 20, 2 (1991), pp. 197-224.

62. Martin Carnoy, "Multinationals in a Changing World Economy," in The New Global Economy in the Information Age, pp. 45-96.

63. Robert Gilpin, The Political Economy of International Relations (Princeton: Princeton Universtiy Press, 1987), pp. 261-62; and Blumenthal, pp. 536-37.

64. Robert Jervis, "The Future of World Politics," International Security 16, 3 (Winter 1991/92), pp. 49-51.

65. Robert Reich, The Work of Nations (New York: Knopf, 1991), pp.85-86, 94-95. See also, Jagdish Bhagwati, "Trade in Services and the Multilateral Trade Negotiations," The World Bank Economic Review 1, 1 (1987).

66. Jock A. Finlayson, "Trade and Global Interdependence," in World Politics, edited by David G. Haglund and Michael K. Hawes (London: Harcourt Brace Jovanovich, 1990), p. 288, 297-99.

67. Raymond Vernon, "Japan, the United States, and the Global Economy," The Washington Quarterly, 13 (Summer 1990), p. 58; and James M. Goldgeier and Michael McFaul, "A Tale of Two Worlds: Core and Periphery in the Post-Cold War Era," International Organization 46 (Spring 1992), pp. 484, 488.

68. Such trends as the increase in "intra-industry" trade and the expansion of trade between developed countries are examined in more detail in Peter Dicken, Global Shift: The Internationalization of Economic Activity (London: Guilford, 1992).

69. On "strategic trade theory," see Paul Krugman, "The Current Case for Industrial Policy" in Protectionism and World Welfare, edited by Dominick Salvatore (New York: Cambridge University Press, 1993), pp. 160-79; David B. Yoffie, ed., Beyond Free Trade (Boston: Harvard Business School Press, 1993); and Helen V. Milner and David B. Yoffie, "Between Free Trade and Protectionism," International Organization 43, 2 (Spring 1989), pp. 239-72.

70. Jagdish Bhagwati, Protectionism (Cambridge: MIT Press, 1989); and W. Max Corden, "The Revival of Protectionism in Developed Countries," in Protectionism and World Politics, pp. 54-79.

71. Michael Borrus et al., "Mercantilism and Global Security," The National Interest 29 (Fall 1992), pp. 26-27.

72. James R. Kurth, "The Common Defense and the World Market," Daedalus 120, 4 (Fall 1991), p. 220-22. See also, James R. Kurth, "The Pacific Basin versus the Atlantic Alliance: Two Paradigms of International Relations," The Annals 505 (September 1989), pp. 39-42; and Raymond Vernon, "Japan, the United States, and the Global Economy," The Washington Quarterly 13 (Summer 1990), pp. 57-68.

73. Gilpin, The Political Economy of International Relations, pp. 204-09, 381-406; and Barry Buzan, "Economic Structure and International Security," International Organization 38, 4 (Autumn 1984), pp. 597-624.

74. Steve Weber and John Zysman, "The Risk That Mercantilism Will Define the Next Security System," in The Highest Stakes, pp. 167-96.

75. Laura D'Andrea Tyson, Who's Bashing Whom: Trade Conflict in High-Technology Industries (Washington, D.C.: Institute for International Economics, 1992).

76. W.W. Rostow, "On Ending the Cold War," Foreign Affairs 65, 4 (Summer 1987), pp. 840-41.

77. Ian C. Parker, "Myth, Telecommunication and the Emerging Global Informational Order: The Politcal Economy of Transitions," in The Political Economy of Communication, edited by Edward A. Comor (New York: St. Martin's Press, 1994), pp. 37-60.

78. Skolnikoff, pp. 137-38, 145; and Bogomolov, pp. 159, 163.

79. James M. Goldgeier and Michael McFaul, "A Tale of Two Worlds: Core and Periphery in the Post-Cold War Era," International Organization 46 (Spring 1992), pp. 484, 488.

80. Fernando Henrique Cardoso, "North-South Relations in the Present Context: A New Dependency?" in The Global Economy in the Information Age, p. 157.

81. Paul R. Krugman, "Developing Countries in the World Economy," Daedalus 118 (Winter 1989), p. 184.

82. These problems are examined in detail in Robert D. Kaplan, "The Coming Anarchy," The Atlantic Monthly (February 1994), pp. 44-76; Thomas F. Homer-Dixson, "On the Threshold: Environmental Changes as Causes of Acute Conflict," International Security 16, 2 (Fall 1991), pp. 76-116; and Thomas F. Homer-Dixon, "Environmental Scarcities and Violent Conflict," International Security 19, 1 (Summer 1994), pp. 5-40.

83. Eugene Staley, World Economy in Transition (New York: Council on Foreign Relations, 1939), pp. 51-52.

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Chapter 22: Connecting Developing Countries to the Information Technology Revolution *

by Jean-Francois Rischard

The revolution in communication and information technologies, and the new economy that it is helping to unleash, is a double-edged sword for developing countries. New low-cost technologies offer developing countries unprecedented opportunities for rapid development, yet these technologies also raise the threshold of competitiveness.

What Is Happening Out There?

The world has been hit by a wave of innovations, the likes of which occur, according to some observers, only once every three generations. Centered around telecommunications and informatics, these innovations are producing a real information technology revolution which is, in turn, setting off side revolutions wherever applications of these technologies have been developed and implemented. Industries transformed by these innovative technologies and their applications include biotechnology, robotics, miniature motors, software production, and high-performance materials. Even the relatively more mundane field of transport has been revolutionized by the new containers, hub airports, and overnight shipping systems made possible by the information technology revolution.

The ongoing development and improvement of technologies indicates that the information technology revolution is still young. The following points support this idea that there is much yet to come:

- Over the next 20 years, the cost of telecommunications may well drop to the point that it will become a virtually free commodity. In a recent study sponsored by the World Bank, the cost assumption for 2010 was on the order of 3 cents for a one-hour transatlantic call. It is not implausible that by 2000, the cost of voice traffic through submarine cable links will already have dropped to one percent of its 1987 cost.

- New data compression techniques and smart combinations of fiber and wireless communications will practically eliminate bandwidth constraints, and will knock connection costs down to a few dollars per station in about a decade.

- A full transition to digitalization is still years away, but when it happens, and when near-universal networks serve the planet some 20 years from now, there will be a convergence of the telecommunication, computer, and media industries into what some have aptly called the "bits industry." People in their homes will have the world at their fingertips on flat screens. As someone said, it will no longer be "Big Brother is watching you," but "Big Brother is you, watching."

- While the information revolution is still in its infancy, two features clearly indicate its future potency: First, whereas the industrial revolution transformed our understanding of human capacity in relation to energy and matter, the information technology revolution is transforming our understanding of human capacity in relation to time and distance. Second, the faster and more pervasive flow of information across the planet suggests that knowledge and information are destined to constitute a more important production factor than labor, raw materials, or capital. These two features of the technological revolution are already visibly revolutionizing business practices and they promise a less visible, but still crucial, social revolution in the future.

The Visible Revolution in Worldwide Business Practices

The following five examples illustrate the impact of information technology on business:

Accelerated, leaner, more standardized business practices. Just-in-time (JIT) production processes are spreading everywhere. Companies such as Toyota base all their operations on this principle, saving billions of dollars. Countries like Singapore essentially run their whole economy on a JIT basis. The Benetton company uses a combination of last-minute dyeing techniques combined with ultra-rapid communications to bring down its restocking time to less than 2 weeks— speeds unheard of even 5 years ago. Johnson Electric Holdings, in Hong Kong, can produce a new micromotor prototype ready for production just 6 weeks after getting the specs, and uses teleconferencing to keep the client informed throughout the process.

Increasingly complex transnational business alliances. A Singapore firm uses Taiwanese capital to produce telephone sets in China for the U.S. market, using Israeli technology. Such "value chains," involving four to five countries or more, have become common, along with all manner of cross-border strategic alliances between firms. The number of such alliances has, in fact, tripled since 1990.

Hypercompetitive purchasing worldwide. U.S. department stores now purchase cotton shorts by asking for bids from 10 countries at a time. Ford recently introduced the concept of a global car and reorganized its worldwide operations so that parts could be purchased wherever they are cheapest. Everywhere, distributors are gaining over manufacturers, who must meet the most competitive of conditions or be left out.

Borderless capital flows. Last year, private capital flows into developing countries totaled $155 billion, more than twice the amount of official development assistance. New players—global companies seeking to make direct investments worldwide and institutional investors, like mutual funds and pension funds—continue to enter the field. The result of this practice, as the recent Mexican peso crisis showed, is an intense scrutiny of national economies, as the standards of the International Monetary Fund and the World Bank are increasingly complemented by the demands of disciplinarian, and often fickle, private investors.

Soaring international trade in services. One of the most spectacular aspects of this revolution in business practices is that services previously assumed to be utterly untradable are becoming tradable. Thousands of telephone operators in Jamaica, the

Dominican Republic, and St. Lucia work for U.S. companies. Every night, the largest U.S. insurance companies fly their paperwork to Ireland, where it is logged into computer systems by workers operating in small villages around the countryside. SwissAir has its revenue accounting completed in Bombay, with a crew of 100 replacing the 200 people previously employed for this purpose, at far greater expense, near Zurich. And in Washington, many physicians now dictate memos into a telephone line, with trained nurses doing the typing in real time in India, at about half the cost of U.S. typing services.

This new phenomenon of international long-distance provision also applies to more sophisticated services. India has captured a half billion dollar slice of the world software programming market, with the Motorola programming team in Bangalore recently being named one of the best in the world.

The Not-Yet-So-Visible Social Revolution

As technology revolutionizes business before our eyes, the same is soon to occur in society as a whole, changing the way we work, learn, organize, and even shop. Following are five examples of the changes to come:

The advent of teleworking on a large scale. Some studies estimate that 15-20 percent of the workforce may be teleworking, or telecommuting, by 2020. In the U.S., some 30 million people already work from home, either full or part time, communicating with their employer or clients from a distance. No one can be certain what impact this sea-change in personal work methods will have on the core of cities, on the travel industry, or on lifestyles, but we know that the impact will be dramatic. Together with teleworking, some predict that we will increasingly see what is called "portfolio working," where self-employed individuals work at a distance for two, three, or more corporations either on contract or for a fee.

Education as a universally tradable commodity. One of the most exciting products of the information technology revolution will be the ability to offer lifelong education to anyone, at low cost, on almost any subject through CD-ROMs, interactive multimedia systems, and teleconferencing. Three universities already existed on the Internet at the end of last year, and that number is certain to grow.

Teleshopping. Some 10 years from now, many of today’s traditional marketing channels will have been complemented, or even replaced, by electronic, interactive catalogue shopping. Even interactive bidding will be possible. This will increase the trend toward hyper-competitive purchasing and transform jobs in wholesaling, retailing, and procurement.

The advent of paperless electronic money systems. This will have a major impact on the work of banks and other financial institutions, as well as in many types of enterprises, as paperless payment becomes standard.

A revolution in human organizations. Organizations will abandon their prevailing command-and-control structures to become more fluid and decentralized. This will develop because organizations are really information systems. When information is embodied in papers, memos, and forms, corporations (and governments) tend to be organized around people. Digitalization brings disembodied information that is easily shared, making it possible to organize around purposes rather than people. People can become "empowered assets," rather than poor information-transmitters. This is one of the reasons why so many large corporations (IBM, GE, ABB) are reinventing themselves, and why so many governments are beginning to do the same. This change in the inner philosophy and makeup of organizations, government included, will be one of the great social changes in the decades to come.

The Implications for Development and the Fight Against Poverty

As a result of the information technology revolution, every country confronts a new world economy that has four features: high speed, knowledge intensive, transnational, and highly disciplinarian (due to the extraordinary competition it breeds among countries and firms). The race for competitiveness will be worldwide, and the finish line will be in constant retreat. The old distinction between rich and poor countries will be overwhelmed by new distinctions: fast and slow, learning and static, plugged-in and unplugged, reliable and unreliable. This competition will unleash tremendous pressures for change, allowing no developing country (even the poorest) to remain exempt.

There is no better way to illustrate the tremendous pressures for change than through examples of transformations already underway and by the potential application of these low-cost, high-leverage technologies on the human resource and poverty agenda, the environmental agenda, and several related competitiveness-related areas. Of course, there are many interlinkages between these three divisions: the new technologies for education and training, for example, fit under both the human resource agenda and the competitiveness agenda.

Education and Training

Research shows that economic development is strongly correlated with educational attainment and outreach—some have called education the most powerful economic technology known to man. The implementation of new information technologies in developing countries will provoke significant leaps in learning and knowledge over the decades to come. There is tremendous potential here for education at all levels and in all fields.

Basic education. The most promising applications, in the medium term, are in teacher training and teacher updating through networked knowledge links. In the longer term, with a simple cellular link and second-hand PC, the concept of the village school can be reinvented, along with the concept of the teacher. Icon-based education and other technology will accelerate functional literacy among even the poorest groups. In South Africa, IBM has experimented with providing disadvantaged children with basic literary skills through the Writing to Read program. In Mexico, the government just launched Telesecundaria, a distance teaching network for 12,000 rural schools that provides basic education beyond the primary school level. Each school will have access to six TV learning channels carried over a digital compression network, enabling a single teacher in each school to tutor students from three grades.

Higher education. Poorly staffed universities in East Africa can be upgraded almost overnight through electronic links with premier European universities, and several initiatives are afoot at the World Bank to create such "virtual universities." Distance learning for secondary and higher education provides an incredible opportunity for all developing countries by changing the cost and quality parameters for education, even in remote areas. Britain's Open University already trains one-fifth of the country's graduates at one-ninth of the cost. These systems also work well for continuing adult education.

Professional training. Highly-task specific technical training can be dispensed anywhere at low cost via CD-ROM. Small enterprises in a specific field, such as textiles, can be helped by small productivity centers linked through the Internet to larger centers in developed countries. Examples of such live conferencing were convincingly demonstrated in the February G7 conference.

Poverty Reduction Through Better Health Systems

The most important area here is not so much curative health care as preventive health care. better nutrition, micro-nutrients, immunization, access to clean water, clean disposal of waste, and so forth. In all these areas, information has a double role since both information dissemination and information gathering are critical aspects. In many developing countries, poor communications and limited access to information technology have deprived health prevention programs of their effectiveness and limited their reach. Indications of this situation are found in the difficulty of controlling communicable diseases, properly training enough health workers, and keeping them up to date.

The new information technologies will make major contributions over the decades to come in two key areas: surveillance and control of epidemics and contagious diseases; and, dissemination of information on best health practices to doctors, nurses, health agents, community leaders, and formal and informal groupings of women. The Global Health Network, an Internet-based global medical information system, helps many health practitioners and researchers all over the world interact and learn together in an organized way, while a major U.S. software firm is developing quicker, cheaper, more reliable information recording systems for field health agents in India. Even in curative health care the possibilities are spectacular, as with long-distance diagnosis on complex heart ailments between specialists in the Mayo Clinic and patients in India using remote imaging. The local "handler" only needs to be a medical technician.

There are many other examples of exciting health applications of new technologies for developing countries, all with tremendous leverage and potential for the alleviation of human suffering— particularly for poor, remote populations with little access to an urban health infrastructure. Many of these approaches already are comparatively low in cost and they will become even more affordable as communications costs go down even further.

Better Environmental Monitoring and Management

A major problem in addressing the pressing environmental remediation and management needs in developing countries is the lack of information on what is actually happening. New information technologies, such as teledetection and computerized databases, can be of enormous help in this area. A land-resource database of the Arun River Basin of Eastern Nepal, for example, produced the first basin-wide mosaic of land use and capability, with detailed maps of deforestation hotspots. Another use for environmental technologies might be enabling a future solution to increasing food needs: the whole field of environmentally balanced agriculture relies on an information-intensive form of agricultural resource management that improves both the production and distribution of food.

Reducing Isolation

What matters these days is not how many phones there are per hundred people, but how many people live within walking distance of a public phone. All over India, small side-street shops offer access to long-distance telephone service. Equipped with just a few chairs, a fan, an electronic billing machine, and sometimes a fax, these small enterprises operate day and night, creating about a quarter million jobs. In Moremanga, a small rural city in Madagascar, Volunteers in Technical Assistance (VITA) is building an information center, which currently consists of a radio communications unit but will soon have Internet connectivity through satellite. Local businesses are paying part of the costs for this venture (with self-sufficiency expected in a year) which will help turn a little city into a commercial center for the area.

Other successful examples include Micro-credit schemes aimed at the poorest of the poor, such as the Grameen Bank in Bangladesh, now use cellular phones to increase their efficiency and accompany their outreach efforts. Some of the more ambitious schemes, such as the Teledesic project (840 low earth-orbiting satellites for $9 billion) will enable every corner on earth to have access to communication through a handset costing a few dollars. The implications of schemes like this are very impressive for those of us in the development business, particularly as some sponsors foresee lower costs for their poverty-reducing applications. A simple cellular telephone station will eventually bring much more to a remote village than the occasional visits of aid workers and government officials.

Helping Small and Larger Businesses Connect

Among the biggest impediments to competitiveness in developing countries are the lack of information about overseas markets, suppliers, and buyers, and the lack of avenues for providing information on local firm capabilities. The new low-cost communication technologies will rapidly and effectively shrink that two-way information gap.

Given adequate communication, developing countries manufacturers can rapidly overcome some of their international information handicaps through electronic bulletin boards and data services for companies like Europartenariat, the UNCTAD trade point system, Commercenet, and several found on the World Wide Web. This is one of the reasons why Internet connectivity programs for Africa are a priority item at the World Bank. One pleasant side benefits is the very low cost of Internet communications. Where a prolonged international call would cost $50 or more for a developing country exporter, the Internet costs are less than one-tenth that amount. The Web is also highly democratic: an exporter in Zambia or Nepal has the same opportunity as any large Western corporation when it comes to opening a home page.

There also are plainer examples of communication technologies that apply to small businesses. In Cote d'Ivoire, farmers use cellular phones to get direct price references from the international cocoa markets. In some West African open air markets, women find out about supplies and prices through the help of one-person phone and fax enterprises. In Peru, one-third of the phone calls via a rural satellite hookup were business-related, and each saved $7 over the slower postal route.

In addition, there are examples, mentioned earlier, of providing services over long distances. The potential exports of clerical and more sophisticated services through teleporting could well amount to some $120-180 billion for developing countries alone, a considerable figure compared with their total exports.

Better Government

Ineffective government is one of the primary causes behind many major development failures of the past 20 years. This is particularly true in Africa, where bad governments make it very hard to start up the lively private sectors so essential to creating jobs and growth. The governmental defects raise the cost of doing business by 20-30 percent above conditions elsewhere.

The new technologies can help government systems become more effective in their day-to-day operations. A $1 million trade system in Mauritania brought down customs processing time to 30 minutes, and more than paid for itself through increased customs revenues. In Brazil, automated systems validate every fiscal expense that same day. The World Bank is now supporting computerized tax administration and audit control in Morocco. Satellite and information technology can be used for computer mapping and land titling programs, which are crucial for giving small farmers and entrepreneurs access to collateralized credit.

Electronic government systems for customs, taxes, and registries of all kinds will also be a booming business. IBM alone is currently working on no fewer than eight national tax systems. Some governments are preparing highly efficient payment systems, such as the Chinese government's plan to equip 400 million people with smart cards, thereby jumping several generations of less effective payments and banking systems.

The increased access by citizens of developing countries to information through low-cost, widespread communications systems will inevitably lead to greater government accountability, transparency, and even democracy. A famous example of this came when Lech Walesa pointed to the TV after being asked what caused all the changes in Poland. For the many developing countries suffering from weak or destructive governments, this represents another key to progress, despite the initial resistance likely from wary government elites trying to protect their local information monopolies.

What Must Developing Countries Do?

The tasks for developing country governments and other stakeholders fall into four categories: raising awareness to understand the significance of information technologies to national interests, creating conditions for the supply of information infrastructure, creating conditions for the demand of information, and ensuring that the needs of the poorest and most vulnerable groups are addressed.

Awareness-Raising Tasks. The awareness-raising task in many developing countries is still momentous, particularly for the poorest countries. The first task is to convince officials, businesses, and wide reaches of the population that:

- the world is changing, and the pace of change is accelerating.
- there are only two options: catch the train or fall behind.
- the cost of inaction, and of backward-looking attitudes, is growing every day.

The second task, however, is even more difficult: these same stakeholders have to be made aware of how to rethink their development strategies and organizational setups. Above all, that means knowing which questions to ask.

These two awareness-raising tasks will not be easy for many developing countries. A majority of people, in both the developing countries and the development aid community, still think very much in terms of the industrial age, and few seem to understand the significance of the new Information Age. Added to this are the inevitable fears of cultural erosion, domination of the English language, and so forth, which have tremendous political power. There are likely to be recurrences of the primitive reasoning of the 1970s, "this has nothing to do with true poverty reduction," or of the reasoning of the 1980s, "the private sector will do it all."

Difficult as these two awareness-raising tasks are, they are the most crucial aspects of this stage of the development process. This is where the World Bank Group, other multilateral agencies, the European Union, the bilaterals, and the private sector can be the most helpful.

Supply-Side Tasks. The correlation between economic development and information infrastructure development will be so compelling that developing countries will have to invest in this area in a massive and unprecedented way. These investments will need to target both modern telecommunications systems and strategic information systems.

With regard to modern telecommunications systems, investment will need to double from today’s $30 billion a year to about $55-60 billion. Those sums would be spread across many situations, with the transition countries going from a teledensity of 20 percent to 40 percent while the poorest countries move up from 1-2 percent, or less, toward 4-5 percent, or even more for ambitious players (such as China, which plans to add 80 million lines over the next decade at a cost of $100 billion).

Investment in strategic information systems would need to target the areas of payment and settlement, customs and tax, trade facilitation, and so on. Such systems are costly: $50-100 million over 5 years is typical for a public finance management system in a medium-sized developing country.

These numbers are so large, and public budgets are so strapped, that the bulk of the effort will have to come from private investors, particularly in the first category. In the strategic information systems category, the public sector may have a somewhat larger role. To attract private investment, developing countries will have to make serious efforts on two fronts: First, they will have to create an information-friendly environment which requires coherent telecommunications reform and information policies, and laws protecting investment, intellectual property, privacy, and data security. This requires open and competitive, yet well-regulated, information and communication markets. It also necessitates effective independent regulatory and standard setups.

Second, developing countries will have to create an investment-friendly environment. This means a business environment that is attractive and reliable beyond the needs of the information sector alone. In creating these information-friendly and investment-friendly environments, the World Bank Group can play an advisory and best practices role and a financial role as catalyst or investor, lender, or guarantor.

Demand-Side Tasks. Countries can not work only on the supply-side of information infrastructure. They also have to invest heavily on the demand-side in areas such as education, technical literacy, and computer literacy. Even more generally, they have to look at their overall ability to become "learning nations." Populations must be systematically mobilized to reach out, "get connected," and develop an interest (even an obsession) in lifelong learning.

This is why the World Bank is considering "knowledge assessments": analysis of a country’s ability to find, absorb, digest, and operationalize knowledge, and to become a learning nation. In those assessments, the Bank would help governments look very broadly at their capacity to learn—not just at education, but also at all the ways through which information is gathered, through the consular attache systems, through the university or scientific networks, or even through such inimical features as the abusive overpricing of international calls.

The Focus on Poverty. In the end, we need to ensure that the poorest countries, and the poorest within those countries, are not left out. The knowledge gap between the have's and the have-not's of the Information Age must shrink rather than increase.

This has to do with universal access, rural telecommunications systems, and the provision of access to vulnerable groups that have few resources to invest. It also means giving priority to applications of the information technology revolution that address the needs of the poorest: educating people, improving their health, reducing their isolation, and coping with urgent environmental issues. We must find a way to give a poverty focus to the information technology revolution. If utilized properly, it has a tremendous potential to alleviate the long-term causes of poverty.

The examples given here help demonstrate why an increasing number of people in the aid business believe that the new technologies, particularly the low-cost telecommunications and information technologies, may well represent the developing countries' best chance to leap forward in development, growth, and poverty reduction. These technologies are not luxuries for developing countries. On the contrary, they are strategic factors of development and poverty reduction that urgently need to be more prominently and systematically integrated into development strategies.

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Chapter 23: Little Engines That Could: Computing in Small Energetic Countries *

by J.L. Dedrick, S.E. Goodman, and K.L. Kraemer

How do very small countries, here defined as having fewer than 10 million people, find places for themselves in the information technologies (IT) arena? Does success require accommodation in the global IT regime that often seems dominated by the U.S. and Japan? Do the little countries scurry around, like birds among the lions and other predators looking for scraps? Are they relegated to second tier "appropriate technologies," or do they operate in the mainstream?

There are a surprising number of little countries around the world whose development of, and uses for, IT are out of proportion to their sizes and natural resource endowments. Their national circumstances and IT activities are as diverse as their geographic distribution.

The Major Minors

Several small countries have become major IT producers or sophisticated users. These include the city-states of Singapore and Hong Kong, Ireland, Israel, New Zealand, and most Nordic nations.

Singapore (2.8 million people) and Hong Kong (5.8 million) have high levels of hardware production, exports, and advanced information infrastructures. Hardly twins, their differences are as striking as their similarities. Both have succeeded as hosts for foreign investment and as export platforms for multinational corporations (MNCs). However, while Singapore has been able to upgrade its level of technology in response to rising wages and competition from low-wage countries, Hong Kong has responded by moving low wage production into nearby southern China. As a result, Singapore's higher-end IT production has continued to grow in recent years, reaching $10.9 billion in 1993, while Hong Kong's production has stagnated since the late 1980s, standing at $2.3 billion in 1993, and still consists mostly of simple assembly.1

Part of the reason for this divergence is the Singaporean government's efforts to train IT professionals and to encourage MNCs to locate advanced manufacturing activities there. Singapore has not only become the world's largest producer of hard disk drives, but also plays an integral role in the products development and manufacturing process. A typical hard disk life cycle starts with a design and prototype in the U.S. Then the first-generation production, including the critical ramping-up process, is done in Singapore. Once manufacturing is routinized, production is moved to a low-wage assembly site such as Indonesia or Malaysia, while the factory in Singapore begins work on the next generation. Singapore's ability to play such a critical role in the process is based on its strong capabilities in engineering and production management, and on its strong telecommunications infrastructure. The MNCs are further supported by many domestic contractors who supply components to specifications.

Singapore has applied IT in a number of other areas. Through the efforts of its National Computer Board, Singapore has computerized its public sector to make government more effective and responsive to the needs of business.2 It has also established Tradenet, an electronic data interchange (EDI) system linking port facilities, government offices, and private trading companies to improve the speed with which goods can pass through the Port of Singapore. Although its IT industry is heavily dependent on production by MNCs, two of its domestic companies control 75 percent of the sound card market.

Hong Kong has a different niche in the IT industry.3 While much of its manufacturing is moving to China, Hong Kong has remained a site for management and trading services. Using its geographic location and ties to China, it has served as a link between southern China's IT industry and the outside world. Hong Kong's business skills and familiarity with the western economic system, combined with excellent port and telecommunications facilities, have allowed it to continue to play a role in the IT industry. It has also become a center for production of portable communications devices, partly due to its own extremely widespread use of cellular phones.

Hong Kong's banking and finance companies are highly sophisticated users of IT. Hong Kong is implementing an EDI system called Tradelink to maintain its competitive position as a trading port. Other trade organizations, such as the Hong Kong Air Cargo Terminal Ltd., are heavily automated. Overall, however, Hong Kong is still behind Singapore in IT investment, spending just 1.5 percent of its GDP on computer hardware, software, and services, compared to Singapore's 2.2 percent.

The Irish IT niche is one of "globalization from without,"4 with MNCs providing a high-technology manufacturing component in IT and pharmaceuticals. Ireland's (3.5 million) advantages include skilled engineers, a low-cost labor force compared to most of Western Europe, and an export platform for non-European MNCs into the European Community. Irish government policies are encouraging the development of IT-based infrastructure, with particular emphasis on getting services beyond Dublin. However, so far it lacks the extensive indigenous IT-using communities characterizing the other major minors.

Unlike Singapore, Hong Kong, and Ireland, with clearly advantageous geographic locations, New Zealand (3.4 million) sits by itself in the middle of the South Pacific. Its economy still depends on agricultural exports, including wool and dairy products. In order to avoid being totally at the mercy of world commodities prices, its farmers and processing industries have used IT to add value to their products through Product grading (e.g., a bar-coding system is used to sort wool by quality and track it from the sheep to the tailor). Other programs plan feeding, manage breeding, and handle finances. These applications have been developed by local software companies and some are now exported.5 New Zealand also developed a fourth-generation software language called LINC, and has services such as home shopping based on LINC software.

New Zealand's government introduced major reforms in the 1980s, with a number of state-owned enterprises being privatized. The largest was New Zealand Telecom, which was deregulated in 1988 and eventually sold to two U.S. Baby Bells, Ameritech and Bell Atlantic. Competition was also introduced into the telecommunications market. As a result, New Zealand now has a first-rate telecommunications infrastructure supporting advanced information services, such as the Tradegate EDI system and electronic funds transfer. The American owners of Telecom are said to use New Zealand as a test market, giving its people early access to new equipment and services. New Zealand's investment in IT was an extraordinary 2.7 percent of GDP in 1992.

Other advanced small countries include Israel (4.9 million), with world-class strengths in software, defense systems, telecommunications, and academic computer science;6 and four Nordic countries: Denmark (5.1 million), Finland (5.0 million), Norway (4.3 million), and Sweden (8.6 million). All five are high per-capita users of IT. Finland is particularly noteworthy since historically it has been among the poorest of the Nordic countries, but now has one of the highest per-capita consumptions of IT in the world. It has its own multibillion dollar indigenous IT manufacturer in Nokia, which is second to Motorola as a world supplier of mobile phones and claims a 20-percent share of this market in Japan.7 Sweden also is the home of a very large IT company for a small country—Ericsson in telecommunications and related technologies—and a fairly sophisticated defense industry. Denmark is moving along an IT path similar to New Zealand's. Norway has developed quality IT applications based on strengths in natural resources (e.g., fishing).

Different Strokes

Other small countries are finding a variety of IT niches in the world. These fall roughly into three categories: those which are essentially picking up fairly low-level, internationally distributed work; regional standouts; and those with dubious niches of opportunity.

More generally, almost all of the more successful countries covered here with serious stakes in the IT industry owe some significant features of their particular forms of success to government policies. It appears that a laissez-faire policy approach is adequate for the diffusion of IT use, but some forms of active government support seem necessary for a country to become a major IT producer.

Regional standouts are small countries that are simply doing better than their larger neighbors. These include Costa Rica, Slovenia (2 million), the Baltics (Estonia (1.6 million), Latvia (2.7 million) and Lithuania (3.8 million)), and Tunisia (8.6 million). Costa Rica is host to the regional offices of a number of MNCs, who bring advanced IT systems with them, giving local workers exposure to sophisticated applications. It has also been a regional leader in bringing international networking to Central America. Slovenia is a former Yugoslavian country emphasizing IT to help with the tasks of independent nation and economy building. It has been hosting MIS conferences, using computerized decision support and meeting systems, and infusing IT into its educational environment. Within the former U.S.S.R., the Baltic states were more IT-active on a per-capita basis than the other republics, although it is not clear to what extent this has continued after independence under difficult economic circumstances. Tunisia is the only Arab country with all four forms of extended Internet connectivity (Bitnet, IP, UUCP, and Fidonet). Many have no connectivity, e.g., its oil-rich neighbor Libya (4.9 million), which also continues political control of IT. Even with only about 5 percent telephone penetration (8.2% urban), Tunisia is far ahead of most of the rest of Africa where rates are usually under one percent.

Some dubious niches are also scattered around the world. Bulgaria (8.8 million) seems intent on claiming the "distinction" of generating more computer viruses per computer professional than any other country. Several places—the Cayman Islands (0.03 million), Panama (2.6 million), and Cyprus (0.7 million), among others—are suspected of using IT-based financial systems to make national industries of money laundering for global organized crime. The United Arab Emirates (2.7 million) and Paraguay (5 million) have been major importers of IT equipment in their regions, mostly for the purpose of smuggling to Iran and Brazil, in violation of assorted export or import controls.

What It Takes

The factors that determine a small country's success or failure in IT are not obvious. We have identified a wide range of activities scattered all over the world in places that have both good and poor geographical locations, in advanced industrialized countries, wealthy newly industrialized economies, and in much less developed nations. Some governments actively promote IT production or use, while others take a hands-off approach. Small size, both geographically and demographically, may be an advantage (e.g., in making it easier to get higher per-capita levels of IT infrastructure built and used). Looking beneath the surface, however, some common characteristics apply to most of the successful countries.

Environment. While these countries vary greatly in level of development, none of them are extremely poor—they average about $11 thousand GDP per capita with none below $1.5 thousand—so some minimum level of development seems necessary. Most have good basic educational systems (although only a few, e.g., Israel and Sweden, have world-class computer research facilities) and high literacy rates. For more advanced IT production and use, specialized skills may be more important than general literacy. Singapore is only in the middle of the pack in southeast Asia in terms of literacy, but it trained over 10,000 computer professionals during the 1980s as part of its National IT Plan.

The major minors are all operating close to the leading edge in IT use. All have communities that are well connected to the global regime in ways that range from extensive modern telecommunications to the import and export of IT products. Professionals have close ties to the international IT community, host and attend conferences, read journals, and increasingly use the Internet. Although none of these countries have internal markets large enough to support globally competitive sectors on their own, these markets are characterized by world-class, demanding customers who have thus contributed to the creation of substantial export industries.

Production of IT hardware clearly requires integration into the global production chains of the MNCs, which are located in the United States, Japan, and Western Europe. Most countries that have succeeded in this area have favorable geographic locations.

Software production and use is less geography-bound, as programmers can use telecommunications links to customers in the major markets. Software production also benefits from English-language capabilities, either as a native language (New Zealand) or a widely used second language (Israel). This can be explained by the fact that common programming languages are all based on English, that the largest paying markets for software are among the English-speaking countries, and that for various reasons English has become something of a common denominator in the computing world.

However, computing use is spreading rapidly to Chinese-speaking parts of the world, and Hong Kong and Singapore might have advantages in the future. A country such as Costa Rica could likewise become a supplier of Spanish-language software for Spain and Latin America. Another potentially large market for software based on a non-Latin alphabet is among the Arab countries.

IT production and use both benefit from an advanced telecommunications infrastructure. Several of the countries covered are world or regional leaders in the quality of telecommunications infrastructure, enabling them to use computers more productively through networking and to link up to international communities of various kinds. Telecommunications and computers are converging in the development of national information infrastructures (NII), which link computers and provide information services over high-speed communications networks. A high-quality NII linked to the developing global information infrastructure (GII) is likely to be a critical competitive factor in the future.

Policy. One key factor is an open policy toward trade and investment. Small countries need to export to reach a sufficient market to support production, especially for hardware. They also need foreign capital, technology, and components to support IT production, and low-cost foreign hardware and software to permit widespread use. These requirements cannot be met if trade and investment are severely restricted by government policy. An example of the effects of open trade can be seen in New Zealand, which maintained a 40-percent tariff on imported computers until 1983, when it dropped to 10 percent. In the ensuing 3 years, IT investment grew at a rate of 30 percent a year, as New Zealand rushed to build a more information-oriented economy.

Past policies to develop technological self-sufficiency have been spectacular failures in very large countries including China, Russia, and India, and are certainly inappropriate for small countries. Appropriate technology choices for small countries depend on existing technological capabilities and whether one is talking about IT production or use. A developing country might be best served by promoting labor-intensive production activities, such as simple assembly, to produce mature technology products. A higher wage, technologically sophisticated country will have to compete in production by applying more technology-and capital-intensive techniques to more advanced products. The appropriate technology level for broad IT use in most economies is often fairly advanced technologies, because hardware and software continue to become less expensive and easier to use.

Another consideration is government promotion of IT production and use. The clearest example of the potentially powerful effects of government support is seen in Singapore, where since 1981 the government has actively promoted the use of IT in the public and private sectors and has sought investment by foreign IT companies through various incentives. Singapore is the biggest IT producer of and second biggest investor in IT of all the small countries. Without government intervention, it is doubtful whether Singapore would have attracted MNCs, developed its own IT industries, or become a regional leader in IT use.

Hong Kong, Denmark, and New Zealand have been successful in their own ways with little government support for IT. However, Hong Kong is an exception that proves the rule. Its location and role as an entrepot have given it a temporary advantage which is now being threatened by the rise of Shanghai and the opening of the Chinese economy. Meanwhile Hong Kong's inability to develop indigenous technological capabilities have prevented it from graduating to more advanced manufacturing and R&D activities. New Zealand and Denmark do well as IT users, but are not serious players in the international IT industry.

The governments of Israel and Sweden played major roles in fostering high-tech capabilities in the national defense sectors, with spillover effects. However, at least in the case of Israel the most useful spillover effects, especially in the software industry, were arguably not explicitly government driven. Much of this was in the form of the regular discharge of many young, aggressive, well-trained and experienced people from military service to the civil sectors.8

More generally, almost all of the more successful countries covered here with serious stakes in the IT industry owe some significant features of their particular forms of success to government policies. It appears that a laissez-faire policy approach is adequate for the diffusion of IT use, but some forms of active government support seem necessary for a country to become a major IT producer.

As the ability to participate in the international community becomes more dependent on sophisticated IT use and global connectivity, issues of information access become more important. Having an e-mail address is becoming almost as vital to many activities as having a telephone and fax machine. However, allowing access to information sources such as the Internet presents challenges to governments that wish to control information flows in their countries for political reasons. Among the countries discussed here, Singapore has been decried for controlling criticism of its government and the circulation of some publications, but it is hardly alone in its desire to control information and maintain certain forms of order. Can such countries participate in the global information economy while maintaining domestic control over access to information, or will their political and social cultures have to change to deal with a potential flood of uncontrolled information?

NOTES

1. Elsevier Yearbook of World Electronics Data, Volumes I-III (Oxford: Elsevier, 1994).

2. V. Gurbaxani, K.L. Kraemer, J.L. King, S. Jarman, J. Dedrick, K.S. Raman, and C.S. Yap, "Government as the Driving Force Toward the Information Society: National Computer Policy in Singapore," Information Society (7: 1991), pp. 155-185.

3. K.L. Kraemer, J. Dedrick, and S. Jarman, "Supporting the Free Market: Information Technology Policy in Hong Kong," Information Society (10: 4, 1994), pp. 223-246.

4. S. Grimes, "Information Technology and the Periphery: The Case of Ireland," Information Technology in Developing Countries (4: 1, 1994), pp. 8-10.

5. K.L. Kraemer and J. Dedrick, "Turning Loose the Invisible Hand: Information Technology Policy in New Zealand," Information Society (9: 4, 1993), pp. 365-390.

6. G. Ariav and S.E. Goodman, "Israel: Of Swords and Software Plowshares," Commun. ACM (37: 6, 1994), pp. 17-21.

7. C. Brown-Humes, "Nokia Rides the Worldwide Airwaves Boom," Financial Times (September 23, 1994), p. 20.

8. G. Ariav and S.E. Goodman, pp. 17-21.

Chapter 24: The Impacts of the Information Age on International Actors and the International System

by Daniel S. Papp and David S. Alberts

What will the world be shaped like in the Information Age? Who will the primary players be? What will their interests be, and how will they function? Those are the trillion dollar questions that must be asked and answered as we try to decipher the future impacts of the Information Age on international actors and the international system.

The preceding chapters provided us with insights on how specific areas of human endeavor and specific types of human institutions and organizations might be affected by the Information Age. In this concluding chapter, we provide our perspectives on how the Information Age in more general terms might affect international actors and the international system.

The chapter is divided into three parts. First, we offer four observations that are applicable not only to international actors and the international system, but also at lower levels of analysis, that is, within individual states, corporations, organizations, and institutions. We term these "multi-level impacts of the Information Age." Second, we assess possible impacts of the Information Age on the main types of current international actors. Finally, we offer four observations that apply primarily to the international system. We term these "system-level impacts of the Information Age."

Multi-Level Impacts of the Information Age

As the technologies of the Information Age become more widely diffused and adopted, certain impacts will have similar effects at the international system level of analysis, the international actor level, and within individual states, corporations, organizations, and institutions. Here, we present four of the most prominent.

Increased Quantity, Dispersal, and Flow of Information. As advanced information and communication technologies become less expensive and easier to use, they will be more widely adopted and increasingly employed. They will no longer be limited to "leading edge" industries and organizations nor will they be limited to only select organizational functions and processes. In fact, these technologies will become the typical means of doing business in all kinds of fields and organizations. As a result, more and more information will inevitably become accessible at every level from the international system level to the individual actor level. More and more people, institutions, and organizations will have more access to and need for information. Except for the most sensitive national and corporate data, this increased quantity of data will be accompanied by increased dissemination and access as the locations at which information is located and can be accessed proliferate.

The increased dispersal of information will offer significant advantages. First, because it will be available at more sites, more users will be able to access information. Second, as a general rule, gaining access to information will also be easier. Users will have access to information closer at hand, and information will be available on a 24-hour basis, virtually eliminating limitations imposed by time dependency for users regardless of the level of analysis.

Some disadvantages will also accompany the increased dispersal of information. As discussed earlier, one disadvantage is uncertainty over the accuracy and validity of information. In addition, dispersion also exacerbates existing privacy-related concerns that sensitive personal information such as credit reports and social security data may be too easily available. Increased dispersion also exacerbates security concerns by requiring more "containers" and "pipes" to be secured. At the national level, the development of high-quality privately owned satellite and remote sensing capabilities has increased concern that sensitive military information and intelligence data may be compromised.

Decentralized Decision Making. As information becomes more widely available, the ability to analyze it will undoubtedly become more widespread. Thus, more individuals and organizations will be in a better position to make decisions that "specialists," "experts," or "headquarters" now make. This will be especially true in advanced industrial and newly-industrialized states, in multinational corporations, and in other institutions and organizations that value education and initiative. The proliferation of the ability to analyze information will likely carry with it a demand to decentralize decision making and empower more people in decision making processes.

In many quarters, this demand is likely to make good sense to those in positions of authority and to be perceived as improving efficiency. In these cases, demand from below for decentralized decision making may well be joined by initiatives from above for the same end result. In all likelihood, then, decision making will become more decentralized as the Information Age progresses. Indeed, as discussed in earlier chapters, this is already happening in many areas of the business world, in banking, in government and the military, and in other sectors of society as well.

Conversely, some international actors, institutions, and organizations will seek to maintain centralized control of decision-making capabilities, especially in more traditional societies, institutions, and organizations. This, too, will be an understandable culturally dependent reaction. We already see this occurring as some states and other international actors seek to minimize the number of locations where information can be stored, to limit access to certain types of information, and to curtail the free flow of information.

Greater Permeability of Institutional and Organizational Boundaries. As the transfer of information becomes easier and easier, institutional and organizational boundaries will become increasingly permeable. Thus, the flow of information will increase not only within institutions and organizations, but also among them.

As with internal flows of information, some institutions and organizations will seek to curtail the inward and outward flow of information. The ongoing efforts of China and other countries to limit access to the Internet is just one example of the reluctance of institutions to permit the free flow of information and communications. While such efforts may be temporarily successful on a limited or case-by-case basis, as a general rule they are likely to fail, at least for those institutions and organizations that participate most fully in the information revolution.

Emergence of New Forms and Types of Actors. Since the technologies of the Information Age will aid and abet individuals and organizations in widely scattered locations that have similar interests, outlooks, or objectives to communicate easily with one another, it is highly likely that the Information Age will witness a proliferation of the formation of "virtual" entities that stake claims to a role in international affairs. Many of these virtual entities will be ephemeral, coming into existence for short periods of time and concentrating on single issues. Most could be and probably will be ignored by the well-established international actors. But some virtual entities may become players in their own right on the national and international scene, and this will change the dynamics at each level.

It is difficult to foretell specifically what impact virtual entities might have at any level of analysis. Their impacts are likely to vary tremendously depending on the quantity of resources available, the popularity of a given cause, and the dedication of those associated with the entity. There is little doubt, however, that such entities will come into existence, thereby further complicating an already complex decision-making environment.

Impacts on International Actors

Advanced information and communication technologies will be absorbed, diffused, and operationalized by different international actors in different ways and at different speeds. This differentiated pattern and speed of absorption, diffusion, and operationalization will lead to different types and rates of change. Factors that will influence these processes may be grouped into three broad categories:

1.) those that are functions of the technological process, such as:

   a.) the technology (product) life cycle;

   b.) technology purchase price; and

   c.) technology maintenance cost.

2.) those that are functions of characteristics which exist within individual international actors, such as:

   a.) an actor's legacy equipment and systems;

   b.) an international actor's social and cultural receptivity to new technologies;

   c.) the degree of insularity within an actor;

d.) the level and reliability of an actor's human, technical and economic support infrastructures;

e.) the level and strength of traditional values and outlooks within a given international actor;

f.) the level of education that exists within a given international actor;

g.) the degree of technical sophistication of users and potential users of the advanced information and communication technology within an international actor;

h.) the levels of concern over sovereignty on the part of states, and over control of decision-making processes on the part of the international actors; and

i.) a host of other political, social, economic and cultural factors idiosyncratic to each international actor.

3.) those that are functions of the degree of cooperation that exists between international actors, such as:

a.) international tariff and trade policies and agreements;

b.) services offered by multinational corporations; and

c.) agreements on international standards.

Many of these factors will also influence how information and communication technologies, once absorbed, diffused, and operationalized, will be organized, managed, operated, and maintained.

How, then, will advanced information and communication technologies shape and form present-day international actors? This shaping and forming process will be complex, but it is worthwhile to speculate on how that process may unfold and how it may effect five major classes of international actors: states, international governmental organizations, multinational corporations, non-governmental organizations, and individuals and the media.

States. For three centuries, states have dominated the international system. Today, however, the advent of advanced information and communication technologies challenges the primacy of the state as the central actor in international affairs as never before. This challenge comes from three directions, all related to the reasons that states exist.

The primary objectives of states throughout the centuries of their domination of the international system have been to provide for the security and economic well-being of all or part of their population. In addition, those states that are nation-states during the last two centuries have also provided a "sense of belonging" to the dominant nationality within them. All this may be changing.

First, the Information Age has significantly affected a state's ability to provide for the security of its population against the threats of information warfare. This inability to provide security comes at the same time as the importance of information and communication technologies is increasing within virtually every society. Given the immense reliance of advanced industrial states on electronic transfer of financial and other data, any disruption of such transfers could raise havoc, economically and otherwise, within a state. Similarly, given the reliance of most governments on electronic communications to maintain contact with their peoples, disruption of communications could significantly degrade a government's ability to influence and maintain control over its peoples.

With the importance and the vulnerability of information and communication systems in mind, several countries, as discussed earlier, are developing strategies for information warfare. Beyond information warfare, the application of advanced information and communication technologies to intelligence gathering and analysis, to the creation of smart and brilliant weapons systems, and to achieve "force multiplier" applications raises serious questions about the ability of states to provide security for their populations in the Information Age.

This is not the first time that new technologies have raised such questions, so the degree of threat posed by these technologies should not be exaggerated. But neither should it be prematurely dismissed or underestimated. Indeed, there is reason to believe that as advanced information and communication technologies are increasingly applied to the tools of war broadly defined, the ability of any state to provide security for its population will increasingly be challenged.

Second, as pointed out in the discussion of business applications of information technologies, economic activity is increasingly being conducted beyond the confines of individual states. This increased internationalized economic activity has taken place in raw materials, components, industrial products, and finished goods. But a significant and growing percentage has been in information- and communication-related goods and services, with information itself becoming a significant commodity. Both the volume and relative importance of transborder trade in information is likely to increase significantly as advanced information and communication technologies are adopted, diffused, and operationalized.

This will have an immense impact on states. Outside of regulatory functions, as more and more international actors gain use of advanced information and communication technologies, and in so doing obtain the ability to act beyond the confines of a single geographically constrained state, the ability of states to provide for the economic well-being of all or part of their population will be further reduced. Because of advanced information and communication technologies, international actors not bounded by geography will increasingly gain the ability to act internationally with little regard to the desires of states.

This phenomenon is already occurring. As we have seen, international finance and banking has been transformed by the ability to transfer funds electronically throughout the world at a moment's notice. Many other service sector and data-intensive industries have also internationalized because of capabilities provided by information and communication technologies, with more significant degrees of internationalization sure to follow.

This leads some to question whether states are losing their ability to achieve the second of their three primary objectives, to provide economic well-being for all or part of their population. And if so, why need states exist?

The same question may be asked regarding nation-states' provision of a sense of belonging to the dominant nationality within them. There is no doubt that in the 1990s, nationalism has been on the rise. Nationalism contributed significantly to the dissolution of the Soviet Union, Yugoslavia, and Czechoslovakia, and is creating problems in Belgium, Canada, Ethiopia, India, Malaysia, and elsewhere as well. At first blush, it would seem that nationalism virtually guarantees the survival of the nation-state, if not the state.

This may be so. However, one must remember that nations have not always needed states to consider themselves nations; sometimes, individuals who comprise a nation view themselves as linked to one another in some way, shape, or form in the absence of having control over land. The advent of advanced information and communication technologies enhances possibilities for peoples of a single nation to be geographically remote from one another but still retain a sense of identity complicated by neither time nor distance.

The extent to which advanced information and communication technologies allow individuals to conceptually overcome the boundaries of time and distance may have a significant impact on whether states remain necessary for nations to have an identity. Advanced information and communication technologies thus raise questions about the future validity of the third reason why states have existed.

None of this implies that states are in imminent danger of disappearing because of advanced information and communication technologies. In some cases, as in Argentina's decision to outlaw call-back technology, Egypt's decision to delay debit card telephone and telegraph charging, and China's efforts to restrict access to the Internet, states are actively seeking to maintain their ability to influence if not control information and communication flows. In other cases, such as the European Union, NAFTA, and MERCOSUR, states are positioning themselves to take advantage of such technologies. Interestingly, however, at least in the EU's case, this response heightens the possibility of a movement toward a post-state regionalized international era.

International Governmental Organizations. As creations of states, IGOs in most respects are hostage to the desires of states. The advent of advanced information and communication technologies promises to do little to change this. Nevertheless, since IGOs transcend state boundaries and often must cope with problems of time and distance, the capabilities provided by advanced information and communication technologies will help overcome some of the difficulties that IGOs face.

This does not mean that states will become more willing to accept the transfer of part or all of their sovereignty to IGOs. In all likelihood, IGOs will find it as difficult as ever, perhaps even more difficult than ever, to acquire supranational authority and capabilities.

Even so, to the extent that advanced information and communication technologies increase the ability of IGOs to perform tasks that states on their own can not successfully accomplish, advanced information and communication technologies may lead to the migration of more responsibilities from states to IGOs.

Multinational Corporations. Multinational corporations (MNCs) are already among the largest users of information and communication technologies, and they will continue to be at the forefront as even more advanced capabilities become available. Indeed, a significant percentage of advanced information and communication technologies is being developed by MNCs.

As we have already seen, businesses in the service sector distribute and exchange tremendous amounts of information throughout the world. In many cases, geography has little or no impact on decisions where service sector businesses locate their data processing facilities. The ability to transfer funds electronically throughout the world has also already had an immense impact on international banking and finance. With the ability to transfer funds electronically at a moment's notice, some observers believe that the world is well on its way to becoming a single banking and financial market. Further advances in information and communication technologies will only accelerate this trend.

The trend toward regionalization and globalization of business will also accelerate as more and more companies acquire cost-effective access to international communications. Advanced information and communication technologies will therefore allow many more firms to become international and marketplaces to become regionalized or globalized. On a regional basis, this phenomenon was one of the factors that increased pressures in Europe for political and economic unity. It is not beyond the realm of possibility that similar pressures may build in East Asia, the Americas, and elsewhere as well.

Thus, for several reasons, there is little doubt that advanced information and communication technologies will enhance the role that MNCs play in international affairs. Several decades ago, a noted business professor observed that MNCs had the potential to hold state sovereignty at bay. In the Information Age, that observation has greater potential than ever to become a reality.

Non-Governmental Organizations. Since this group of actors is so diverse, advanced information and communication technologies may be expected to impact them in a wide variety of ways. Nonetheless, some general observations may be made.

Many of these actors have widely scattered memberships. Thus, many of them may be expected to benefit significantly from the increased speed, greater capacity, enhanced flexibility, and improved access afforded by advanced information and communication technologies. It is therefore reasonable to assume that many NGOs will become increasingly active, better coordinated, and more influential as advanced information and communication technologies become more widely available.

At the same time, many of the actors in this category are not well-off economically. However, if as predicted, the wider bandwidths that are becoming available drive down the costs of communicating, the relative lack of resources should not necessarily put them at a significant disadvantage. Also, it is not necessary to have the absolute latest in information technology to benefit enormously. The huge discounts off of original prices that are given for "last generation" technology makes these capabilities much more affordable. One may also expect to see a further proliferation of NGOs and related organizations (including the possibility of virtual organizations) as well as a networking of such organizations as a result of the capabilities afforded by advanced information and communication technologies.

Individuals and the Media. Meanwhile, at the level of individuals, telephones, electronic mail, and facsimiles already link people together in ways we never anticipated. Much of the personal use of these technologies is for social, educational, and business purposes. However, following the 1989 Tiananmen Square massacre in China and during the 1991 Soviet coup attempt, electronic mail and facsimiles provided an important link to the outside world—and vice versa—for individuals in China and the former Soviet Union.

At the same time, the ability of the international media to provide foreign perspectives and outlooks on a real-time basis to virtually every major media outlet in the world is creating a sense of global connectivity, if not community, that has never before been widespread among masses of the population. While it is too much to argue that this sense of connectivity is leading to changed views on the parts of individuals about their role and the role of their countries in the world, it is not too much to say that to many individuals, the international media is altering the way that they view the world.

To reiterate, given the diversity of this group of international actors, advanced information and communication technologies will have an extremely diverse impact on the role that these actors play in international affairs. Many will enhance their international roles as a result of the increased speed, greater capacity, enhanced flexibility, and improved access afforded by advanced information and communication technologies. And as costs continue to fall, demand for information and communication technologies from this group of international actors will increase, and their capabilities will increase relative to more traditional technology-rich actors.

System-Level Impacts of the Information Age

Beyond the effects of the Information Age on individual types of actors, some of the impacts of the Information Age will be primarily at the system level of analysis. Here, we present four of the most prominent.

The Disruption of Current Power Relationships Between and Among Types of International Actors. For most of the last 300 years, states have dominated the international system. This domination may be coming to an end, driven in part by the advent of advanced information and communication technologies. These technologies will enable other types of international actors to challenge state dominance as never before.

This process has already begun. As discussed above, multinational corporations already electronically transfer large quantities of funds and information across national borders with little regard for demands of state sovereignty. Similarly, non-governmental organizations have also increased their importance in and impact on international affairs. The role of MNCs and NGOs in international affairs has often expanded at the expense of states and intergovernmental organizations, witness both the NGOs women's conference outside Beijing, China, and recent efforts by NGOs to stop French nuclear testing in the Pacific.

This does not imply that the era of state dominance of the international system is over, nor does it imply that the role of the state as a class of international actor will significantly diminish during the near-term future. It does imply, however, that the concept of the sovereignty of states will be challenged as it has rarely been challenged before. It also implies that the analysis of international affairs and the international system can no longer be restricted exclusively—and in some cases primarily—to states.

Inevitably, then, struggles for power and influence will erupt between different types of actors as a result of the impacts of information and communication technologies, as these technologies help make the emerging system more diffuse and ambiguous and as current power relationships between classes of international actors become increasingly disrupted.

Enhanced Globalization and Regionalization. Raymond Aron once observed that the international system was like a billiard table, with events in one part of the world rebounding off each other and eventually having an impact on events on the other side of the world.

Aron's observation is an accurate description of what happened in previous international systems, but his assessment will be even more accurate in the emerging international system. Given the greater connectivity that advanced information and communication technologies will provide in many areas of the world, future international systems, future international perspectives, and future economic systems will tend to become increasingly globalized.

But this is not necessarily a foregone conclusion. Conversely, these technologies may contribute to the development of a more regionalized world as opposed to a globalized world. To a certain extent, this is already occurring with the development of regional trading blocs such as the European Union (EU), the Free Trade Area of the Americas (FTAA), and the Asia-Pacific Economic Cooperation (APEC) zone. While it is incorrect to view these blocs as primarily the results of advanced information and communication technologies, the growth in importance of these blocs and even sub-regional blocs such as

NAFTA and MERCOSUR is aided and abetted by advanced information and communication technologies.

The point to be made here is simple: there will be a trend toward consolidation, but the result of that trend could be either regionalization or globalization.

However, there will be opposition to both globalization and regionalization. Fearful of losing identity, control, or influence, some actors are, as we have already pointed out, seeking to restrain the use of advanced information and communication technologies in their areas of control. For example, several states have already outlawed certain technologies because of the adverse impact on revenue collections by national telegraph and telephone ministries. Similarly, in some areas, jingoistic nationalism, conservative traditionalism, or ideological or religious extremism may view advanced information and communication technologies as a danger to the nation, the culture, the ideology, or the religion, and act to curtail their use.

There is no doubt that advanced information and communication technologies will provide humankind with tantalizing new capabilities for connectivity far beyond any capabilities enjoyed in the past. This connectivity enhances the probability of globalization and regionalization, but does not pretermine either outcome.

Increasingly Skewed Patterns of Distribution of Wealth Among Actors and Within Actors. As we have already noted, not all international actors will adopt, diffuse, or operationalize advanced information and communication technologies at the same rate. Thus, some actors will benefit more than others from these technologies. In all probability, North America, Western Europe, and Japan will lead the way. Argentina, Brazil, India, several of the ASEAN states, and a few other countries will follow somewhat behind. Most of the rest of the world will lag behind still further.

However, even within those regions that lag behind, there will be users of advanced information and communication technologies. Those users will be certain MNCs, NGOs, individuals, and other non-state and non-IGO international actors. Regardless of their location, they will be in the best position to benefit from the capabilities afforded by advanced information and communication technologies. The implications of different rates of adoption of these technologies are immense both for the international system and for individual actors, especially states.

On the international level, to the extent that advanced information and communication technologies will create new wealth, these different rates of adoption, diffusion, and operationalization will likely increase the already skewed patterns of distribution of wealth that exist between states unless poorer states adopt a modernization strategy that leverages information and communication technologies to close the gap. As we have seen, a few states are in fact doing this. Outside these states, the Information Age has potential to exacerbate the North-South conflict.

At the state level, this could lead to greater tension between wealthy states and poor states. At the same time, given the empowerment that advanced information and communication technologies will provide other classes of actors, some NGOs, small groups, and even individuals could take it on themselves to attempt to redress real and perceived imbalances in the distribution of wealth between states. They may even choose to use advanced information and communication technologies in the form of information warfare to undertake such action.

Within states, much the same thing could occur. Again, to the extent that advanced information and communication technologies will create new wealth, skewed patterns of distribution of wealth will probably be exacerbated, increasing the potential for strife and conflict within states. And again, NGOs, small groups, and even individuals could take it on themselves to redress real and perceived imbalances in the distribution of wealth within states, by peaceful means or not.

As new wealth accumulates as the result of advanced information and communication technologies, decisions must be made about how this new wealth will be distributed. The stability both of the international system and individual actors within the system may rest with how wisely and well such decisions are made.

A More Diffuse International System. Taken together, the combined impacts of the Information Age indicate that for an extended period of time, the international system will be undergoing a transformation and the distribution of power will be quite diffuse. More information will be available at more places and flow faster and more freely than ever before. Decisions about subnational, national, and international actions will be made in more places than ever before. Boundaries between actors—states, MNCs, IGOs, NGOs, and so on—will be more permeable than ever before. New types of actors will emerge on the international scene, and more types of actors than ever before will play prominent roles in international affairs. Existing power relationships between and among actors will be disrupted. Tendencies toward regionalization and globalization will be strong, but to some extent mitigated by pressures of nationalism and localism. Already skewed patterns of distribution of wealth may well become even more skewed, with shrewd exploiters of these technologies becoming very wealthy very quickly.

The outlines of this future international system —some might call it lack of system—are already discernible. In some ways, especially for policymakers, it will be quite unsettling. More external nodes of decision will require attention than ever before. On occasion, a previously unimportant actor may become prominent virtually overnight. This will be especially true for non-state actors. Sometimes, it may be difficult to identify lines of responsibility for a given international event.

These realities will make international affairs in the Information Age more complex, more confusing, and less structured than in the past. Decision makers, and the institutions and organizations in which they work, must therefore be flexible, able to respond quickly and intelligently to unforeseen circumstances and situations.

Clearly, the Information Age promises to usher in a brave new world replete with uncertainties. The one certainty that will exist is, as it has always been, that of change. However, as observed earlier, we are in a sense fortunate, for we are now only at the dawn of the Information Age. Thus, we have a window of opportunity during which we can reflect about the impacts that the Information Age might have before its full impacts are upon us.

But this window is closing fast, and the full impacts of the Information Age are fast approaching. Thus, the time to begin examining the questions and issues raised in this anthology is now. The answers that we develop will allow us to influence trends, policies, and events that will play roles in determining what the Information Age becomes. For as Peter Drucker once observed, albeit paraphrased, assessing the future impacts of information and communication technologies on human affairs is not an effort to assess the future, but to assess the future of present decisions.

About the Authors

Part I. The Information and Communication Revolution

Joel Achenbach is a Staff Writer at the Washington Post.

David S. Alberts is Director of Advanced Concepts, Technologies, and Information Strategies at the Institute for National Strategic Studies of the National Defense University.[Also see About the Editors.]

W. Thomas Kemp III holds a Master's Degree in Public Policy from the Georgia Institute of Technology and is a student in the School of Law at Mercer University.

Andrew Kupfer is an associate editor of Fortune.

Daniel S. Papp is Executive Assistant to the President and Professor of International Affairs in the Sam Nunn School of International Affairs at the Georgia Institute of Technology.[Also see About the Editors.]

Thomas A. Stewart is an editor of Fortune.

Alissa Tuyahov is a Master's Degree student in the School of Public Policy at the Georgia Institute of Technology.

Frank Webster is a faculty member in the School of Social Sciences of Oxford Brookes University.

Part Two. Business, Commerce, and Services

David S. Alberts is Director of Advanced Concepts, Technologies, and Information Strategies at the Institute for National Strategic Studies of the National Defense University.

Joanna Smith Bers is the former Executive Editor of Bank Systems and Technology.

John Seely Brown is Vice President and Chief Scientist of the Xerox Corporation, and Director of the Xerox Palo Alto Research Center.

Enrico Coiera is a Senior Project Manager at Hewlet-Packard's Bristol Research Laboratory. He has been an active researcher in Medical Informatics and Artificial Intelligence for over a decade.

Paul Duguid is a Research Specialist at the University of California, Berkeley.

Ajit Kambil is Assistant Professor of Information Systems at the Stern School of Business of New York University.

Howard D. Mehlinger is Director of the Center for Excellence in Education and Professor of Education and History at Indiana University.

Daniel S. Papp is Executive Assistant to the President and Professor of International Affairs in the Sam Nunn School of International Affairs at the Georgia Institute of Technology.

The Radio and Television News Directors Foundation, located in Washington, D.C., is the only organization devoted exclusively to serving the electronic journalism profession.

Robert L. Segal is a Principal with Frank Lynn & Associates, a Chicago-based consulting firm specializing in channel marketing.

Part Three. Government and the Military

David S. Alberts is Director of Advanced Concepts, Technologies, and Information Strategies at the Institute for National Strategic Studies of the National Defense University.

The Benton Foundation is a Washington-based private foundation that works at the intersections of communications, public policy, and philanthropy to realize the social benefits of communications.

Bruce D. Berkowitz is an Adjunct Professor at Carnegie Mellon University.

Martin Fogelman is in the Doctoral Program in Information Science of the Nelson A. Rockefeller College of Public Affairs at the State University of New York, Albany.

Peter Huber is a Senior fellow at the Manhattan Institute.

Johanna Neuman is the foreign editor of USA Today and an adjunct lecturer at George Washington University's Elliot School of International Affairs.

Daniel S. Papp is Executive Assistant to the President and Professor of International Affairs in the Sam Nunn School of International Affairs at the Georgia Institute of Technology.

Jeffrey Record is a Visiting Professor in the Sam Nunn School of International Affairs and a Senior Research Fellow in the Center for International Strategy, Technology, and Society at the Georgia Institute of Technology.

Part Four. International Affairs

David S. Alberts is Director of Advanced Concepts, Technologies, and Information Strategies at the Institute for National Strategic Studies of the National Defense University.

J.L. Dedrick is a Senior Fellow at the Center for Research on Information Technology and Organizations at the University of California, Irvine.

Daniel S. Papp is Executive Assistant to the President and Professor of International Affairs in the Sam Nunn School of International Affairs at the Georgia Institute of Technology.

Jean-Francois Rischard is Vice President for Finance and Private Sector Development at the World Bank.

James Robinson is a former professional lecturer on international relations at the School of Advanced International Studies at Johns Hopkins University. He is now a professor at the Instituto Technologico Autolomo de Mexico.

Barney Warf is Professor and Chair of Geography at Florida State University, Tallahassee. His research interests include the political economy of information and financial services.

About the Editors

DAVID S. ALBERTS is both Deputy Director of the Institute for National Strategic Studies and the Director of Advanced Concepts, Technologies, and Information Strategies (ACTIS) at the National Defense University, which includes responsibility for the School of Information Warfare and Strategy and the Center for Advanced Concepts and Technology. He also serves as the executive agent for the Department of Defense's Command and Control Research Program (C2RP).[Also see About the Authors.]

Dr. Alberts has extensive experience developing and introducing technology into private and public sector organizations. This extensive applied experience is augmented by a distinguished academic career in computer science and operations research and government service in senior policy and management positions.

DANIEL S. PAPP is Executive Assistant to the President of the Georgia Institute of Technology and Professor of International Affairs in Georgia Tech's Sam Nunn School of International Affairs. A Phi Beta Kappa graduate of Dartmouth College, Papp received his Ph.D. from the University of Miami. His fields of specialty include international security policy, U.S. and Russian foreign and defense policies, and international system change. Papp has been Visiting Professor at the Western Australia Institute of Technology; Research Professor at the Strategic Studies Institute of the U.S. Army War College; Senior Research Professor at the Center for Aerospace Doctrine, Research, and Education of the U.S. Air War College; and Visiting Professor at Fudan University in Shanghai.

Papp is the author of Contemporary International Relations (5th Edition, 1997); Soviet Policies toward the Developing World: The Dilemmas of Power and Presence (1986); Soviet Perceptions of the Developing World in the 1980s: The Ideological Basis (1985); and Vietnam: The View from Moscow, Peking, Washington (1981). He also edited the autobiography of former U.S. Secretary of State Dean Rusk, As I Saw It (1990); and co-edited International Space Policy (1987); The Political Economy of International Technology Transfer (1986); and Communist Nations' Military Assistance (1983). His current research is on the impact of information and communication technologies on international affairs.[Also see About the Authors.]