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A Conference Report

The USSR Confronts the Information Revolution

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Intelligence

The USSR Confronts the Information Revolution

A Conference Report

Proceedings of a conference held at Airlie House, Virginia, 12-13 November 1986.

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Preface

On 12-13 November 1986 a conference, convened under the auspices of the Director of Central Intelligence, analyzed the implications of the information revolution for the Soviet Union. The conference brought together distinguished experts from the academic, business, and public policy communities:

Ivan Selin (conference chairman)	Chairman, American Management Systems
Norman Augustine	President and Chief Operations Officer, Martin-Marietta Corporation
Carter Bales	Director, McKinsey & Company
Michael Brunner	Executive Vice President, AT&T Federal Systems
Leo Cherne	Vice Chairman, President's Foreign Intelligence Advisory Board
Diana Lady Dougan	Ambassador, Coordinator, International Communication and Information Policy US Department of State
Robert J. Eckenrode	Executive Vice President, Nynex Corporation
Seymour Goodman	Professor, College of Business and Public Administration, University of Arizona
Jan Herring	Former National Intelligence Officer for Science and Technology
Erik Hoffmann	Professor, Department of Political Science, State University of New York at Albany
Jack F. Matlock, Jr.	Ambassador, Former Special Assistant and Senior Director for European and Soviet Affairs, National Security Council

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This paper, prepared by staff of the Central Intelligence Agency, documents the findings of that conference. It represents only the views of the above participants, except where noted in the text. It does not necessarily represent the views of the participants' affiliated organizations, the Central Intelligence Agency, or any other US Government agency.

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Summary

Western economic, military, and social development is being increasingly influenced by the advance and application of information technologies. Microelectronics, computers, telecommunications, and software are supporting explosive growth in the availability of information in all aspects of Western life. Rapidly expanding applications of information technologies are supporting fundamental change in Western economies and societies, affecting relationships among individuals, interest groups, institutions, and countries.

Judging from their writings and statements, Soviet officials view Western developments with a mixture of concern and admiration. They recognize the growing contribution of information technologies to Western industrial and military might and the difficulty of playing catchup in such a rapidly accelerating technology base. They also recognize the potential for information technologies to undermine state control, both through greater penetration by Western "propaganda" and through the growing ability of Soviet citizens to independently obtain, analyze, and disseminate information. At the same time, they admire Western innovation and dynamism, which they use as a standard to evaluate (and rebuke) their own government and industry.

After a period of drift and lethargy in the 1970s, the Soviet Union under Gorbachev has embraced information technologies as critical ingredients in efforts to maintain Soviet international competitiveness. Soviet officials expect information technologies to:

- Provide an important impetus to restructuring the economy and supporting sustained high growth through the 1990s. They expect substantial productivity dividends from rapid growth in the application of computers, instrumentation equipment, robots, and advanced machine tools and will concentrate these applications on modernizing the industrial base.

- Support development of considerably more capable weapon systems and their manufacture in more efficient factories. Advances in sensor, signal processing, and battle management technologies are increasingly determining weapon effectiveness.

- Contribute to an improvement in the quality of life and the development of at least elements of a Western "information culture." The Soviets are initiating a massive computer literacy program but expect to move very slowly into the realm of consumer electronics. They express confidence that they can increase information technology applications without fostering significant social or cultural change, or suffering loss of state control.

The Soviets have a lot of ground to make up to attain their goal of equaling Western technical, economic, and military strength by the year 2000:

- Western experts generally hold that Soviet information technologies lag those of the West by five to 10 years or more. The Soviets have done better in major hardware development than in the development of support technology like computer peripherals and software. In information technologies they have depended to a particularly great degree on Western advances.

- The Soviets lag the West to an even greater degree in applying information technology. They have achieved considerable success in certain military applications but have established only islands of automation in industry and have made inroads into the home only in the form of state-sanctioned entertainment media.

Conferees believe that the major roadblock to Soviet progress is the failure to establish an economic system that effectively rewards development and application of information technologies. An information revolution cannot be imposed from the top. Soviet progress will depend in part on the extent to which the Soviets create a hospitable environment, which risks at least some loss of central control. Conferees concluded that—despite signs of "openness"—the Soviet Union will not move from a party-dominated command system to a more pluralistic system. They predicted that:

- The Soviets in 1995 probably will remain five to 10 years behind the West in information technologies, doing relatively better in areas that lend themselves to a "national program" approach (for example, telecommunications) and relatively worse in areas that do not (for example, software).

- The Soviets will preferentially apply information technologies in the military, government, science, industry, and, as a means to an end, education. Applications in economic planning, battle management, and

internal security will support the maintenance of centralized control. Industrial applications—mainly computer-aided design and computer-aided manufacturing—will aim at improved quality and (especially) efficiency. Entertainment applications will spread, but personal computers are likely to make few inroads into the home through at least the early 1990s.

Conferees judged that even those modest objectives would be jeopardized if the Soviets chose to substantially reduce their historically high dependence on Western information technology. Continuing resort to Western technology might afford some Western leverage over Soviet development, but, in the light of diminishing US technical advantages, only if Western allies acted in concert.

Conferees agreed that the new, more pragmatic Soviet leadership will be more effective than its predecessors in making information technology work for productivity growth and military advancement. At the same time, materially closing the gap with the rapidly advancing Western target would require substantial change in the Soviet system to make it more hospitable to innovation and growth. Conferees judged that such change was unlikely, even to the degree achieved in the mid-1980s in China. Thus, they expect steady if unspectacular Soviet development, with little change in the governing political and social institutions:

- Most doubt that Gorbachev will transform the Soviet Union into an engine of economic development, achieving his goal of 5-percent annual growth in the 1990s. There is at least as much skepticism that Soviet technology and products will become competitive with the best Western alternatives. If they do not, the USSR will continue to have an export profile like that of a Third World country—selling mainly raw materials.

- Western programs to develop "smart" conventional weapons, advanced reconnaissance and battle management systems, and systems associated with the Strategic Defense Initiative may place the Soviets at a severe disadvantage if they do not keep pace with the West.

To make matters worse for the Soviets, information technologies (like high-density integrated circuits) are difficult to reverse engineer; thus, the traditional Soviet answer to their shortcomings—a crash program to acquire and copy—is of limited value.

On the political and social front, many Western analysts expect that there will be a gradual moderation of party-state control of information technologies—partly intended, and partly unintended:

- Over the next five years, modest challenges to control could emerge from direct Western broadcasts, the growing availability of consumer entertainment media (especially videocassette recorders), and increasing access to telecommunications.

- In the 1990s the Soviet "computer culture" may take hold in earnest, when millions of Soviets will be computer literate and domestic production should support widespread industrial applications and the beginnings of widespread private ownership. Security authorities then would confront greater problems in monitoring telecommunications use and access to data bases and efficient, high-speed production reporting systems. Soviet economic authorities will see their chronic battle against data falsification move to the information technology frontier and will be hard pressed to avoid at least isolated instances of computer crime and even sabotage.

Conferees nevertheless judged that such potential threats to state control could be contained, albeit not without forfeiting some of the potential benefits offered by unfettered information technologies.

The conferees concluded that by the mid-1990s at the very latest the shortcomings of the strategy to close the information technology gap with the West may force the Soviet leadership to reevaluate its approach. Tension may increase between advocates of greater economic decentralization and advocates of tight political control. Although there is room for compromise and innovative management, conferees concluded that Soviet leaders will place a premium on maintaining political control, which raises the prospect of continuing and possibly intensifying economic and technical shortfalls.

If this happens, the United States may confront a Soviet Union in the 1990s even further from its goal of achieving equality with the most advanced Western countries in terms of economic and technical development and citizens' welfare. The Soviet Union may be forced to rely to an even greater degree on military power to maintain its influence in the world. Conferees did not address the consequences of dealing with a "sick bear" but noted that Soviet progress in the "information revolution" will significantly influence the severity of the bear's illness.

The USSR Confronts the Information Revolution

Introduction

Advances in computing and communications promise to transform global society in the 21st century. The massive, sustained increase in the capability to access, process, analyze, and transmit large amounts of data has emerged as a major force in technological innovation and a key determinant of national economic health. Information technologies have remolded existing industries and created entirely new ones. Cheap yet powerful computers have dramatically expanded information available to the ordinary citizen and simultaneously placed his privacy at risk. Military programs like the Strategic Defense Initiative call for successful integration of computing and communications activities of unprecedented scope and complexity.

This paper draws together published research and conference findings to assess the promise and challenge of information technologies in the Soviet Union. It begins with a brief overview of the so-called information revolution in the West and summarizes Soviet reaction to it. It then analyzes where the Soviets are today and enumerates their published goals for the future. Finally, it assesses likely Soviet progress and the potential consequences of this progress for Soviet economic development and political control.

What Is the "Information Revolution"?

Advanced Western countries are experiencing explosive growth in the amount and availability of information, a phenomenon supported by rapidly expanding applications of computing and communications systems. A variety of public, corporate, and academic institutions have contributed to the rapid development of what has been termed the information society. By measures of product development, cost trends, and applications, the key attribute of the information industry and broader information society has been change.[1] Moreover, despite occasional fitful progress, false starts, and dashed expectations, the advance of the information industry is contributing to fundamental structural change in Western economies and societies. Such change is affecting relationships among individuals, interest groups, institutions, and countries and threatens to do the same for the Soviet Union.

Most experts hold that Western progress has depended in large part on a hospitable economic and social system that provides both support and incentive. Fierce competition—domestic and international—drives progress. Effective government generally has (1) provided "seed" money to support fledgling industries, either through acquisition policies (such as those for defense) or outright grants; (2) eliminated barriers, as in the US deregulation of the telecommunications industry; and (3) stayed out of the way by exercising relatively little control of information dissemination or social change. Development of the technologies, support infrastructure (such as education and finance), and applications has been generally balanced and mutually reinforcing. This has supported the very rapid spread of applications and the development of a nearly universal user community.[2]

Technology Ingredients

The information revolution is dependent on a handful of interrelated technologies.

Microelectronics. Advances in semiconductor manufacturing have increased exponentially the density and performance of integrated circuits (ICs)—the basic ingredient of all modern computer and communications hardware. Some IC prices have remained stable, but mass production of inexpensive, general purpose ICs has resulted in the proliferation of microelectronics-based computing and communications by the military, industry, and the public. Continuing

advances in manufacturing methods ensure that this trend will continue. Globally, electronics is reportedly a $300 billion a year business that is expected to triple by the year 2000.[3]

Computers. Although advances in the power, speed, and efficiency of large mainframe computers were fairly predictable, the surge in the use of minicomputers and personal computers (PCs) was largely unforeseen. In 1985 US business bought 2,000 mainframes for $6.9 billion, while 84,000 minicomputers were sold for $9.5 billion. Sales of minicomputers are expected to grow at an annual rate of 8 to 9 percent for the balance of the decade, while sales of mainframes are projected to grow at 2 percent. PC sales in 1985 stood at $3 billion worldwide and are expected to grow 20 percent in 1987.[4] A modestly priced PC typically used in an office today often outperforms the large, costly mainframe computers used as recently as a decade ago.

Telecommunications. The advent of digital transmission and switching systems has substantially reduced the cost of voice communications and has permitted new services, such as teleconferencing and facsimile transmission. Advances have also supported high-rate data communication services, linking computers and data bases in commerce, government, and industry. In 1983 sales of communications equipment—such as communications satellites, cable television, cellular radios, video data systems, and local area networks—totaled almost $60 billion worldwide and were expected to climb to $90 billion by 1988. In 1983 one large telecommunications network was linked to 100,000 computer terminals and required 4,000 minicomputers and 300 mainframe computers to operate.[5]

Software. Perhaps the most rapidly growing and changing component in the information industry is the software that generates the myriad instructions that operate, link, and apply computers and telecommunications hardware. Global sales of software totaled $26 billion in 1985 and were growing at an annual rate of more than 17 percent. In the United States alone, PC software sales have doubled annually since 1980 and now account for one-third of total software sales of $18 billion. By 1990 business is projected to spend more on computer software than on hardware.[6]

Software increasingly determines the function and performance of digital systems, enables hardware to be ever more generally applied, and serves as the nervous system of national and local telecommunications and information networks. Development of software for artificial intelligence will strongly influence progress in meeting major US information-processing challenges—such as SDI battle management and the fifth-generation computer.[7]

Applications

Intensifying global technological and economic competition makes the effective exploitation of these information technologies a key factor in military and economic survival. Most modern weapon, command and control, and logistic systems, for example, depend on these technologies.

Information technologies already pervade Western science, industry, and society, aiding analysis and decisionmaking, managing industrial operations, and providing convenience and entertainment for the consumer. Scientists use large, high-performance mainframe computers to access and analyze enormous streams of data, while engineers routinely use minicomputers to grapple with more modest problems and employ PC networks to share information. Desktop terminals and PCs provide executives and white-collar workers in government and industry with a rapidly growing capability to access and analyze statistical, financial, and operational data. Advanced telecommunications links within and between organizations support high-speed information networks used to access or share information, thereby enhancing a company's productivity and competitive position.[8]

In industry, information technologies have moved onto the plant floor. In the United States, purchases of factory automation systems doubled between 1980 and 1985—to $18.1 billion—and are expected to double again by 1990.[9] Minicomputers and microcomputers routinely control manufacturing processes, machine tools, and robots. Flexible manufacturing systems link machine tools and programmable robots under the supervision of a computer to further automate manufacturing processes. Local area networks

integrate production scheduling, procurement, and material handling. Computer-aided design terminals with complex and often specialized software packages create in hours designs that would require months to complete manually. Many larger manufacturers are developing computer-integrated manufacturing approaches that will eventually integrate many of these functions into a fully automated factory.[10]

Information technologies have rapidly expanded the variety and quality of services available to private citizens. "Smart" appliances, pocket calculators, automatic teller machines, and laser scans at stores and supermarkets save time. Cable television and videocassettes provide high-quality entertainment and in some areas even make it possible to shop in the home. PCs and telephone modems that can be linked to remote data bases or to local and national networks enable professionals to work at home, help students with their homework, allow hobbyists to readily share information, and host video games. The application of information technologies in medicine created more precise, nonintrusive diagnostic tools to monitor individual health, linked service paramedics to diagnostic equipment at hospitals, and allowed for the implantation of pacemakers with built-in microchips. Fire and police departments increasingly control their vehicles with the aid of computer networks, and local governments use office automation to speed customer services.

Impact

The impact of advancing information technologies on US economic productivity, growth, and international competitiveness is debatable. Some analysts argue that productivity for white-collar workers—three-fourths of the US labor force—is no greater than it was in the 1960s. They hypothesize that managers and workers either have not yet learned how to use computers properly (if at all), or that the burden of meeting more intrusive government demands for tax, fiscal, and labor relations reporting has overwhelmed productivity gains. Other assessments point to the advantages major airlines and financial service firms have gained over domestic and foreign competitors by raising productivity through office automation. There is a consensus that the introduction of information technologies has streamlined US manufacturing operations, renewing growth even in mature industries like those for automobiles and aircraft.

Nevertheless, manufacturing productivity gains in Japan—even in critical elements of the electronics industry—have outstripped growth in the United States, inducing fears that America is losing the high-tech race.[11] For example, in the early 1970s US firms totally dominated the market for integrated circuits. Today, these firms account for 39 percent of the value of sales by non-Communist countries, while Japan accounts for 42 percent and its share is increasing rapidly. The high cost of developing new technologies has forced many US companies out of the market, whereas Japanese companies generally have ready access to substantial financial resources.

Information technologies are increasingly important in weapons development and production. Superiority in "smart" munitions, avionics, missile guidance, fire control, and surveillance and command and control systems—rooted in advances in microelectronics, microcomputers, and software—is widely viewed as America's primary military advantage. Information technologies offer tremendous improvements in locating and hitting targets and are consuming ever-increasing portions of development costs. Computers and software accounted for less than 2 percent of development costs for the F-4 Phantom, the mainstay of the US fighter inventory during the 1960s and early 1970s. The corresponding percentage for the F-15 was over 26 percent, and that for the F-18 was greater than 40 percent. In 1985 the Department of Defense spent $194 million for the very-high-speed integrated circuit (VHSIC) project, with the goal of achieving a hundredfold increase in the density and performance of silicon-based ICs by 1990. The Pentagon reportedly has plans to use the first generation of VHSIC chips in 37 major weapon systems by 1992. Military software demands will also be fueled by the 250,000 computers estimated to be in military operation by 1990.[12]

Computer and communications security is a vital concern throughout government, business, and industry, given the danger of espionage and sabotage. A

recent survey of more than 17,000 computers used in the Department of Defense concluded that one-half required better access control. Disaffected engineers or programers could insert a few lines of code among the millions of lines of operating code a large computer may use and severely disrupt the machine functions. Hackers—often teenagers—share information on techniques for illegally accessing computers on some of the roughly 1,000 computer bulletin boards operated in this country. The question of how to proceed against hackers has raised unprecedented issues in jurisprudence.

The information revolution is also placing, at least potentially, the privacy of the individual at risk. Some estimate that the individual is referenced on average in roughly 40 local and Federal Government agency files and in about the same number of private-sector files. The Internal Revenue Service is obligated to pass its records to 38 different government offices. A 1984 Gallup Poll revealed that two-thirds of the US population believed that they had lost or are likely to lose some privacy. A 1983 Harris Poll revealed that 86 percent of the citizenry felt it was possible for the government to use available information to persecute its "enemies."[3]

Although there appears to be general agreement that the information revolution is likely to bring about sizable changes in the world's economies, the questions of how much, how soon, and in what direction are hotly debated. Some analysts make the point that it is difficult to forecast the effects of these new technologies because their application will be heavily determined by economic, political, and demographic conditions. In any event, the importance of product "intellectual content" is likely to increase the dominance of the services sector in national economies. Dislocations of workers in aging smokestack industries, the semiskilled, and—increasingly—white-collar workers may be a substantial force as well.

How Do the Soviets View the Western Information Revolution?

The Soviets closely follow developments in Western information technologies and applications. As in many other aspects of the East-West competition, two themes frequently arise in their statements and writings: concern over the potential threat and a carefully crafted balance of admiration and criticism as they move to emulate Western progress. Although different factions in the Soviet establishment may place varying emphasis on each theme, nearly all spokesmen toe the official line: Western development must and can be matched, borrowing positive aspects and sidestepping the negatives. Soviet officials, however, are at odds over where applications will provide the greatest benefit.

Concern

Soviet leaders—especially Gorbachev—have acknowledged the danger of lagging the West in the development and application of information technologies. They have criticized the lethargy of the 1970s, implying that the Brezhnev leadership failed to act on the promise of information technologies and to appreciate the pace and consequences of Western advances. They have specifically criticized overreliance on copying Western advances. Officials have noted the difficulty of reverse engineering, as well as the accelerating Western progress in many of the key technologies. They express concern over the prospect of a permanent and possibly increasing lag.

The economic consequences are frequently highlighted. Soviet leaders and officials talk about achieving international competitiveness in manufacturing, both in the high-technology products themselves and in the many product groups—like vehicles and machine tools—where applications of information technologies greatly affect cost and quality. Other officials—frequently scientists—talk about the importance of maintaining prestige as a first-rate technical power.

More broadly, Soviet officials cite the contribution of information technologies to productivity growth and economic development in all advanced industrial countries. Noting that productivity increases must fuel virtually all Soviet growth for the remainder of the century, they have argued that the mastering of information technologies is essential in their efforts to match Western industrial might, international influence, and consumption levels. They believe economic

competition between the two systems is more noticeably moving into the scientific and technical sphere and will be decided precisely in that sphere. They also acknowledge the "bandwagon" effect in the West—the tendency of advances in information technology to rapidly promote further advance—as a way of highlighting the danger of playing catchup.

Military concerns also surface. Generally, Soviet military and political leaders have acknowledged the role of a strong economy in supporting military power. More specifically, Soviet military leaders have cited the contribution of information technologies to advancing Western weapon capabilities—most recently in smart conventional weapons and SDI. Western improvements in command and control technologies—never a Soviet strength—are causing considerable concern. The Soviets note that progress in informatics technologies is essential to emulate and, in many cases, also to counter.[14]

The Soviets also voice concern over the effects of Western information technology applications on the Soviet populace. Western broadcasts convey Western viewpoints and values and, accordingly, have been jammed for many years. The Soviets recognize that the advent of direct-broadcast satellites will make Western propaganda more readily available to the Soviet citizen. Although Soviet officials do not openly admit it, their efforts to tightly control means of information production and distribution—like copying machines—indicate fear over the consequences of Western computer, telecommunications, and video technologies falling unrestrictedly into the hands of the Soviet consumer.

Admiration and Criticism

Active Soviet proponents of information technologies and applications, probably encouraged by Gorbachev's admonition to confront and acknowledge shortcomings, speak and write favorably about Western accomplishments. They are impressed by Western dynamism, particularly in rapid industrial assimilation and mass production, and admit that they were caught by surprise. The Soviets cite Western cost advantages—comparing, for example, Western computers costing in the hundreds of dollars with the Soviet-designed 8-bit Agat, costing up to 3,000 rubles. They have praised Western innovators like Stephen Wozniak, the cofounder of Apple Computers. And some have even acknowledged that Soviet systems like the Agat are modeled after Western systems and basically use Western-developed components.

Open criticism seems to come from two quarters. Some officials with a vested interest criticize aspects of Western development—like decentralized computing—that are incompatible with Soviet approaches. Other writers in the popular press frequently use Western experience with information technologies to criticize the capitalist system. Information technologies are variously accused of causing bankruptcy, unemployment, alienation, and invasion of privacy and of supporting Western militarism and espionage.[15]

Soviet officials reassure their people that socialism can reap the benefits and avoid the pain: "We, of course, do not have these problems and cannot have them." In a variation of the same theme, Gorbachev stated that "we can and must cope with acknowledged problems."

Conferees concluded that the Soviet Union under Gorbachev is determined to confront and respond to the Western information revolution. Soviet leaders believe that information technologies can radically alter industrial competitiveness and the military balance. They particularly fear the West's growing ability to increase military effectiveness by stressing quality and management of weapon systems rather than quantity. They seem ambivalent about a strategy of copying Western advances. They recognize the advantage of a quick fix to Soviet industrial productivity and military capability, but many fear that a follower strategy will relegate the Soviet Union to an economic backseat and cause its R&D capabilities to atrophy. Yet many Soviets either do not fully understand or reject implications of the political root cause of Western success—the interaction between a private, decentralized, high-reward entrepreneurial economic system and the development and application of information technology.

Soviet leaders probably do not believe that adopting Western information technologies will seriously affect their ability to control their people. They probably intend to minimize decentralization of control by forgoing certain applications of electronic systems, microcomputers, and printers. Many uses in the West—for example, banking and retailing—need not be extensively pursued in the USSR. The Soviets also probably have faith in the ability of their oppressive state security and centralized economic apparatuses to control the more restricted industrial applications that they intend to pursue. Soviet leaders, however, clearly fear the spread of Western political and social views and fear that the "demonstration effect" of Western living standards may lead Soviet consumers to demand more consumer amenities.

What Are the Goals of the Soviet Information Revolution?

Gorbachev has embraced the information revolution. He has called for the "technical restructuring" of the Soviet economy and singled out information technologies and their supporting industries for highest priority development in the USSR and Eastern Europe.[4] Gorbachev expects to recharge the Soviet economy as information and other advanced technologies reverse the long-term decline in the growth of Soviet labor productivity and GNP, a goal made more urgent by the prospect of very little increase in the Soviet labor force.[5] Overall, he wants to launch the Soviet Union on a new development course and holds out the hope that it will be in the same league as the United States and Japan by the year 2000.

Gorbachev's domestic policy initiatives related to these goals represent moderate—not revolutionary—reform. He is seeking and getting immediate gains by enlisting greater worker commitment. He is directing investment toward civilian engineering R&D and production, sources of much dual-use technology, in the hope that technology advances will sustain long-run productivity and quality improvement in all sectors, including the military.

Gorbachev's goals for information technologies, while ambitious, reflect these moderate efforts to reform the Soviet economic system. Information technologies are to help make centralized planning and control viable, not obsolete. As in the West, they are to help modernize the Soviet economy and maintain military power. They are to help remedy perceived low prestige, enabling the Soviet Union to project a strong, progressive image, both internally and internationally. The information technologies are *not* expected to foster great social and cultural change, and any impact on the quality of life is to be largely a controlled byproduct of their general impact on economic development.

Gorbachev has set ambitious *economic targets* for the suppliers of information technologies, and prominent officials promise substantial gains from information technology applications:

- Production of computer equipment is slated to grow 18 percent annually through 1990. By that time the Soviets are to produce 1.1 million personal computers, after producing virtually none until the mid-1980s.

- Output by the main producer of instrumentation equipment is to grow by 19 percent per year in the 1986-90 period, up from 6 percent in the previous five-year period.

- Compared with 1981-85 production, production of robots in the 1986-90 period is to more than double, NC machine tools almost double, and machining centers more than quadruple.

The conference concluded that, unlike the West, where information technologies have had the greatest effects in financial sectors, the Soviet Union can obtain the greatest benefits through industrial applications. The Soviets can use information technologies to improve industrial planning, enlisting more low-level participation in the process. Their priority objectives are to increase R&D productivity and to drastically modernize their manufacturing infrastructure. They are counting on flexible manufacturing systems

and other computer-aided machinery to provide the necessary precision to meet the design requirements of advanced military systems, including subsystem miniaturization, increased structural strength, and reduced weight.

In the 1960s the Soviets had hopes of creating industries totally linked by computer networks. They have begun to back away from that objective and, for the present, appear content to create islands of automation within industry. Nevertheless, installation of computer-assisted design and manufacturing (CAD/CAM) equipment is increasing dramatically in R&D and production enterprises. Optimistic Soviet officials have claimed that CAD systems will shorten product development times by 50 to 80 percent. (Such gains have been realized in US industry.) Other officials have claimed that automation in engineering industries will at least double labor productivity and that automation of continuous processing can free up to one-half of the laborers.

Specific Soviet *military goals* are less clear. It is evident, however, that the Soviets have not become any less aggressive in meeting the challenge of advancing Western weapons technology. As weapon costs skyrocket and technology breakthroughs offer large performance gains, there are indications that the Soviet military is pressing harder than in the 1970s for weapons of better quality, even at the cost of reduced quantities. Continued development of SDI, in particular, will induce the Soviets to give priority to the development of the sensor, signal processing, and battle management technologies necessary for development of comprehensive countermeasures or a comparable system. Information technologies are central to Soviet military strategy, both in the weapons and in the factory.[6]

The authorities also promise an improvement in the *quality of life* and a smooth transition to the new information society. Gorbachev has come down forcefully in support of changing the information cultures in bureaucracy and society. Perhaps because of this support, the Soviets are beginning to print more statistics on sensitive issues, more open and frank evaluations of the performances of officials in all bureaucracies, and more open criticisms of bureaucratic and social pathologies such as withholding information and lying about production fulfillment. In the near term, the regime will emphasize education and training; for example, in 1985 a mandatory course on the basic principles of computers and computer programing was begun for 9th and 10th graders. The Soviets are planning to supply 500,000 personal computers to the schools by 1990—about 45 percent of total production—and 5 million by the year 2000. Mass communication services, as well as home personal computers and VCRs, are expected to increase and improve. Advocates claim that citizens' lives will be enriched and creative forces unleashed throughout society. As a leading indicator of Gorbachev's policy, the national press has shown an increased openness that contrasts sharply with the continued conservatism of the local press.

Gorbachev also realizes that he faces opposition from a wide spectrum of society, including segments of the party and state bureaucracies at all levels. But, like his conservative opponents, he has given no indication that he endorses any fundamental reduction in national party control. Conservative officials point to the need to mobilize control organs to guard against "infection" by "bourgeois" ideas but express confidence—at least in public—that such infection can be contained. An architect of the computer literacy program has promised that information technologies "will change our life, making it fuller, wiser, more sensible and, in the end, happier than now."

The Soviets have several options for developing information technologies, all promising progress but none offering much prospect of overtaking the West by the end of the century. They are poorly positioned to tap the domestic sources that fueled Western development. The Soviets lack a broad commercial base, having geared their industry to military needs. Western commercial applications of consumer electronics, for example, have driven progress and rapid growth of the electronics industry. In the West, defense applications of ICs account for only about 7 percent of the value and 3 percent of the physical volume of IC production. The conferees also concluded that the Soviets are unlikely to introduce measures that would substantially improve the effectiveness of their massive R&D base in serving the needs of producers.

The Soviets probably will continue to rely heavily on imported technology. They will favor the acquisition of production technology with both military and civilian applications, including turnkey facilities, and will eschew reliance on Western countries for continuing supplies of components. Their efforts will be hindered by hard currency shortages and by the growing difficulty of reverse engineering increasingly sophisticated information technologies. Moreover, the greatest Soviet needs—in microelectronics, systems engineering, and software—are extremely difficult to satisfy through imports without active Western participation, something constrained by export control regulations. Moreover, even a successful follower strategy probably would condemn the Soviets to being at least one technological generation behind.

The Soviets will probably focus the application of information technologies on industry and the military. Increasing industrial productivity is the most pressing goal. Military leaders are aware that production technology advances are necessary for a strong military, and they will push for modernization of the defense industrial base and a gradually growing emphasis on quality over quantity in weapon acquisition. On the social front, the Soviets probably will move only gradually to increase the supply of consumer electronics such as VCRs.

Where Are the Soviets Starting From?

Soviet and Western observers generally agree that the USSR trails considerably behind Western nations in the development and application of information technologies. These lags have persisted—and in some areas lengthened—despite a massive commitment of resources to information technology R&D dating back to the 1960s. Today the USSR has the largest R&D establishment in the world and has achieved impressive success in many areas of science. While this competence has enabled Moscow to erode certain Western leads at the laboratory stage, familiar problems in industrial innovation and application have hindered Soviet progress. The massive size of the Soviet R&D effort, coupled with its failure to significantly narrow the technological gap with the West, suggests an ineffective R&D management strategy, a diagnosis with which Gorbachev has openly concurred.

Technologies

Western experts generally hold that Soviet microelectronics, computer, and telecommunications technologies lag those in the West by five to 10 years and, in some cases, by even more, depending on the specific technology.[7] In general, the Soviets probably fare better in major hardware development than in the development of support technology such as computer peripherals and software.

Where advance is more amenable to a massive, focused campaign—such as in certain telecommunications and microcircuit development programs—the Soviets do relatively better and the Western lead may shrink; where advance depends more on coordinated and mutually reinforcing development in a host of interrelated technologies—such as in computers or computer-aided manufacturing—the Western lead is more likely to be sustained or even increased:

- In microelectronics, the Soviets are at least two generations (approximately five years) behind the United States and Japan and are following Western approaches. In part because of their late start, the Soviets have built their microelectronics industry primarily by copying the West and using Western equipment.
- Soviet computers are by and large copies of Western computers and are at least one generation behind.
- The Soviets have an archaic telecommunication system, but one that is being modernized and made more effective with heavy investment.
- Software has always posed a major problem for the Soviets. Their systems software is primarily of Western origin. Application software is their Achilles' heel, because it is job specific and is difficult to modify for another area of operation.

Across all information technologies, Soviet advancements have depended significantly on imported or stolen Western technology.[20]

In the last several years, Soviet officials appear to have become more acutely aware of the need for much-improved coordination of interrelated information technologies. Support services—software, peripheral equipment, maintenance, and user training—have repeatedly been singled out as the most serious problem areas.[21] Soviet leaders have responded by creating organizations to coordinate development and foster compatability among the hundreds of independent product lines.[22] To date, the response appears to be largely bureaucratic—new oversight committees, expanded technical standards, and formal quality certification.

Moreover, to obtain hardware, software, and other support, the Soviets are trying to capitalize on the resources of their East European partners in the Council for Mutual Economic Assistance (CEMA). This also is not new—computer development (initially the Ryad Series) was the first major product of CEMA integration of R&D in the early 1970s. Recently, CEMA announced the S&T 2000 program, singling out key information technologies for much-expanded cooperative development efforts. Soviet organizations will manage these development efforts and try to direct them toward areas where East European countries are technical leaders.[23] They will also gain by using Eastern Europe as a conduit for Western information technology.

Applications

According to Soviet official data, information technologies are being applied on an increasing scale throughout the economy. R&D and industrial customers are receiving preference in the allocation of computers, for example. Mainframe computers used for inventory control, payroll, and other management support functions are fairly common in large plants, while minicomputers are applied extensively in process control. Soviet and Western authors, however, claim that Soviet computers are generally used less intensively than those in Western firms.

Western authors have described the Soviet telephone system as primitive by Western standards and notorious for poor-quality transmission and unreliability, even though Soviet telecommunication has followed US architectural strategy. The plan for 1985 called for increasing the level of existing network automation—switching of long-distance calls without the assistance of an operator—to a mere 55 percent. The Soviets also have a large but unsophisticated communications satellite network. They have launched six times as much payload weight as the US Intelsat system but have less than one-fifth the communications capacity. Leading-edge technologies such as optical fibers for data transmission, network control programs, and digital switching currently appear in Soviet literature as problems that must be solved before wide-scale use begins. At the same time, the Soviets make more modest demands on their telecommunications system than is typical in an advanced Western country.[24]

The development of the computer, microelectronics, and telecommunications industries allowed the Soviets in the mid-1970s to begin introducing automated management systems (ASUs) on the plant, regional, and national levels. They use ASUs for economic, administrative, inventory, product-planning, and process control applications. By 1985 the USSR reported it had installed over 6,800 ASUs. Difficulties in applying large-scale ASUs apparently have convinced the Soviets to deemphasize ministerial- and enterprise-level systems in favor of lower level systems for production control and information processing, as illustrated in the tabulation below:[25]

	1971-75	1976-80	1981-85	Total 1971-85
Number of ASUs installed				
Technical process control	564	1,306	2,611	4,481
Data processing	108	133	259	500
Ministry management	168	92	60	320
Enterprise management	838	389	296	1,523
Total	1,678	1,920	3,226	6,824

In general, Soviet and Western analysts agree that in range and intensity of applications the USSR remains well behind the West. The Soviets have highly automated factories, but many are islands in a sea of aging industrial plant. Uneven development—especially in services—has also contributed to a failure to achieve desired gains in efficiency.[26] Even when technology does not threaten state control, the Soviets have not moved aggressively to exploit the potential for productivity growth. For example, they could supply their engineers with substantial numbers of domestically manufactured hand-held calculators, but they choose to produce only small numbers of elementary models.

The Soviet system itself weakens a manager's interest in understanding—much less embracing—the information age, whether he provides or uses information services. There is a huge disincentive to apply automation in the management structure of the Soviet economy, and until there is a change in the incentive system, few substantive changes can be expected. Soviet authors acknowledge that these shortcomings significantly reduce the economic benefits obtained from automated management systems.[27] Moreover, they recognize that the Soviets do not require state-of-the-art technology to realize substantial gains.

Conferees concluded that the Soviets have been effective in using dated technology to create competitive weapon systems but will move to use considerably more advanced technologies in future generations of weapons. More extensive military applications of information technologies—especially in command and control—may require changes in military doctrine and tactics as the Soviets move away from relying on overwhelming numbers of men and weapons. This could cause political and social problems, and these would be intensified if greater reliance on information technologies drove up military expenditures. The Soviets probably have little choice but to move in this direction. Information technology promises such huge increases in military capability that they would be increasingly hard pressed to compensate with numbers.

Information technologies have had varying impact in the home and have made limited inroads into the schools. The USSR has significantly upgraded and expanded its television and radiobroadcasting capabilities.[28] Soviet surveys reveal that most citizens obtain an increasing share of their information from broadcast media at the expense of print media and lectures. Videocassette recorders are in great demand; an estimated 300,000 are already in homes.[29] Personal computers appear to have made the least impact, because of shortages of equipment, maintenance, and training.[30]

Information technologies also have the potential to be used by organs of political and social control. Western analysts have assumed that the privileged position of the KGB, police, and Communist Party apparatus would assure them ready access to the best available technology for communications intercept and surveillance.

How Fast Will the Soviets Progress in the Information Revolution?

Judgments about the pace of Soviet progress depend on assumptions about how Moscow will choose between partially incompatible goals. Most authors agree that the centralized, socialist Soviet system creates an inhospitable environment for maximizing advance in information technologies and their applications. Thus, as one author (Rex Malik) puts it, the Soviets face an "agonizing dilemma"—balancing the gains of development with the risks of losing political and social control.

Experts differ, of course, over where the Soviets will end up along this continuum and what the consequences will be for their position in the world. We summarize below the key elements of a consensus that seems to emerge in the literature—the Soviets will "muddle through" but will not reach the levels of leading Western nations by the year 2000.[31]

The Ingredients

Even before Gorbachev, most Western experts believed that Soviet information technologies would continue to advance at a healthy rate, benefiting from

the traditional impetus of massive resource commitments, exploitation of Western developments, and leadership attention. Gorbachev has given a strong boost to the program, especially in terms of resources. Even so, few observers expect the Soviets to narrow the gap significantly, except possibly in some specialty military applications. Most believe the USSR will remain five to 10 years behind in most technologies—that is, in 1995 they will have about the same array of technologies available that the United States has today. Moreover, most expect Soviet progress to be faster in information technologies that lend themselves to a "national program" approach (for example, telecommunications) than in those that do not (for example, software).[2]

These judgments are predicated on the widely held belief that Gorbachev is trying to modernize the Soviet system but will not fundamentally change it by moving from a party-dominated command system to a more pluralistic, decentralized system. He is moving aggressively on weak links—orienting science to the needs of production; stressing services, maintenance, and computer literacy; and generally trying to create an environment that encourages individual initiative and creativity. These measures, together with efforts to alter the information cultures of the bureaucracies and society, are moderately reformist. Although many Soviet officials support Gorbachev's moderate policy reforms, most Westerners believe the Soviet governing apparatus and society will resist or delay advances in information technology.[3]

The conference endorsed these views and concluded that prospective Western advances in information technologies will make it hard for the Soviets to remain only one or two generations behind. Conferees felt that the Soviets could leapfrog a generation in certain information technologies, like microelectronics, but only if they can obtain major help from other countries, like Japan. The telecommunication system shows the greatest chances for substantial improvement, mainly through the heavy investment in foreign technology. Software, especially for applications, is likely to continue to be a major shortcoming. The microelectronics and computer industries are unlikely to obtain sufficient resources to close the gap with the West.

The Applications

Western and Soviet experts seem to agree that information technologies will be applied preferentially in the military, government, science, industry, and, as a means to an end, in education. Conservative Soviet authorities write of the need for "unified state control" of information technologies, and even the most vocal believers in these technologies generally write about the provision of centralized services.

In the government, police, and military establishments, information technologies are likely to be applied extensively to support the maintenance of central control. For economic management, computers have been described as the "last great hope of central planning." Although early dreams of "computerizing" the entire economy have been scaled back considerably, computers are likely to find increasingly widespread use at all levels in planning production and supply. The conferees judged that the Soviets are capable of doing most of what they wish to do with their existing telecommunication system, and that programed improvements for automated data links will increase Moscow's ability to collect information and convey instructions. In the military, information technologies will continue to be incorporated in weapon systems, but the real frontier is command and control. Soviet military literature extolls such computer applications, and most experts believe that information technologies will be more extensively applied in combat modeling, operational planning (including reconnaissance and fire support), and strategic battle management. Conferees presume that the KGB and militia will be quick to pioneer surveillance and recordkeeping applications, but doubt that the technologies will support truly all-encompassing measures of control—at least by the year 2000.

In the economy, most experts expect that the Soviets will apply information technologies extensively in information dissemination, product design, and manufacturing process control. They have long invested large sums in acquiring and disseminating technical information, and they are moving to automate this process more extensively. Access to Western data

bases will be aggressively pursued. Soviets acknowledge—and Western experts agree—that computer-aided design will be a high priority as the Soviets move into components and systems that are either impossible or prohibitively expensive to develop by other means (for example, very dense integrated circuits and high-performance aircraft). Computer-aided manufacturing probably will be pursued the most vigorously, because it is so important for reaching Gorbachev's productivity and growth goals. Many Western experts believe the Soviets will succeed in producing large numbers of robots, automated machine tools, materials handling equipment, and control computers, but will not develop an effective integrated systems approach. Islands of automation will spread, but continuing deficiencies in software, maintenance, technical standards, and incentives will impair comprehensive advance and efficient use.

In the home, Western experts expect substantial progress in entertainment applications but see little prospect of a "computer culture" comparable to that in the West. Mass communication services already permeate Soviet society. Given the receptivity of Soviet citizens to radio and (especially) television, Soviet officials probably will try to improve the quality, timeliness, and variety of offerings, if only to compete with Western alternatives. At the same time, information technologies are likely to be used in jamming or other means of interfering with these Western alternatives. Ownership of videocassette recorders and possibly video cameras will become more widespread as Western systems and Soviet products become increasingly available. The apparent Soviet concern over the impact of these systems makes it difficult to forecast how rapidly this process will unfold. Ownership of personal telephones will increase, but most experts believe that even by the mid-1990s it will not reach levels prevalent in the West in the mid-1980s. Finally, most Western experts seem to believe that personal computers will reach Soviet citizens in relatively small numbers. The priority of applications in the computer literacy program and in industry, along with restrictions on imports, makes it unlikely that large numbers will be available to the Soviet consumer before the early 1990s. Deficiencies in or unavailability of peripheral equipment—such as printers or modems—will further restrict personal applications.

The conferees concluded that the Soviets would fall far short of meeting information technology targets if they chose to rely on indigenous resources. Thus, the West may have some leverage over Soviet advance, primarily through the denial of technology for dual-use applications. US leverage is eroding, however, as the Soviets become increasingly able to obtain state-of-the-art information technologies from other Western, and especially Japanese, sources.

What Will Be the Consequences for the Soviets?

All conference participants agreed that the new, more pragmatic Soviet leadership will be more effective than its predecessors in making information technology work for productivity growth and military advancement. At the same time, developments in the West—at least in terms of quality and effectiveness—are moving forward rapidly and in some areas are probably accelerating. Conferees judged that materially closing the gap with the Western moving target would require substantial change in the Soviet system to make it more hospitable to innovation and growth. They judged that such change was unlikely, even to the degree experienced in the mid-1980s in China. Thus, the conferees expect steady if unspectacular Soviet development, with little change in the governing political and social institutions.

If the Soviets do indeed "muddle through," the Soviet Union of the 1990s will not be much different than it is today—a repressive society still trying to catch up to the West, but still dangerous militarily. Progress and change will be constrained by a Soviet system that resembles the current model. Of course, the scenario assumes that the West will continue to hold the Soviet Union at arm's length in its quest for high technology and influence the evolution of Soviet political and social systems mainly by the provision of information.

The Economy and the Military

Conferees agreed that improved worker effort, massive infusions of R&D and investment resources, and selected technology transfers would raise industrial

productivity, but probably not enough to meet Soviet goals. This, in turn, makes it unlikely that the Soviets will reach Western levels of per capita production and quality of life by the year 2000. Although no one is willing to hazard a precise forecast, most doubt that Gorbachev will transform the Soviet Union into an engine of economic development, achieving his goal of 5-percent annual growth in the 1990s. There is at least as much skepticism that Soviet technology and products will become competitive with the best Western alternatives. The Soviets probably will continue to have an export profile like that of a Third World country—selling mainly raw materials. A continuation or worsening of the USSR's position in those markets would impair its ability to rely on the West.

Soviet priorities and the organization of the Soviet system are likely to ensure that the most rapid progress in information technologies will be in the military. Arms control agreements or Gorbachev's civilian modernization programs could lead to diversion of some military-industrial resources. But there is no sign of any fundamental shift in priorities, and the military evidently recognizes that they stand to benefit from advances in industrial information technologies like factory automation. Soviet weapon program management techniques serve to concentrate high-quality resources, including imported or stolen Western technology, on weapon programs. The Soviets have generally been successful at deploying improved weapons on schedule, thereby cutting selectively into Western military technology leads in fielded military systems.

At the same time, the Soviets also will be aiming at a moving target in the military arena. Western programs to develop smart conventional weapons, advanced reconnaissance and battle management systems, and systems associated with the Strategic Defense Initiative suggest that an acceleration—if not an explosion—in information technologies will be driving much of the Western advance. Conferees judged that the Soviets would do well to keep pace with the West over the next decade.

These pessimistic conclusions are based on the fact that progress in the information industries—of all technology areas—is particularly incompatible with key features of the Soviet-style socialist, command economic system. Development of information industries requires a coordinated advance across a broad front of interdependent technologies and the provision of supply, support, and financial services. Spontaneity, "bottom-up" creativity, powerful incentives, and technical support provide the impetus for change, and flexible management, well-developed horizontal communications, and material support accommodate change. The Soviet system, even moderately reformed, furnishes virtually the antithesis of this environment. It is ponderous, cumbersome, vertically oriented, and penalizes innovation. To make matters worse, information technologies like high-density integrated circuits are difficult to reverse engineer; thus, the Soviets' traditional answer to their shortcomings—a crash program to acquire and copy—is of limited value.

The Political System

On the political and social front, many Western analysts expect that there will be a gradual moderation of party-state control of information technologies—partly intended, and partly unintended. Gorbachev's "openness" campaign sets the stage for greater individual access to information systems. His industrial automation drive and his efforts to encourage individual and local administrative initiative require some moderation, certainly more delegating of responsibility for decisions of secondary importance, and possibly more sharing of authority with regional and local officials. Moreover, Soviet officials have acknowledged that the increasingly sophisticated and demanding Soviet citizen must be catered to, and indeed one Western author (Wilson Dizard) argues that the Soviet "yuppie"—and not the dissident—will be the driving force behind any loosening of control. Finally, the technologies themselves can work both ways; some at least potentially support increased state surveillance, but many (especially in the factory) are compatible with more decentralized decisionmaking.

At the same time, the Soviet leadership has reason to worry that an increasingly computer-literate citizenry may develop the ability to obtain, manipulate, and

transmit unauthorized information, whether at home or on the job. Even within the bounds of the official system, information technologies can be a double-edged sword—Moscow can use them to centralize and penetrate, but local authorities can use them to deceive. Moreover, according to Academy of Sciences Vice President Yevgeniy Velikhov, Soviet social scientists are also looking into possible consequences of the information revolution that have been discussed in the West—worker alienation and reduced peer contacts. There are also hints of concern over worker "dislocation," if not unemployment.

Challenges to control are likely to arise. Several areas offer threats and opportunities over the next five years:

- *Direct Western broadcasts*, most likely to become increasingly accessible to ordinary citizens—although increased jamming or Soviet cable television could check this trend.[34] Foreign radiobroadcasts like Radio Liberty and Radio Free Europe have forced the Soviet leadership to be more forthright with their populace over such issues as the KAL-007 incident and the Chernobyl' disaster. In the early 1990s direct-broadcast satellites for television could carry Western programs and advertisements, illustrating what is available to the Western consumer. Paradoxically, to the reported consternation of party officials, even Soviet television may have a moderating influence. Television, a major entertainment medium, is undermining the effectiveness of political lectures and other, more traditional means of conveying propaganda. The conference concluded that jamming of foreign radiobroadcasts, especially Western broadcasts, can be expected to continue.

- *The growing availability of consumer entertainment media, especially videocassettes*, both Western origin and blank tapes.[35] The Soviets fear propagation of "antisocial" values and behavior—crime and moral degeneration. They also fear that such access may foster growing consumerism, undermining efforts to promote continuing sacrifice to shore up Gorbachev's growth strategy.

- *Telecommunications*. Increasing access to telephones (and possibly modems), plus improvement in the national systems, increases control and surveillance problems for the KGB. Conversely, installation of a system similar to the US "911" telephone system, an idea that came from a Soviet patent, could be used by the KGB to monitor personal communications and facilitate tracking. The Soviets' 1982 cutoff of international direct dialing illustrates their willingness to take drastic measures. In any event, the state's burden will be eased by the fact that Soviet information networks are and will continue to be considerably narrower and more focused than Western networks.

Beyond the next five years the Soviet "computer culture" may take hold in earnest. By that time, millions of Soviet citizens should be computer literate. Soviet production of personal computers and peripheral systems should be adequate to support widespread industrial applications and at least potentially the beginnings of widespread private ownership. At that time Soviet security authorities could confront problems of monitoring telecommunications use, data base access, and access to efficient, high-speed report production systems. Soviet economic authorities will see their chronic battle against data falsification move to the information technology frontier, and Soviet experience suggests that they will be hard put to avoid at least isolated instances of computer crime and even sabotage.

The conference judged that such potential threats to state control could be contained, albeit not without forfeiting some of the potential benefits offered by unfettered information technologies. Conferees acknowledged, however, that alternative scenarios offered by Western authors raise the possibility of more serious conflict or disruption within the Soviet system:

- One scenario holds that Soviet authorities may underestimate how quickly and how seriously spreading information technologies may challenge

state control. As information technologies expand, a "crossover point" is reached—possibly suddenly—at which developing installations and networks overwhelm the ability of controls.*

- Another scenario raises the possibility of a policy crisis. Tension may grow between "conservatives" and "modernizers" as one or both sides become dissatisfied with trends in Soviet economic progress and political control. Disagreement could lead to an abrupt change in policy, with ramifications extending beyond the world of information technologies. It could prompt a dramatic liberalization of the Soviet system, or a monumental internal crackdown and external belligerence. Malik, perhaps the most alarmist of the writers on this topic, concludes that "we are on track for a highly dangerous situation."

On balance, the conferees expect Gorbachev's policies, applied to information technologies, to foster some moderation of political and social control over the next 10 years. Yet the Soviets probably will not accept a Chinese-style trade-off in which central control is substantially relaxed to improve the country's economic position. They also are not likely to resort to Western techniques—like extensive reliance on market forces—to create a truly hospitable environment for information technologies. Moreover, elements of the Soviet leadership will try to buck any moderation, while the technological innovators push for more moderation.

The conferees concluded that by the mid-1990s at the very latest the shortcomings of the strategy to close the information technology gap with the West may force the Soviet leadership to reevaluate its approach. The conferees expect growing tension between advocates of greater economic decentralization and advocates of tight political control, but do not foresee a crisis developing. Although there is room for some compromise and for innovative methods of leadership and management, Soviet leaders probably will place a premium on maintaining political control. This raises the prospect of continuing and possibly intensifying economic and technical shortfalls.

If this occurs, the Soviet Union in the 1990s may be even farther from its goal of achieving equality with the most advanced Western countries in terms of economic and technical development and citizens' welfare. It may be forced to rely to an even greater degree on military power to maintain influence in the world arena—becoming, as the *Economist* put it, an "Upper Volta with rockets." Conferees did not address the consequences of dealing with a "sick bear," but noted that Soviet progress in the "information revolution" will significantly influence the severity of the bear's illness.

Notes

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[5] Forester, op. cit., pp. 116, 122.
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