Chapter 2

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International cooperation and competition in space science and technology have played important roles in the U.S. civilian space program since its inception in 1958. Although the program was primarily established to meet a competitive challenge from the Soviet Union, the National Aeronautics and Space Act identifies international cooperation as a fundamental U.S. goal and declares that "activities in space should be devoted to peaceful purposes for the benefit of all mankind" (sec. 102a).

For many years only the United States and the Soviet Union had the capacity to build and launch complex space systems. In the last decade, the Western European countries and Japan have also succeeded in developing advanced space systems; in large part they have done this by assimilating U.S. technology and expertise through cooperative scientific and commercial ventures with the United States.

In the 1980s, advanced foreign capabilities have or will become comparable to those of the United States in virtually every area of civilian space technology except manned flight. Foreign accomplishments now provide new opportunities for bilateral and multilateral cooperation; they also present the challenge of greatly increased commercial, political, and military competition.

Significant changes have also occurred in the U.S. relationship with the developing world. A few developing countries, resolved upon using space technology to promote their economic growth, have begun to press for the establishment of international organizations and legal regimes with the power to ensure equitable access to space systems and resources. Such developments are often inconsistent with U.S. policies and objectives, particularly those designed to encourage private competition and investment in space activities. This has occasioned a reassessment of the traditional U.S. support for certain cooperative activities, particularly those sponsored by the United Nations or its specialized agencies.

Because of their interest in maintaining U.S. leadership in space technology, in capturing the economic benefits of commercial space activities, and in using space technology as an instrument of foreign policy, the House Committee on Science and Technology and the Joint Economic Committee asked the Office of Technology Assessment (OTA) to prepare this report. [1] The committees requested an assessment of "international cooperation and competition in space, " that would "compare the technical status of foreign space systems . . . and investigate ways that U.S. space applications and space science programs could be used more effectively to further U.S. commercial and foreign policy interests. " They asked OTA to examine U.S. relationships with developing as well as industrialized countries and to offer suggestions about how "this country can work together with other nations for mutual benefit. "

This study builds upon the OTA report *Civilian Space Policy and Applications*. [2] That assessment identified international competition in space technology as a critical issue, described the current and projected space programs of other countries, and discussed domestic initiatives to make better use of our own space assets. During the course of the current study, OTA also published two technical memoranda each of which highlighted important issues of cooperation and competition. [3] *UN/SPACE '82: A Context for International Cooperation and Competition* focused on U.S. participation in the second United Nations

[1] **Letter from Congressmen Don Fuqua, Ronnie G. Flippo, Larry Winn, Jr., and Harold C. Hollenbeck of the U.S. House of Representatives Committee on Science and Technology to the Honorable Ted Stevens, Chairman, Technology Assessment Board, Mar. 8, 1982; Letter from the Honorable Roger W. Jepsen, Vice Chairman, Joint Economic Committee to the Honorable Ted Stevens, Chairman, Technology Assessment Board, Mar. 24, 1982.**

[2] *Civilian Space Policy and Applications* **(Washington, DC: U. S. Congress, Office of Technology Assessment, OTA-STI-177; June 1982).**

[3] **Technical memoranda are issued on specific subjects analyzed in recent or ongoing OTA projects, They are issued at the request of Members of Congress who are engaged in committee legislative actions that are expected to be resolved before OTA completes its assessment.**

conference on the Exploration and Peaceful Uses of Outer Space.[4] The conference offered a window through which to view the needs of the developing world, the formation of international space policy, the roles that the United States and its agencies play in this process, and the potential effect of the process on U.S. public and private interests. *Remote Sensing and the Private Sector: Issues for Discussion* investigated the recent proposal to transfer the meteorological and land remote sensing satellite systems to the private sectors Among other things, it discussed the size of the market, public good aspects of remote sensing, U.S. Government (including military and intelligence) needs for data, and the use of remotely sensed data to further foreign policy objectives.

In order to identify and refine the issues presented in this report, as well as the two previously published technical memoranda, OTA convened several workshops that assembled experts from different subject areas:

Space Technology and Foreign Policy: UNISPACE '82 offered an opportunity to review the development of international space policy, the role that the United States and its various agencies play in this process, and the potential effect of this process on public and private U.S. interests, After OTA completed the first draft of the UNISPACE '82 Technical Memorandum, it held a workshop to discuss the draft and the issues raised by U.S. participation in international conferences.

Commercialization *of Remote Sensing:* OTA organized two different workshops on this subject. In the first, participants drawn primarily from the private sector discussed those broad issues implicit in the transfer of remote sensing systems related to international trade, use of remotely sensed data in foreign policy, public good aspects of land and meteorological remote sensing, and finally, national security issues. The second workshop, composed solely of participants from the executive agencies, discussed most of the same issues from the standpoint of Government policy and plans.

International ***Trade*** *in Space Equipment:* This workshop discussed the applications and effects of current rules on trade in space-related services, equipment, and products. Additional issues discussed included potential Government responses to "unfair" practices in space markets, the likely evolution of the industrial organization of the space transportation industry, and the potential effect of deregulation on the international communications industry.

OTA is grateful to the workshop participants and to the many others who provided information or reviewed portions of this draft or of the drafts of the two technical memoranda. Their helpful and timely comments and suggestions helped to make it possible to complete this report.

[4] *UNISPACE* **'82:** *A Context for International Cooperation and Competition–A Technical Memorandum* **(Washington, DC: U.S. Congress, Office of Technology Assessment, OTA-TM- ISC-26, March 1983); requested by the House Science and Technology Committee and the Joint Economic Committee.**

'Remote *Sensing and the* **Private Sector: Issues** *for Discussion— A Technical Memorandum* **(Washington, DC: U.S. Congress, Office of Technology Assessment, (OTA-TM-ISC-20, March 1984); requested by the House Science and Technology Committee and the House Government Operations Committee.**

FOREIGN COMPETITION

Having begun in many cases by building components and subsystems for U.S. and INTELSAT satellites, European and Japanese capacities now extend to the design and operation of complete systems for communications, land remote sensing, and weather observation, as well as the vehicles to launch them. Although no single country can yet match the U.S. range of technical abilities, nor its experience in systems operation, foreign technologies are now fully comparable in specific areas, such as expendable launch vehicles and satellite ground stations.

Until recently, the United States benefited from the space programs of other nations because they provided markets for U.S. goods and services. Now, even though the overall market is increasing, foreign competition could threaten U.S. firms with the loss of significant sales and the country as a whole with potential loss of prestige and political influence. Already, technology developed by the European Space Agency (ESA) supplies a large portion of the satellite communications and space transportation needs of the European community. I n 1985, the French SPOT system is expected to begin supplying commercial remotely sensed data internationally. The Third World markets for space technology, once completely dominated by U.S. producers, are gradually opening to European and Japanese sellers.

These advances are part of an overall evolution of European and Japanese expertise in advanced technology. Influential opinion sectors in Europe and Japan believe that they must compete fully in advanced technology, and associated management skills as a prerequisite for economic growth, political status, and national security in a world dominated by the two superpowers. To obtain the necessary technology and skills they have targeted specific industries for special attention, particulady industries where international competition was thought to be important. Space technology is a prime exemplar of this phenomenon; it has not only been promoted domestically through research and engineering programs, but also imported from the United States via educational and scientific exchanges and through the activities of U.S. aerospace and communications firms.

In part because of its long-standing position as the unchallenged leader in space applications technology, the United States has been slow to recognize and respond to foreign challenges. This report offers a range of policy options which attempt to define appropriate roles for Government in its task of maintaining technological leadership in an increasingly competitive international environment.

PRIVATE SECTOR SPACE ACTIVITIES

The Carter and Reagan Administrations and Congress have encouraged private sector investment in space technology. Consequently, in addition to expanding its major role in satellite communications, the U.S. private sector would like to offer space transportation services. It may soon be obtaining and selling satellite remote sensing data, and has also offered limited expressions of interest in materials processing in space.

The U.S. Government attempts to avoid competing with private commercial activities. However, since the development and use of space technology is a long-term, expensive undertaking and certain specialized government needs cannot always be supplied by the private sector, governments have traditionally been the driver behind the evolution and growth of space technology. This preeminent government role, combined with the political sensitivity of the use of technologies that by nature transcend national boundaries, has inhibited the transfer of space technology to private sector hands.

In remote sensing and space transportation, although the U.S. Government creates a large part of the total demand for these services, it is also a potential competitor to private sector efforts. This report offers policy options which attempt to resolve the conflict between the Government's responsibilities for encouraging private sector investment in space and its responsibilities for maintaining the technological vitality of the Nation.

INTERNATIONAL COOPERATION

International cooperation for peaceful purposes has been a central element of the U.S. civilian space program since its inception. Cooperative activities have taken primarily three forms: 1) bilateral agreements with other industrialized countries, usually with a technological goal; 2) multilateral agreements in United Nations and other international forums to develop the legal, regulatory, or organizational norms for using space; and 3) assistance projects undertaken by the U.S. Agency for International Development, with the help of the National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA), which **use space** technology to benefit developing nations.

To make up for lack of individual size, European countries have also developed methods of cooperating multilaterally in order to pool financial and technical resources. The multinational ESA is coordinating projects in advanced satellite communications, ocean and land remote sensing, and expendable launch vehicles. It is also the lead agency for extensive bilateral agreements with the United States in space science and in the design and construction of Spacelab, the manned Shuttle laboratory. In Japan, the national space agency, NASDA, is developing its own family of launch vehicles (based on technology leased from U.S. corporations), as well as advanced communication satellites and ocean remote sensing systems. Japan also has an active space science program. Much of this work is being pursued in cooperation with U.S. aerospace and electronics firms as well as with NASA. The Soviet Union cooperates most actively with allied socialist states. More recently, it has developed programs with India and also with France.

In the past 25 years, the United States has engaged in hundreds of bilateral and multilateral cooperative ventures in every area of space technology. U.S. launchers have orbited complete satellites and instrument payloads for dozens of countries. As others develop indigenous space capabilities they become potentially valuable partners for cost-constrained U.S. projects. Yet, cooperation in any high-technology venture can result in some transfer of valuable technical "know-how." As private sector commercial activities increase there will be less Government incentive to cooperate because successful cooperation may lead to a decrease in market share or create new competitors.

The U.S. cooperative relationship with developing countries is also undergoing a period of significant change. In the past, the United States used the Landsat or the Advanced Telecommunications Satellite (ATS) programs to demonstrate how space technology could benefit the developing world. In recent times, however, the United States has come under strong criticism from developing countries for failing to support an agenda dedicated to equal and guaranteed access to space technology and resources.

The dominant dispute over the use and acquisition of space technology is between the industrialized and the developing countries, In general, the developing countries seek to gain greater access to, and control over, the resources of outer space and the advanced space technologies of the industrialized nations. They do this primarily by advocating legal and regulatory regimes for space activities in international organizations, where they outnumber and can outvote industrialized countries. The developing countries also promote the establishment of multilaterally funded and controlled bodies to transfer know-how and technology to the Third World. Industrialized countries, on the other hand, fear turning over control to multilateral organizations. In the United States, the ideological emphasis has shifted from a policy of using space for "all mankind," to a desire to encourage the private exploitation of space. Yet private exploitation of space resources assumes acquiescence by other countries in U.S. goals. Increased private sector activities will require political as well as market accommodation by all countries,

ORGANIZATION OF THE REPORT

The main body of this report begins with discussions of cooperation and competition in **chapter 3** and **chapter 4.** These chapters provide the conceptual and institutional context essential to understanding the technology-oriented policy options that appear in the report. The interaction between cooperation and competition is demonstrated concretely in each of the following technology chapters.

Chapter 5 describes the technology and the current issues involved in space transportation. It discusses commerce in space transportation equipment and services and the relative merits of their individual needs and products. Shuttle and Ariane price competition, launch vehicle demand, the role of the private sector and the long-term effects of government owned or sponsored technology are all examined. It also considers the history and future of cooperation in space transportation.

Chapter 6 examines international cooperation and competition i: ı satellite communications, the only fully commercialized sector of space technology, in the context of the international telecommunications industry as a whole. International satellite communications, which has been highly structured by regulation in the past, is now an arena in which a deregulated U.S. domestic telecommunications industry is poised to implement new technologies in international markets if it can gain access to them. This chapter analyzes how the outcome of technological competition between fiber optic cables and communication satellites could affect the long-term demand for satellite communications services and equipment and how economic, political, and regulatory factors could affect this competition. It analyzes U.S. policy toward international institutions like INTELSAT and the ITU, NASA's advanced communication satellite research program, international trade in telecommunications equipment and services, and international facilities regulation.

Chapter 7 focuses on remote sensing and the technical, political, and economic issues involved in the operation of this technology. It pays particular attention to the worldwide market for meteorological, land, and ocean remote sensing services and summarizes civilian needs of the U.S. Government. The United States is attempting to transfer land remote sensing functions (the Landsat system) to the private sector. This chapter examines the transfer process and explores policy issues related to it. Because several foreign governments are planning to launch remote sensing systems, this chapter summarizes the attributes of these systems and examines the competitive challenge the systems pose for the United States.

Chapter 8 examines foreign and U.S. materials processing research and assesses the potential for the development of marketable products. It also discusses competitive foreign services and equipment. The value of pursuing cooperative MPS programs is discussed in detail, particularly with reference to basic scientific research.

Chapter 9 describes current cooperative and competitive aspects of space science. [t details the role of cooperation in reducing costs and expanding possible activities, and discusses the emergence of competition as a new factor in space science.

Finally, chapter 10 offers a broad examination of the cooperative and competitive policy options presented in the technology chapters and discusses the wider issues posed by U.S. involvement in international civilian space activities. The chapter suggests several options for addressing these issues.