COMMERCIALIZATION OF SPACE

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Abstract

The term "Commercialization of Space" encompasses a broad spectrum of privatization and commercialization activities. These activities can be grouped into five categories: private sector develops from existing technology for private sector use; pure privatization; private sector develops for United States Government use; private sector develops from new technology for private sector use; and, finally, full commercialization. It is important to understand the differences between these categories, especially since the government's role is different for each category. This paper defines the commercialization of space categories and highlights the key issues in each. A description of key NASA actions is included for each category.

Introduction

Promoting space commerce is not a new concept for NASA. Over the past two decades, NASA's policies and actions have provided a climate for the development of commercial communications satellites, commercial upper stages in the Shuttle, as well as numerous other commercial space ventures.

While the concept of private sector investment and involvement in civil space activities is not new, the impetus provided by the Reagan administration to expand significantly the potential for commercial activity in space is new. Further, congressional intent to expand private sector involvement in space has been made clear through legislation.

In his July 4, 1982, National Space Policy Statement, President Reagan set forth the policy of private sector participation in space. He announced that the United States would encourage domestic commercial exploitation of space capabilities, technologies, and systems for national economic benefit. Further, the United States Government will provide a climate conducive to expanded U.S. private sector investment and involvement in civil space activities.

The National Policy on the Commercial Use of Space was released in 1984, along with NASA's Commercial Space Policy. In that same year, the NASA Office of Commercial Programs (OCP) was established in order to provide a focus for the agencywide commercial space program. The mission of the office is to make commerce in space a reality by encouraging private investment in commercial space ventures and by facilitating commercial application and transfer of existing aeronautics and space technologies to United States industry.

On February 11, 1988, President Reagan announced a revised national space policy and a 15-point commercial space initiative which endorses maximum NASA support for space commercialization efforts. The policy provides support and direction for a vigorous U.S. commercial presence in Earth orbit and beyond. The policy confirms the belief that

expanding private sector investment in space by the market-driven commercial sector generates economic benefits for the Nation and supports governmental space sectors with an increasing range of space goods and services.

This paper defines the scope of commercial development of space activity, identifies the issues unique to various commercial markets, and provides a description and status of OCP's activities directed at improving and expanding industrial interest in the commercial development of space.

Commercial Development of Space

The term "Commercialization of Space" encompasses a broad spectrum of privatization and commercialization activities which can be grouped into five categories. It is important to understand the differences between these categories, especially since the government's role is quite different in each.

Category 1 - Private Sector Develops from Existing Technology for Private Sector Use. In this category are activities undertaken by the private sector to develop a new service or product from existing technology for private sector use. An example of this kind of activity is the mature commercial communications satellite industry. This is an industry which NASA helped to develop through support during its early years.

Private sector investment and involvement in space activities began in 1961 when the American Telephone and Telegraph Company approached NASA to request that NASA provide launching services for two experimental communications satellites, named Telstar. These satellites were launched into low-Earth orbit in 1963. During this same period, a NASA program (Syncom) was underway to demonstrate the potential of the geosynchronous orbit for satellite communications. These factors combined later to result in the 1965 launch of the first commercial satellite into the geosynchronous orbit for the International Telecommunications Satellite organization. Since then, satellite communications have blossomed into a sizeable commercial enterprise that has become the envy of other modern growth industries.

A major issue remaining today is how to continue to properly advance technology in this area. OCP is considering several possibilities, including establishing a Center for the Commercial Development of Space (CCDS) focused in this field. CCDS's are non-profit consortia of university, industry, and government working together to conduct space-based, high technology research with commercial potential. NASA currently supports 16 CCDS's by providing partial initial funding to continue for 5 years at which time the CCDS is expected to be self-supporting. These CCDS's are conducting space-related research and development (R&D) over a wide range of areas from materials processing and remote sensing to space power and propulsion.

Category 2 - Pure Privatization. Privatization takes place when the private sector takes over operations and production of technologies and programs previously developed and operated by the government. These are revenue generating activities, such as launch services provided by expendable launch vehicles (ELV) that were previously provided only by the government.

NASA continues to firmly endorse the development of a U.S. private sector launch capability. NASA's role in the facilitation of private sector operations of ELV's is in identifying the necessary support and determining the means to transition programs to the private sector. Agreements are negotiated to provide assistance, services, and facilities as may be available.

NASA has negotiated a number of commercial ELV agreements. In March 1987, NASA and General Dynamics Corporation signed the first U.S. Government agreement transferring operation of a government-developed ELV to the private sector. Agreements have also been signed with Martin Marietta Corporation for support to their commercial Titan Program, and with Space Services, Incorporated, allowing use of NASA facilities for launch of the privately developed Conestoga launch vehicle. Agreements are also being negotiated with McDonnell Douglas Astronautics Corporation for the Delta launch vehicle, and LTV Aerospace and Defense Company for a commercial Scout Program.

The government is also a customer for commercial launch services. NASA completed a mixed-fleet study in late 1986 which shows a need for more than 30 ELV's prior to 1995 for launching approved and planned NASA missions. This requirement should provide a strong impetus for the new industry.

In May 1987, NASA announced a multiphased implementation plan for fulfilling NASA ELV needs identified in the mixed-fleet study. In Phase I, NASA will procure services noncompetitively to support critical spacecraft launch needs. The missions are mainly scientific missions whose spacecraft are in existence and which, therefore, can be transferred to an ELV with minimum impact. Services for these missions will be procured commercially where the required ELV is commercially available. Launch services for types of ELV's the Department of Defense (DOD) currently has under contract with industry may be acquired through DOD.

Beyond Phase I, NASA intends to procure launch services competitively from the private sector whenever they are available on a commercial basis. NASA plans to contract with industry for multiyear service contracts for each class of ELV requirement.

Launch services for specific missions will be ordered on an annual basis as new programs are approved and funded.

Category 3 - Private Sector Develops for United States Government Use. Another key area in the commercialization spectrum deals with activities in which the private sector develops space systems and capabilities for the United States Government as the primary market. An example of this kind of activity is the development of the solid propellant upper stage called Transfer Orbit Stage (TOS) by the Orbital Sciences Corporation (OSC).

TOS was developed by the OSC at a time when NASA was considering the development of the stage for itself. It was developed under a cooperative agreement with NASA. OSC agreed to develop the stage with private funds and NASA agreed to provide technical monitoring of the TOS development and to not develop a competing upper stage. TOS was originally planned for use on the Shuttle, but can be flown on the Titan.

The key issues in this category include identification of commercial opportunities, maintaining consistent government policies, and the need to reform cumbersome procurement practices. Criteria must be developed to determine when the government should purchase privately developed services and space systems rather than developing infrastructure and capabilities through conventional contracting methods.

OCP is developing a Commercial Space Infrastructure Policy which establishes the criteria by which proposals for development of commercial infrastructure, including those for Space Station, will be evaluated. Interim policy guidelines and a NASA Management Instruction have been developed. Additionally, a financial analysis capability is being developed to help support government decision-making. A list of candidate projects for commercialization is also being developed, offering the private sector new opportunities to provide space-related systems and services.

Category 4 - Private Sector Develops from New Technology for Private Sector Use. This is a quite different aspect of commercial space which involves the development of new technology by the private sector leading to the provision of new goods and services for commercial markets. These are embryonic enterprises that can be expected to require a development period of 5 or more years. It is this category of activities which holds the greatest potential for economic payoffs to the Nation's economy; therefore, it is vitally important that the government provide appropriate incentives and support.

The key issues associated with these activities include the high cost of accessing space, the long lead times associated with development and investment payback, and the level of risk. Also at issue is the availability of consistent, assured space transportation and a flexible pricing policy. And, like other areas of commercial development, issues relating to insurance and foreign competition pose difficult problems.

NASA has developed a significant number of innovative working agreements to minimize risks and give private firms access to government facilities and other capabilities. These agreements are each

designed to meet requirements of different commercial ventures. The Joint Endeavor Agreement (JEA) and other types of agreements between NASA and the private sector are the instruments through which NASA attempts to mitigate the private sector's extraordinary upfront technical and financial risks associated with these capital investment projects. For example, under a JEA, there is no exchange of funds. Private industry funds experiments and the government provides the transportation and other services.

An example of this type of agreement is the JEA with Boeing Aerospace Company. Boeing's objective is to grow larger, more perfect crystals that could provide significant advances in semiconductor and optical systems technology. The Boeing experiments involve manned operation of a chemical vapor transport furnace aboard the Shuttle. Superior crystals can be formed by vaporizing a material, combining it with a second vapor, and cooling/solidifying the compound. Under the JEA, Boeing will provide the furnaces and other equipment, fund the experiments, and process some NASA samples on each flight. NASA will integrate the experiment packages into the Orbiter, provide some equipment, space for the furnaces, and crew support for operating them.

Another type of agreement, the Space Systems Development Agreement (SSDA), has attracted significant private sector interest. A deferred payment provision for launch services, which can have many variations, is the primary characteristic of the SSDA. SSDA's are offered to eligible customers who are in the late development stage of R&D but who intend to make revenue from the launch. The fly-now, pay-later aspect of these agreements helps the customer's cash flow problem while allowing NASA eventual recovery of costs. To be eligible for an SSDA, the company must submit a business plan acceptable to NASA which demonstrates a reasonable expectation of launch charge payment. The project must be for the first flight(s) of a new industry with significant national economic or social benefit.

In August 1988, NASA and SPACEHAB, Incorporated, signed an SSDA with deferred payback provisions. SPACEHAB is a commercially developed and manufactured pressurized metal cylinder which fits in the Shuttle payload bay and connects to the crew compartment through the Orbiter airlock. Commercial ventures and sponsored research requiring mantended access to the environment of space will be the primary target market for this venture.

The President's initiative concerning SPACEHAB is for NASA to make best efforts to launch it within the payload bay in the early 1990's. NASA has manifested SPACEHAB on flights STS-51 (June 10, 1991), STS-65 (October 15, 1992), and STS-75 (July 29, 1993).

Another area which warrants significant attention is the negotiations process. During business dealings with the commercial space industry, a recurring concern is expressed. The process by which companies negotiate formal agreements with NASA for cooperative space activities needs to be simplified. OCP is conducting studies of the agreement process and will recommend streamlining changes by the end of the year.

One element of this initiative is the establishment and use of a committee of NASA officials to approve or deny requests for cooperative agreements. In the

past, agreements were sent in series through the appropriate NASA offices, a process which can be time-consuming and nonproductive. A system which provides for offices' representatives to perform simultaneous review of agreements is one method proposed to greatly speed the process.

NASA will also assume greater responsibility for judging the merits of commercial proposals. When screening procedures are established and published, industry will be able to make better proposals which can be processed quicker. NASA will also assign flight priority to commercial payloads based on their relative merit to ensure that the taxpayers' resources are invested as judiciously as possible.

OCP is also developing a flight plan to meet the anticipated needs of industry. OCP has been allocated 31 percent of the secondary payload space on non-DOD flights for commercial use. It is important to ensure that this space is used judiciously, and is of optimal benefit to industry. In order to do this, development of a plan to manage and optimize the space allocated to commercial secondary payloads aboard the Space Shuttle, and guidelines for users that could enhance their chances for flight opportunities, is critical.

Internal OCP capabilities have been strengthened in the areas of manifest planning, analytical and physical integration, and systems engineering and analysis. As a further step in planning, a comprehensive flight requirements plan which will support industrial needs through the 1990's has been created.

Development of a new pricing policy for commercial customers' use of government transportation and on-orbit services is critical. Business firms must have a pricing policy to calculate bottom-line costs to determine whether or not they can participate in commercial space activities. It is also necessary to insure that government-offered services do not preclude or compete against commercial sector initiatives. This balanced approach will serve to maximize the opportunities for U.S. private sector commercial development of space and international competition.

There have been discussions of increasing the price of Shuttle transportation to equal "full cost." Given the increases in cost per flight which are sure to accompany manifest reductions anticipated over the next few years, a price based on full cost will certainly be prohibitive to emerging American industry. A pricing policy which will not discourage all but the traditional aerospace giants from getting involved in commercial space is essential. New, creative approaches are being investigated in order that the results are broad, flexible policies which will accommodate a spectrum of industries.

NASA research is a key stimulant to commercial ventures. Through an increasing emphasis on micro-gravity research in NASA's science program, industry will be provided the benefit of new discoveries which may have commercial application. One of the most significant activities which has been undertaken in this area is the creation of 16 CCDS's. These Centers combine the rich talents of American universities with corporate interest and resources to focus on research leading to new commercial space opportunities. To date, 119 companies and 32 universities have become affiliated with CCDS's.

NASA is very proud of the research being conducted under the program. In late 1986, two researchers associated with two CCDS's announced a superconductivity breakthrough. In conjunction with research on the use of the vacuum of space for producing semiconductor materials, Dr. Paul Chu, of the University of Houston (Texas) CCDS and a former student, and Dr. Mau Wu, of the University of Alabama, Huntsville (Alabama) CCDS, successfully raised the temperature at which material becomes superconductive to as high as 95 kelvin (-288.69 degrees Fahrenheit). The significance of the breakthrough is that the higher temperature enables the use of liquid nitrogen as a coolant, replacing the more costly helium required at temperatures below 77 kelvin (-321.09 degrees Fahrenheit).

In early 1988, superconductive research took another leap when Dr. Chu reported a new material which is superconducting at 115 kelvin (-252.7 degrees Fahrenheit). This new material, while still ceramic, does not contain rare Earth elements. The less expensive composition will reduce potential applications costs even further. A potential space application is further microminiaturization of components which would result in more efficient systems, weighing less, requiring less power, and having less need for heat rejection.

Category 5 - Full Commercialization. In full commercialization, space finally becomes "just another place in which to do business." At this point, companies engage in commercial activities which are extensions of what they do here on Earth. It must be noted that without Space Station Freedom, commercial activities will not reach full commercialization. Space Station Freedom is essential to provide the critical mass of in-orbit infrastructure needed to support and foster commercial enterprises.

Two key issues in this category are defining commercialization goals for the Nation, and mapping out a strategic plan to get there. The development of a competitive space industry requires that private firms be fully involved in U.S. space activities. NASA must form a partnership with business entities to understand the needs of industry, and to structure approaches for optimal results.

To this end, NASA announced the establishment of the Commercial Programs Advisory Council (CPAC) on February 22, 1988. The new group is a subcommittee of the NASA Advisory Council and functions within NASA's formal advisory committee structure with emphasis on the commercial use of space.

CPAC is chaired by Mr. Edward Donley, former Chairman and Chief Executive Officer and current Chairman of the Executive Committee of the Board of Directors, Air Products and Chemicals, Incorporated. He also served from 1986 to 1988 as Chairman of the Business Higher Education Forum of the American Council on Education which published, during that period, a report entitled "Space: America's New Competitive Frontier." Mr. Donley has an extensive knowledge of business and understanding of the global competitive challenge that the United States faces.

Membership on CPAC consists of representatives from large and small research and production firms, venture capital firms, banking institutions, business management firms, and academic institutions with strong commercial research and product development ties.

Through the NASA Advisory Council, the new group will advise NASA on current and proposed program elements aimed at fostering the commercial development of space. Areas which will be considered include: research priorities from the viewpoint of potential commercial applications; research data base structure and accessibility for optimum industry use; research facilities and hardware that would most effectively stimulate commercial space endeavors; and, NASA/industry arrangements and agreements that enhance national policy objectives.

Commercial space program planning, unlike most NASA program planning, requires significant participation by industry, academia, and other government entities involved in the commercial development of space. OCP is developing a comprehensive long-range strategic plan, extending over the next 25 years, which is based primarily on the views of a broad cross-section of these groups.

Throughout the history of our country, some of the most innovative and creative ideas have come from small business entrepreneurs. In its current competitive position, the U.S. cannot afford to lose this creative force. NASA is working on ways of reaching the small business community and channeling their ideas into actual accomplishments. The challenge is how to reach small businesses, how to involve them, and how to sustain momentum. An approach of NASA is to use existing program structures to reach out to the small firms for ideas with commercial potential and guide them through the development phase. The Small Business Innovation Research (SBIR) Program is being used as a "bridge" into the CCDS's, the JEA process, and, finally, space flight. The SBIR Program will identify ideas with commercial potential, support them through the Phase I and Phase II development phases, and sustain the projects through the CCDS Program, cooperative agreements, and other appropriate programs.

Summary

NASA and other government agency involvement is a common thread across the spectrum of space commercialization activities. In any space commercialization or privatization activity, NASA currently plays one or more integral roles: the customer, the seller, or the owner of required assets.

NASA, through OCP, has developed an infrastructure to promote the commercial development of space. Private industrial research is supported through seed-funding CCDS's and facilitating use of NASA ground facilities. OCP then works with companies, if they are successful, to negotiate cooperative agreements. In the test marketing phase, NASA can support industry through such methods as deferred payment on launches. Finally, NASA will ultimately support commercialization by use of Space Station Freedom.

The evolving NASA program for the commercial development of space is conceptually based on a proven one which has been used successfully by NASA to accomplish the establishment of the communications satellite industry and has maintained the United States aeronautics industry in a position of world leadership for over 40 years. That program is a partnership between government, industry, and the university community with each doing what it does best.

Clearly, industry is still interested in space commerce. But they need increased access to space, increased time to conduct research in space, and increased time to prove concepts and technology. Through these and other initiatives, NASA is exploring ways to allow industry to have this increased access to space.