Contract NASW-3775

January 20, 1984

SPACE STATION COMMERCIAL USER DEVELOPMENT

National Aeronautics and Space Administration
Space Station Task Force
Washington, D.C.

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January 20, 1984
Job No. 09019-065-001

National Aeronautics and Space Administration
Space Station Task Force, Code MFA-13
Washington D.C. 20546

Attention: Mr. Richard Anglin

Subject: Report on Space Station Commercial User Development (NASA Contract NASW-3775)

Dear Mr. Anglin:

Booz, Allen and Hamilton is pleased to submit our report on Space Station Commercial User Development.

We have been pleased with the response we have observed from the potential space station users whom we have identified thus far. Several of these users are beginning to consider the nature of possible agreements into which they might enter with the Agency, and others show signs of similar development in the future.

We believe that NASA should continue to support the development of these and other as-yet unidentified users, and that the initiation of a space station program would be the single most significant indication of the government's commitment to space commercialization. Such a step would send a clear message to American industry that their interests in space-based activities would be supported by a sufficient level of space infrastructure, provided initially by the government. We believe that this would set off a surge of interest, and at the appropriate time, investment, on the part of the private sector and lead to the development of a significant number of additional commercial space ventures.

As we have indicated in our analysis of the intermediary function in Task 3, we believe that NASA should now give consideration to the early establishment of a single intermediary for a space station program. This is the most efficient means for NASA to conduct its user development activities. In our judgement, implementation of the concept should begin as soon as a program start is approved.

We appreciate the opportunity to work with NASA in developing the Space Station Program and the provisions for commercial activities which are to be part of it. We look forward to continuing this and other work for NASA and the Space Station Program in the future.

Sincerely yours,

Peter M. Stark

BOOZ, ALLEN & HAMILTON Inc.

Peter M. Stark
Program Manager

Approved:

Peter Wright Wood

Peter Wright Wood
Senior Vice President

PWW/dkk

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PREFACE

This report describes the Space Station Commercial User Development Study carried out by Booz, Allen and Hamilton Inc. under NASA Contract NASW-3775 from April, 1983 through January, 1984.

The study was divided into three tasks. Task 1 was entitled Commercial User Development Plan, and required the preparation and submission (within the first 45 days of the contract) of a plan for carrying out commercial user development, that is, the development of interest on the part of non-aerospace firms in identifying and starting to plan concepts for commercial applications for the proposed civil manned space station. It then required that the plan be carried out for the remainder of the contract period of performance, and this has been done, with encouraging results. To date Booz, Allen has contacted approximately 37 potential space station users, of which five are presently considered particularly good prospects and are being given high priority for continued development; another 11 require further assistance to define their interests. Because of the preliminary nature of the concepts which users are considering, and the proprietary information which is often involved, NASA has permitted Booz, Allen to confine its reporting of company identities to anonymous descriptions, such as "Large Chemical Company." The actual names will only be revealed to selected NASA personnel, when necessary to develop cooperation or agreements with NASA.

Task 2 was entitled Space Station Commercial Scenarios, and required that Booz, Allen translate the requirements of the missions under consideration by the users into the space station capabilities which would be necessary to support them. Since NASA had developed a data base of missions from the user missions identified during the Space Station Needs, Attributes, and Architectural Options (SSNAAO) studies completed in April, 1983, that data base was being used as the requirements against which to design the space station. Accordingly, NASA directed Booz, Allen by letter to review and revise the commercial mission portion of that data base under Task 2 to reflect Booz, Allen's work with potential commercial users. The changes and additions to that data base are presented in the second section of this report.

Task 3 was entitled Space Station User Development, and required that Booz, Allen analyze the various ways that NASA could use a commercial firm as an intermediary between NASA and the private sector in helping to develop commercial users for

the space station. Booz, Allen analyzed this question in terms of the different phases through which the commercial space market will evolve, and developed an approach to using an intermediary which changes to fit the evolving needs of the market. Under this approach, NASA funding for an intermediary will be incrementally reduced as the market becomes capable of providing or supporting the intermediary's functions. This is consistent with NASA's desire to assist the private sector in understanding and developing commercial uses of space in the early, immature space market, but yet to reduce the Agency's financial support and rely on the dynamics of the free enterprise marketplace as the market matures.

Booz, Allen recommends that NASA evaluate this approach to providing the services of an intermediary for developing commercial users of the space station and begin to implement the selected approach as soon as a program start has been approved. This is necessary if commercial firms are to be ready to make use of the space station when it becomes available, and to ensure that the United States fully exploits the attributes of earth-orbit space, and takes leadership in the world community of space-faring nations in the development of these commercial opportunities.

Booz, Allen & Hamilton is grateful to the Space Station Task Force and to its Commercial Working Group for their cooperation and guidance throughout this effort. The excellent technical support provided by McDonnell Douglas Astronautics under subcontract to Booz, Allen is also acknowledged.

I. TASK 1: COMMERCIAL USER DEVELOPMENT PLAN

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This task consisted of preparing, submitting, and carrying out a Commercial User Development Plan. The plan was submitted and approved on June 7, 1983, and is summarized in Exhibit 1. Since then, the plan has been executed in dealing with a number of potential commercial users. A prioritized list of these potential users has been developed and is continuously updated to reflect new developments related to ongoing user contacts as well as the emergence of new potential users.

Thus far user development efforts have resulted in the development of a number of candidate commercial missions which could have application to a space station. A total of 29 face-to-face meetings with potential users and another 16 with NASA personnel, as well as extensive correspondence and teleconferencing, have been devoted to the development of the five highest priority users. In addition, contact is being maintained with 11 other firms which have expressed clear interest in space-based work. A total of 37 firms have been contacted as part of this user development effort, and numerous other firms have initiated contact themselves to gain information about commercial space opportunities and NASA's user development activities.

In addition, Booz, Allen has conducted an active public awareness program in order to disseminate information about NASA's interest in developing commercial activities in space. A summary of these activities is provided in Exhibit I-2.

1. LEADING USER PROSPECTS

This section summarizes the five leading user prospects developed under this plan and the key issues associated with developing these users. The following section addresses wider issues related to commercial user development which have been identified in the course of this work.

(1) Small Private Company:

A small private company is interested in testing the effects of microgravity on a proprietary separation process. This process could potentially be applied to space station production of biological and inorganic materials. The firm is chiefly interested in KC-135 flights at this time but it is also examining the possibility of experiments involving space flight.

EXHIBIT I-1

I. USER DEVELOPMENT. . .

OVERALL USER DEVELOPMENT PLAN STEPS

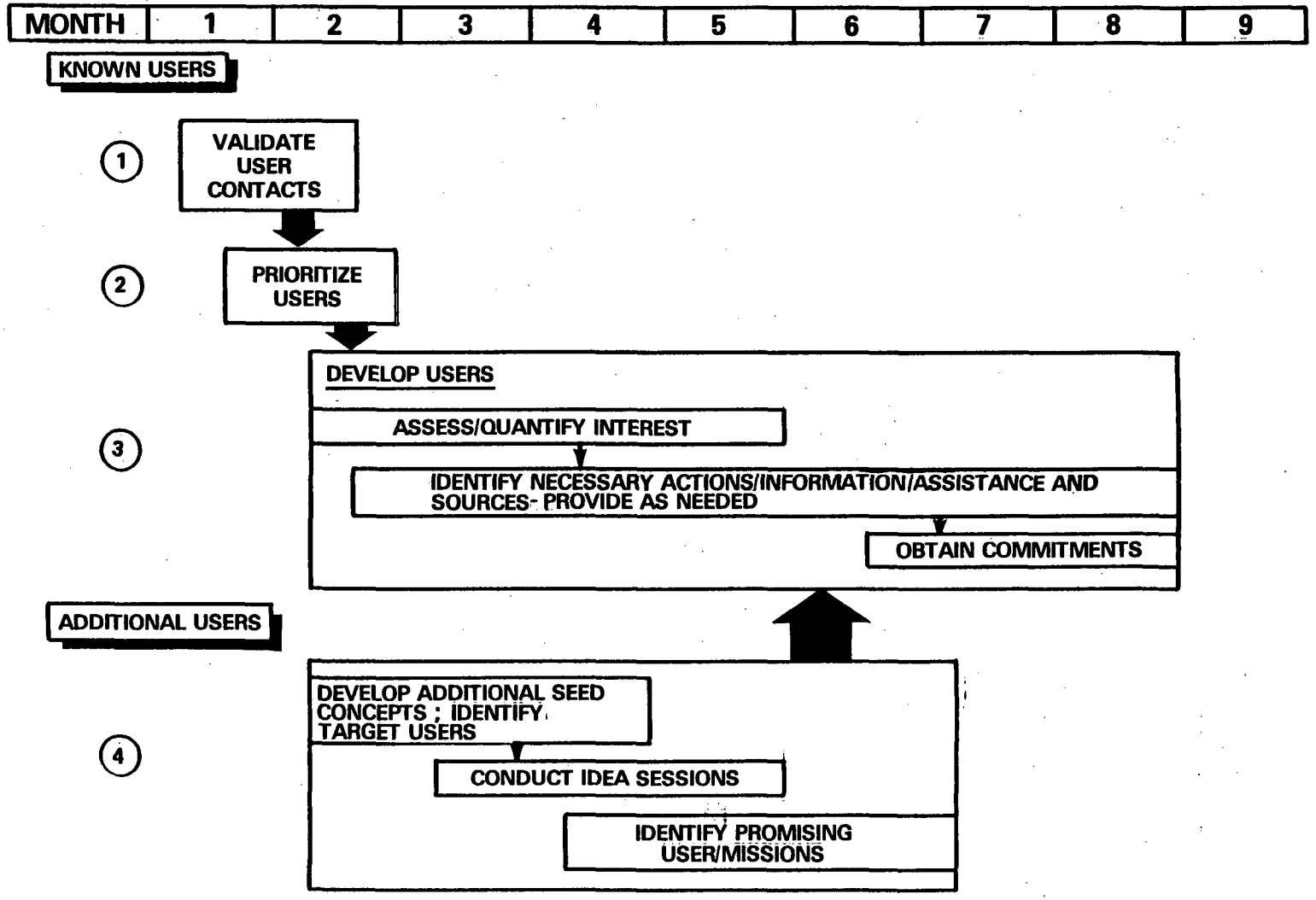

EXHIBIT I-2

Summary of Booz, Allen Awareness Program Activities
(April 1983 - January 1984)

- Dr. Myron Weinberg, special consultant to Booz, Allen, participated in a panel discussion of space stations at the Aviation/Space Writers Association meeting, and his comments were reported in the Aerospace Daily of April 15, 1983

- Booz, Allen held a press conference on April 19, and as a result articles appeared in the Aerospace Daily (April 22), Chemical and Engineering News (May 2), Aviation Week and Space Technology (May 9), and Inside R&D (May 11). The C&E News article resulted in three calls from interested readers, two of which have turned into potential users. In addition, this press conference and a previous one in October were the stimulus for the Business Week cover story "A Return to Space" of June 20, for which Booz, Allen provided assistance

- Peter Wood spoke on the subject of commercial missions for a space station at the Corporate Principals breakfast of the AIAA Annual Meeting in Long Beach, CA on May 11

- Booz, Allen met with the editor of Space Business News prior to its initial publication to assist them in developing their understanding of the developing space market

- Peter Wood and Dr. Weinberg were interviewed by Dun's Business Month for publication in a future issue

- The Chairman of the Board of Booz, Allen, James B. Farley, was appointed to the Office of Technology Assessment's Space Station Advisory Committee, and participated in that group's evaluation of space station concepts and alternatives

- Dr. Weinberg spoke to the NASA/ASEE 1983 Summer Program on Autonomy and the Human Element in Space at Stanford University on July 1, and Peter Wood was briefed on the conclusion of this program on August 22

- Peter Wood and Dr. Weinberg co-authored a paper on commercial user concerns for the AIAA//NASA Space Station Symposium on July 18-20

EXHIBIT I-2 (Continued)

- Dr. Weinberg presented a talk on the commercial development of space to the Congressional Staff Space Group on July 14, and has been invited to give an expanded version of the same talk to the Congressional Space Caucus (composed of over 129 members of Congress)

- Peter Wood and Dr. Weinberg testified before the House Subcommittee on Space Science and Applications on August 2. Coverage of this testimony was provided in Aviation Week and Space Technology (August 8), as well as in Space Business News and Defense Daily

- Dr. Weinberg presented a talk at the American Astronautical Society's Annual Meeting in Colorado Springs on October 3

- Peter Wood visited Marshall Space Flight Center on October 19 and addressed senior Center management on Booz, Allen's user development activities and a number of user development and commercialization issues

- Dr. Weinberg drafted an editorial for General James Abrahamson, NASA Associate Administrator for the Office of Space Flight, which appeared in the October issue of Pharmaceutical Technology magazine

- Peter Wood testified before the Senate Subcommittee on Science, Technology, and Space at its hearings on civilian space station development on November 15

- Dr. Weinberg spoke to a conference of the American Society of Mechanical Engineers in Boston on November 17

- Peter Wood testified before the Senate Subcommittee on Science, Technology, and Space at its hearings on Industry, University, and Government Cooperation in Huntsville, AL on December 7, 1983, and discussed the space station and its proposed commercial laboratory

- Peter Wood and Dr. Weinberg were interviewed by Space Business News on the subjects of space commercialization in general and Booz, Allen's user development efforts in particular. The interview appeared in the January 2 and 16, 1984 issues.

- Peter Wood was interviewed by Space Calendar on January 16

This user is concerned about not divulging too much information about its proprietary process. A key challenge to NASA is to enable flight testing of this process without requiring excessive documentation about the process itself.

A more basic issue associated with this user is NASA's need to respond quickly to the user's requests and queries in order to capitalize on the current high level of interest within the firm. Small entrepreneurial firms are not well suited to prolonged bureaucratic procedures, and their interest is liable to shift if NASA is unable to respond to the needs of the user at the critical stage of experiment definition. Responsiveness should include a willingness on NASA's part to assist with data analysis under the terms of a cooperative agreement in order to minimize the overall scale of the venture as perceived by the user. This assistance could be part of a quid pro quo which would include, on the user's part, a willingness to run NASA samples on its apparatus.

(2) Large Chemical Company

A large chemical company is interested in a proprietary experiment to test the effects of microgravity on a chemical reaction. The STS office has expressed interest in flying the experiment on Shuttle, possibly under the terms of a JEA drafted expressly for research. McDonnell Douglas, under subcontract to Booz, Allen, is developing a design concept intended to minimize cost, possibly by enabling the experiment to be run on the Shuttle mid-deck. Cost minimization is important to this particular industrial researcher (as it would be to most others) because the proposed space experiment represents only a small part of his overall research program.

The key issues for this user relate to confidentiality and the scale of the experiment. The process to be tested is highly proprietary, and confidentiality with respect to both the process and the identity of the firm must be preserved. As NASA becomes more involved in the planning, this could present a challenge to the Agency. Secondly, NASA is challenged to enable the research to be done at a minimum cost (dollars and manpower) to the firm. Developing this user represents an excellent test of NASA's plans for making space easily accessible to researchers in the private sector.

(3) Industry Association

An industry association is interested in the potential application of remote sensing technology to monitoring

ground-based phenomena of concern to the industry. Remote sensing is likely to be a major mission supported by a space station. Portions of the current concept may not be technically feasible, but it presents the possibility for NASA-industry cooperation in joint research and should be pursued in earnest.

A meeting held in January between NASA technical experts and an industry task force raised the possibility of using industry needs as a focus for research in remote sensing technology. Both parties agreed to exchange information about industry needs and remote sensing capabilities. The challenge to NASA is to effectively use this conduit as a vehicle for expanding relations with this non-aerospace industry.

(4) Bio/Pharmaceuticals Company

A major bio/pharmaceuticals manufacturer is interested in testing separations in microgravity using the McDonnell Douglas (MDAC) electrophoresis apparatus. The experiments could eventually lead to additional space-based production of pharmaceuticals beyond those planned by the MDAC/Johnson and Johnson partnership.

The key challenge with this user is to coordinate discussions with MDAC. If successful, this user could set a precedent for further user agreements with owner/operators of space facilities and equipment other than NASA.

(5) Proposed Commercial Laboratory Joint Venture

A number of major private sector companies, including investment banks, venture capital companies, commercial laboratory operators, and other technically based firms have expressed interest in participating in a venture to provide the laboratory module(s) for NASA's proposed space station and operating it on a commercial basis. As currently conceived, a group of such private companies would acquire, outfit, and activate the laboratory module(s), and own and operate it on a fee-for-service basis, providing laboratory services to commercial firms, universities, and government agencies, including NASA. NASA would charge the laboratory for the services provided by the space station, such as power, common supplies, and living accommodations for the laboratory crew. The laboratory would also be charged for the transportation of supplies and personnel back and forth from the ground via the space shuttle.

The objective of this venture would be to provide a commercially operated space research and test facility for

use by both private and public organizations. It would also enable private sector participation in the construction of a U.S. space station, and contribute to assuring U.S. leadership in the commercialization of space.

There are a number of major issues involved with a concept of this type. They include the terms under which NASA would consider permitting private ownership and operation of a major space station component, European interest in providing a similar component of the space station and NASA's policies with respect to this possibility, the basis for charging users for services received from the space station, and the types of support that NASA might be willing to provide to assist private industry in carrying out such a venture.

An initial meeting of six of the interested companies was held in mid-January. Among the major concerns expressed in the meeting was the question of the timing of the investment required with respect to when the first return would be available. With a projected space station availability of 1992 (or later if development were to fall behind NASA's schedule, which was considered optimistic by some firms), it would be a long time before any significant income would become available from laboratory operations. This could make the return on investment unattractive unless major expenditures are not required before the late 1980's.

Despite these concerns, the attendees re-affirmed their interest in exploring the concept, and identified a number of necessary next steps. These include a comprehensive market analysis, discussions with NASA concerning the above issues and others, the formation of an organization with responsibility for developing the concept, the identification of other interested participants with relevant functions or expertise, and the development of a business plan for the venture. Interest was expressed in identifying ways in which NASA might be able to assist interested parties in taking some of these next steps. Booz, Allen will be discussing this with the Space Station Task Force (SSTF) shortly. Most of those in attendance indicated a willingness to take part in periodic meetings to develop the concept further, and arrangements to make this possible are being developed.

Consistent with the nature of the contract with NASA, Booz, Allen's role in this process is that of coordination and guidance, and not that of a potential participant. Booz, Allen would not become a party to any resulting venture, but would continue to function as an intermediary between NASA and any group which may emerge.

2. LESSONS LEARNED

In the course of these user development activities, the approach first presented in the Commercial User Development Plan has been refined. In particular, the following important lessons have been learned:

- Each user is unique. Every company or individual interested in working in space has a different set of needs and concerns, and unless they are identified and properly addressed, NASA will fail in its attempts to develop them into real users of space

- A NASA Headquarters advocate should be assigned to each prospective user when commitment of interest is obtained. Someone within NASA must be responsible for making sure that proposals flow through internal channels, that questions are answered promptly, that sources of technical expertise within the Agency are identified and consulted when necessary, and that the type of arrangements which NASA is willing to make with the user are properly communicated and understood

- NASA and its intermediary must address the specific needs and concerns of each potential user. These needs include protecting proprietary data, promptly providing answers and taking actions in order to capitalize on current enthusiasm, helping mid-level researchers develop inexpensive means of carrying out research in space so as to facilitate company approval processes, and stimulating user interest by focusing on current problems and identifying spacebased solutions

- An intermediary is useful in both simplifying and carrying out NASA's user development activities. It removes from NASA's limited staff, the burden of carrying on the day-to-day interaction with each individual user and at the same time brings to bear personnel with a better understanding of the industry segments of interest, the user's technology, and the business aspects of his situation. This permits NASA personnel to deal only with the portion of the user interface which needs to involve NASA, and lets the intermediary distill the key problems and issues to a point where NASA can deal with them quickly and in a focused manner.

These lessons learned have been incorporated into the user development effort, and Booz, Allen has continuously worked with members of the SSTF to make their interface with each user and their associated issues as simple and productive as possible.

II. TASK 2: SPACE STATION COMMERCIAL SCENARIOS

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As requested in the NASA letter dated September 12, 1983, the September 1, 1983 editions of the Space Station Mission Model and the Langley Data Base Commercial Mission Printouts have been reviewed. Based on Booz, Allen's work with potential commercial users to date, several adjustments should be made to these documents. These adjustments, along with supporting rationale, are provided in the following sections.

1. SPACE STATION MISSION MODEL

In the Commercial Missions portion of the Integrated Time Phased Mission Set, beginning on page 2-4, the names of some missions should be changed as follows:

- Mission COM 1206* from IEF Production Units to Alternative Separation Production Units. Iso-Electric Focusing is only one of a number of alternative (to electrophoresis) separation techniques, and since others are under consideration, this mission should reflect the possibility that any one of them may come about, not just IEF

- Missions COM 1208, 1211, and 1213 from DSCG, VCG, and Solution Crystal Growth Production Units to Crystal Growth #1, #2, and #3 Production Units, respectively. Again, since there are several different types of crystal growth processes under consideration, it would be more appropriate to indicate that some type of crystal growth units are being provided for rather than picking specific ones this far in advance. More accurate descriptions can be substituted as users progress in their development of specific processes

- Mission COM 1213 from Optical Fiber Production Units to Undercooled Liquid Production Units. Optical fibers are only one type of undercooled liquid, many of which could conceivably be produced in space. Again, the more generic name is more appropriate at this time

- Mission COM 1229 from Iridium Crucible Production Units to High Purity Metal Production Units. The

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* Mission numbers from the Langley Data Base, in which the first two digits denote the mission's discipline (12 = materials processing), and the last 2 represent a subjective prioritization within the 37 commercial missions.

user who is considering this particular mission has reduced his priority on this mission in favor of several others which appear more promising at this time. While he still believes there is a benefit to be derived from producing iridium crucibles in space, purification of metals in general (under consideration by this user and another) would be a more accurate way to describe these units at this time.

2. LANGLEY DATA BASE COMMERCIAL MISSION PRINTOUTS

Based on Booz, Allen's current understanding of these missions or the category of missions which they represent, a number of parameters should be filled in or changed as follows:

- Mission COM 1201 Materials Processing Lab:

  - Data/Communications should be Realtime, not Offline, since the lab must offer on site Analysis and adjustment to experimenters

  - Launch Mass of 7050 kg should be questioned, since it seems to be less than Spacelab and it is not clear why

  - Minimum G should be 10^{-5} instead of 10^{-4} to meet laboratory needs

  - Crew size should be 4, with 2 crewmen per 12 hour shift for continuous operation

  - Skill hours per day should be 12 instead of 10, as above

  - Service manhours of 750 would appear to be an error if the term refers to the number of hours per service visit; in that case they might be between 10 and 20

  - Under Special Considerations, there does not appear to be any reference in the sheets for the footnote.

- Mission COM 1202 EOS Production Units:

  - Status should be Planned as opposed to Candidate, given the degree of development of EOS and MDAC's stated interest in using a space station

  - Importance of Space Station should be 7 or 8, again given MDAC's statements as to the value of

a space station to their levels of production and new product development

- Launch Mass of 7500 kg should be questioned, since it shows as being heavier than the lab module, which itself has been questioned for other reasons*

- Minimum G required should probably be 10^{-5}.*

. Mission COM 1203 ECG production Units:

- Status should probably be Candidate instead of Planned, given the degree of development to date by MRA when compared to that of MDAC

- Minimum G listed as 10^{-6} is not thought to be feasible on the space station, at least as presently understood. 10^{-5} would probably be more accurate and should be acceptable.

. Mission COM 1206 IEF Production Units (relabel as Alternative Separation Production Units):

- Importance of Space Station should only be 7 or 8, since it may be feasible to conduct some such production on free-flying platforms

- Description should exclude continuous flow electrophoresis, since that is covered by a distinct mission; it should also be noted that isoelectric focusing probably cannot accommodate living organisms, and this should be made distinct from stationary column electrophoresis, which can

- Minimum G of 10^{-3} should actually be the maximum, and the minimum should be 10^{-5}.

. Mission COM 1208 DSCG Production Units (relabel as Crystal Growth #1 Production Units):

- Status should probably be considered an Opportunity, since although NASA research indicates the process holds promise, there does not appear to be any commercial user currently pursuing this process

*The SSTF should ultimately check each of these with MDAC

- Minimum G should probably be 10^{-5} as a level feasible on a space station

- Service interval of 11 days would appear to be inconsistent with the shuttle revisit internal baselined at 90 days.

- Status should be Opportunity, lacking a currently active commercial user

- Importance of Space Station of 10 does not fit with description of the units sharing a free-flying platform; one or the other should be corrected

- Operating power level of 2000 watts seems low; power requirements will probably be closer to 5000 watts

- The EVA every 90 days does not seem to match the use of two crewmen for 8 hours per day each, since Booz, Allen understands the intent of the crew hours per day parameter to be aimed at sizing station crew time

. Mission COM 1229 Iridium Crucible Production Units (relabel as Ultra Pure Metal Production Units):

- Importance of Space Station should be 7 to 8 since man tending is almost certainly required

- Data/Communications should be both Realtime and Offline, with On-board Data Processing required and storage of 5 MBITs

- Minimum G should be 10^{-5}, with a maximum of 10^{-3} permitted for short excursions only

- Crew should be 2, one each on a two shift basis, one hour per shift, to support continuous operations

- The 30 day service interval would be nice, but should reflect whatever is feasible given station schedules

. Mission COM 1230 Biological Process Production Units:

- Importance of Space Station should be 9, due to man tending requirements

- Operating power should be a minimum of 5000 watts, 24 hours per day, continuous operation, due to heating requirements for fluid reactor

- Data/Communications should include both Realtime and Offline, with On-board Data processing required and storage of 5 MBITs

- Launch mass should be more like 7000 kg instead of 10,000, since mission is fairly dense but not high in volume

- Minimum G should be 10^{-5}, as best achievable

- Crew size should be 2, working 4 hours per day (2 hours per man per shift) for continuous operation

- Service interval, as above, should reflect what is achievable with the station, i.e., 90 days if that is what the station will be on.

. Mission COM 1232 Merged Technology - Catalyst Production Units:

- Importance of Space Station should be 8, due to man tending requirements

- Operating power should be 5000 watts for heating

- Data/Communications should be Offline, with On-board Data Processing required and storage of 5 MBITs

- Minimum and maximum G levels should be 10^{-5} and 10^{-3}, respectively

- Crew size should be 2, for 4 hours per day (2 hours per man per shift), no EVA required.

III. TASK 3. SPACE STATION USER DEVELOPMENT

III. TASK 3: SPACE STATION USER DEVELOPMENT

This task directed Booz, Allen to "investigate and provide recommendations on the feasibility, desirability and limitations of utilizing a commercial firm(s) as an intermediary(ies) in developing the commercial utilization of the Space Station." This intermediary would act between NASA and industry to facilitate commercial activities on the space station.

The task was begun by presenting Booz, Allen's understanding of the need for an intermediary; the functions and services associated with such an intermediary were then specified, as well as how it would operate. Following this, the options possible for each of the major characteristics of an intermediary were analyzed. This analysis led to recommended options for each individual characteristic in each phase of market maturity, and these recommendations then led to complete intermediary models for each phase. Finally, the next steps required for establishing a space station intermediary were developed.

1. NEED FOR AN INTERMEDIARY

An intermediary is required to bridge the gap between non-aerospace private industry and NASA. This gap results from NASA's limited experience in dealing with the non-aerospace private sector and the private sector's limited knowledge of NASA organizations and procedures. It is complicated by the private sector perception that NASA and the government are unable to protect proprietary information.

These problems make it difficult for NASA to identify and reach out to potential users who have no knowledge of the space environment. It confuses interested new users who do not know how to approach NASA for information. Also, potential commercial users may be reluctant to share sensitive information with NASA when they are considering a financially risky new venture.

The experience of space station user development thus far has demonstrated the value of an independent third party intermediary in stimulating new users. This analysis examines the specific characteristics which would be desirable for a permanent intermediary and the conditions under which it should operate.

2. GOALS AND ASSUMPTIONS

In order to properly examine the concept of an intermediary and consider how it should operate, it is first necessary to establish just what an intermediary should be expected

to achieve. Considering the undeveloped state of space commercialization and the corresponding absence of candidate space station users, the intermediary should have the following major goals:

- Identifying and stimulating potential new space station users
- Facilitating and assisting in the development of these users, including identifying and working with the appropriate NASA office, and assisting the user in the development of his concept
- Encouraging private sector investment in the commercial use of space and the manned space station, including investments in research, prototype testing in microgravity, and possibly space station modules.

NASA has directed that this analysis be based on several assumptions:

- That there will be a manned space station, developed and owned initially by the federal government
- That this station will include independent private sector activity, and
- That for the purposes of this analysis there will be a commercial intermediary (i.e. non-NASA, non-government).

Consistent with this direction, non-commercial alternatives such as government agencies or government corporations were not examined.

3. KEY QUESTIONS

In order to fully define an intermediary in accordance with the preceeding goals and assumptions, some key questions must be answered. These questions, which form the basis for Booz, Allen's analysis, concern the services provided by the intermediary, the key characteristics of the intermediary and the issues associated with various alternatives for each characteristic, and possible approaches to providing the intermediary's services.

The key questions are:

- What services would the intermediary provide?
- How would the intermediary operate with respect to other NASA user development activities?

- What are the key characteristics of the intermediary and what functional options exist for each characteristic?

- What issues are associated with each characteristic and which options are best over time?

- What are the best approaches to providing intermediary services over time, given the evaluation of characteristics and options?

The following analysis aims to answer these questions and identify the optimal approach to achieving the goals of the intermediary.

4. INTERMEDIARY DEFINITION

The intermediary can be defined by its functions, the services it must provide to successfully perform these functions, and how it must operate to best provide these services.

In order to achieve its goals the intermediary must perform three primary functions:

- It must provide a simplified NASA/industry interface in the early stages of the working relationship, when the participants (NASA and the private sector firm(s)) are still unfamiliar with each other

- It must provide an identifiable and accessible base of operations where potential users can obtain information and guidance about NASA opportunities, but must also have sufficient mobility to reach out to industry in order to stimulate new users

- It must generally encourage NASA/industry interaction and promote private sector commitment to commercialization.

Booz, Allen has identified eight key technical, financial, and managerial services which should be provided by the intermediary in order to properly perform these functions. These services are:

- Identify and attract business interest, and obtain commitments of interest

- Identify and attract sources of investment capital to support specific space station activities, and assist in team building

- Guide and assist users from initial interest through contact and negotiation of agreements with NASA

- Provide access to technical information using an understanding of aerospace industries and of NASA organization and procedures

- Protect proprietary information and overcome reluctance to work with the government by acting as a buffer between potential users and NASA. Protection of proprietary information may require the use of appropriate secrecy agreements between the intermediary and potential commercial users

- Provide NASA with an understanding of business practices and user attitudes and requirements, in order to foster and encourage policies, procedures, and programs that are attractive to users and investors

- Identify the potential for merging technologies of multiple users through an understanding of engineering and technology

- In close cooperation with NASA, conduct an awareness program to broaden the understanding of the application of the attributes of space to commercial activities in space among industry leaders and the general public.

The space station intermediary may be providing the above services in an environment in which numerous NASA offices are concerned with commercial user development. The intermediary should avoid duplication of effort by coordinating with user development activities sponsored by the STS Marketing office, the proposed Office of Space Commerce, the Office of Industry Affairs, and the Office of Space Science and Applications, and NASA Centers where appropriate (e.g., Marshall Space Flight Center). These user development activities must all be coordinated in order to avoid potential users being confused or perhaps even annoyed by repeated solicitations from parties representing NASA; the space station intermediary must cooperate in this coordination effort even though it does not control it.

In addition to identifying the services which the intermediary would provide, NASA asked Booz, Allen to look at the potential restrictions which might limit NASA's ability to use a third party as an intermediary. We have analyzed a variety of such limitations, and have found evidence that not only supports the use of a private sector intermediary, but argues against the use of government for such activities. For instance, OMB Circular A-76 is predicated on the assumption that the private sector can perform functions which are essentially commercial in nature more efficiently than the government. It stipulates that agencies must rely on the private sector for

such services unless the government can provide them at a lower cost; it further defines the methodology to be used for such cost comparisons. Based on this, it would appear that rather than limiting NASA's use of a third party as an intermediary, A-76 would appear to provide a congressionally and administratively sanctioned tool for developing such a function. Also, since A-76 only limits the use of commercial activities in the areas of military readiness, certain Veterans Administration work, and work which can be performed substantially cheaper in-house, there would not appear to be any categorical prohibition on the use of a commercial firm as an intermediary.

With respect to the question of how an intermediary might be compensated if it were employed by the government, a ruling of the Comptroller General has been identified which deals with the use of appropriated versus other sources of funds. 45 Comp Gen 253 (1965) addressed a Small Business Administration (SBA) requirement to pay private brokers or agents for the sale of certain instruments by means of a commission from the sale. The SBA Appropriations Act for 1966 limited the funds which could be used for administrative expenses, and since the sales represented an administrative expense for the SBA, it was concluded that the compensation should come from appropriated funds and not commissions. No similar restrictions on administrative expenses have been identified in either the Space Act or NASA's annual Appropriations Acts which would NASA from using non-appropriated funds to support an intermediary.

Within Booz, Allen's current understanding and use of the contractual instruments between the government and private industry, there are no statutory or regulatory restrictions which would hinder the handling of confidential information or protected data by an intermediary. (For example, see the business restrictions in the Freedom of Information Act, or the NASA Procurement Regulations regarding release of confidential information.) In the same regard, potential conflicts of interest can be readily dealt with through appropriate contractual language. An example of one potential conflict of interest is contained in the Performance Incentives section of the analysis of intermediary characteristics which follows. If NASA were to employ an intermediary which was permitted to take an equity or other form of interest position in one of the ventures it was representing to NASA, that would constitute a conflict of interest since NASA would effectively be paying the intermediary to improve its own position. That would represent the most common or likely form of a conflict of interest with an intermediary which drew any of its funding from NASA, and any NASA contract should be structured to prohibit such activity on the part of the intermediary. This should be true regardless of whether or not the intermediary is involved in negotiating an agreement for its venture. Other potential users would

suspect the motives with respect to their venture of an intermediary which was a party to any ventures.

5. ANALYSIS OF INTERMEDIARY CHARACTERISTICS

The following analysis considers intermediary characteristics in three different phases of space market maturity. In the current phase, or the short term, commercial interest in space processes is limited and there is no space-based production. The middle term begins some time after the private sector perceives there has been a commercial "success" in space; private sector interest will grow and some space-based production may begin. The long term sees more extensive commercial production in space and a mature market for commercial space activities. The need for an intermediary may disappear in the long term, since a mature market may no longer require active stimulation of new commercial users.

Booz, Allen has selected four key characteristics which collectively define an intermediary model. By examining the possible options for each characteristic and selecting the best option for each time phase, an optimal model can be constructed for each phase.

These four key characteristics are:

- Source of funds: Who pays for the intermediary?
- Number of intermediaries: How many independent or associated intermediaries exist at the same time?
- Performance incentives: On what is the intermediary's compensation based and how is it tied to his performance?
- Relationship to NASA: What type of relationship, if any, does the intermediary have with NASA?

For each of the four key characteristics a number of options are possible. Various combinations of these options represent alternative intermediary models. These options are identified in the following paragraphs:

- Source of Funds: Funding can come from either NASA or the private sector. NASA funding could come from either appropriated funds or reimbursements from the STS or space station operations. Private funding could come from space station users or owner/operators, or from associations representing industries interested in stimulating space commercialization. These could be aerospace or non-aerospace industries

- Number of Intermediaries: There could be one or more intermediaries operating independently or linked through prime contractor/subcontractor arrangements

- Performance Incentives: A variety of incentives are possible to motivate optimal performance from the intermediary. Contracts could be constructed as either cost plus fixed fee, or as cost plus some type of performancebased reward. Alternatively, the intermediary could receive only a performance-based fee, or could even participate in user ventures.

- Relationship to NASA: The intermediary could have a contractual or cooperative relationship to NASA or be totally independent. For the purposes of comparison, we also examine the consequences of having an intermediary as a component of NASA (i.e. a NASA office).

The options for each of the four characteristics of the intermediary are analyzed in the following sections. In each case, the options are examined in terms of their suitability for each phase of space market maturity. The options are then compared and a selection for each phase is made.

(1) Source of Funds

The following paragraphs discuss the possible sources of funds for the intermediary and evaluate the pros and cons of each option. Exhibit III-1 shows these options and the associated analysis.

1. NASA -- Appropriated Funds

In this option, the intermediary is supported by appropriated NASA funds. Sufficient appropriated funds for the intermediary could probably be made available in the short and middle terms, based on current projections of NASA budgets. Any major change in NASA budget strategy could jeopardize the availability of funding for the intermediary. Similarly, in the long term, the availability of appropriated funds to support the intermediary depends on NASA's willingness to support the intermediary for a long period, and in a market which may not require one. However, a transition from NASA to private sector funding is possible in the late-middle to long term.

2. NASA -- Reimbursements

In this option the space station intermediary is supported by reimbursements from space station users

EXHIBIT III-1

SOURCE OF FUNDS

CONTINUED →

	NASA (APPROPRIATED)	NASA (REIMBURSEMENTS)	INDUSTRY ASSOCIATION
DESCRIPTION	INTERMEDIARY SUPPORTED BY APPROPRIATED FUNDS	INTERMEDIARY FUNDED BY STS OR SPACE STATION REIMBURSEMENTS	PRIVATE CONTRACTOR(S) FUNDED BY INDUSTRY GROUP ASSOCIATIONS; MANUFACTURING AND AEROSPACE INDUSTRIES MAY SUPPORT DIFFERENT INTERMEDIARIES
DISCUSSION	• SUFFICIENT FUNDS PROBABLY COULD BE AVAILABLE IN SHORT OR MIDDLE TERMS. • LONG TERM FUNDING DEPENDS UPON NASA FUNDING PRIORITIES • TRANSITION TO NON-NASA FUNDING POSSIBLE IN LONG TERM	• SUFFICIENT FUNDS UNLIKELY IN SHORT OR MIDDLE TERMS. • LONG TERM FUNDING DEPENDS UPON NASA FUNDING PRIORITIES. • TRANSITION TO NON-NASA FUNDS IS POSSIBLE IN LONG TERM.	• SUFFICIENT FUNDS UNLIKELY FROM EITHER INDUSTRY IN SHORT-TERM DUE TO LOW PRIVATE SECTOR INTEREST • AEROSPACE INDUSTRY MAY BE MORE WILLING TO COLLECTIVELY SUPPORT INTERMEDIARY IN MIDDLE TERM. • AEROSPACE INDUSTRY-SUPPORTED INTERMED. MAY CONFLICT WITH INTERNATIONAL MARKETING ACTIVITIES OF INDIV. FIRMS. • LONG-TERM FUNDING PROBABLY POSSIBLE FROM EITHER INDUS. • INTERMEDIARY MAY BE "CAPTIVE" OF DOMINANT SUPPORTING GROUP. • FACILITATES ACCESS TO TECHNICAL RESOURCES OF INDUSTRY
CONCLUSIONS	• ATTRACTIVE SHORT TERM OPTION	• POSSIBLE MIDDLE TERM OPTION	• POSSIBLE MIDDLE- TO LONG-TERM OPTION

EXHIBIT III-1

SOURCE OF FUNDS (CONT'D)

	USERS	OWNER/OPERATORS
DESCRIPTION	RECEIVES FEES FOR PROVIDING SERVICES TO COMMERCIAL USERS AND POTENTIAL OWNER/OPERATORS	SUPPORTED BY OWNER/OPERATORS OF SPACE FACILTIES AND SERVICES, TO PERFORM MARKET DEVELOPMENT
DISCUSSION	• SUFFICIENT FUNDS UNLIKELY IN SHORT TERM DUE TO LOW USER INTEREST • POSSIBLE IN LONG TERM • CLEAR BIAS TO FEE-PAYING USER/CLIENT, BUT COMPETING USERS LIKELY TO HAVE DIFFERENT INTERMEDIARIES	• SUFFICIENT FUNDS UNLIKELY IN SHORT TERM DUE TO SMALL NUMBER OF OWNER-OPERATORS • OWNER-OPERATORS COULD COLLECTIVELY SUPPORT AN INTERMEDIARY IN THE MIDDLE TERM TO STIMULATE USER ACTIVITIES, PERHAPS AS A NASA CONDITION FOR PARTICIPATION • NEED FOR AGGRESSIVE MARKET DEVELOPMENT MAY EVENTUALLY DISAPPEAR. OTHER MARKETING-ORIENTED SERVICES COULD BE INTERNALIZED BY PARTICIPANTS. • SOME BIAS MAY BE POSSIBLE TOWARD ACTIVITIES WHICH BENEFIT SUPPORTING FIRMS.
CONCLUSIONS	• POSSIBLE LONG TERM OPTION	• POSSIBLE MIDDLE TO LONG TERM OPTION

or from STS reimbursements. Although space station reimbursements will not be available for intermediary support until the station is closer to operation, STS reimbursements might be applied to the space station intermediary since space station users will be creating new business for the STS. While STS reimbursements are presently somewhat low, they could support the level necessary for an intermediary in the middle term, until the market can reasonably support it or the need disappears.

3. Industry Association

In this option, the intermediary is one or more private contractors funded by industry group associations. The manufacturing industry and the aerospace industry could conceivably support different intermediaries to promote space commercialization among firms in their industries. Due to the current low level of commercial space activity, sufficient funding from any industry association seems unlikely in the short term. In the middle term, the aerospace industry may be willing to collectively support an intermediary to serve in a marketing capacity, similar to a trade association. This intermediary could, however, encounter difficulties if its activities conflict with the marketing activities of individual firms in the supporting association. In the middle to long term, a manufacturing industry association might also be willing to support an intermediary to encourage space manufacture, if such a course is seen as important for the long term health of the industry. In the long term, the intermediary might become a captive of the dominant groups within the supporting associations, neglecting smaller sectors such as services. The industry funding arrangement would, in either case, facilitate the intermediary's access to the technical resources of industry.

4. User Funding

In this option the intermediary is supported by fees for the services it provides to potential users and owner/operators. Sufficient funding to support an intermediary is unlikely in the short term, due to the low interest in the potential-user community. In this option the intermediary is clearly biased to his fee-paying client, but potential users with competing interests would presumably employ different intermediaries.

5. Owner/Operator Funding

In this option the intermediary is supported by owner/operators of space facilities and services to perform market development. Sufficient funding from owner/operators is unlikely in the short term since there are presently only a handful of owner/operators (e.g. owners and operators of free flying platforms, orbital transfer vehicles, launch services, satellite servicing and retrieval, and on-orbit laboratory services). In the middle or long terms, owner/operator funding could sustain an intermediary, and NASA might require contributions to intermediary support as a condition for participation in the space station program. As observed in the case of industry association funding, an owner/operator funded intermediary may be biased toward activities which benefit the owner/operator providing the largest share of support. In the long term, the need for an intermediary to perform market development may disappear as owner/operators perform their own marketing functions internally.

NASA funding will be necessary in the short term due to the initially low level of interest in space activities in the private sector. Use of space station reimbursements are unlikely much before the establishment of the space station, but STS reimbursements could be used to support an intermediary in the middle term due to generation of STS traffic by future space station users. As an individual user develops and gains financial support, it should start to support any intermediary services it requires. Criteria for reduction and eventual cutoff of NASA funding support can be developed as case histories are built. As the market matures, the funding burden could be shifted to the private sector case by case, including users, owner/operators, or industry associations. An industry association-funded intermediary would be analogous to a trade association for marketing.

User-funded intermediaries would be analogous to manufacturers' technical representatives, with competing users employing different intermediaries. Owner/operator-funded intermediaries would be analogous to travel agents, although as the market matures, owner/operators might wish to internalize its functions as part of their marketing effort.

(2) Number of Intermediaries

The following paragraphs present the options for the number of intermediaries and evaluate the pros and cons of

each option. Exhibit III-2 summarizes the issues associated with each option.

1. Single Intermediary

A single intermediary offers a number of advantages in an undeveloped market. A single representative of NASA avoids confusion among potential users about who actually speaks for NASA. It can effectively and directly coordinate and conduct a coherent awareness program to increase understanding of NASA programs. It can also recognize opportunities for merging technologies among potential users. Finally it simplifies the burden of coordination imposed upon NASA in overseeing intermediary activities.

2. Multiple Intermediaries

Multiple intermediaries offer a number of advantages in markets where intermediary functions are better understood and confusion is less of a hazard. Multiple intermediaries might provide more complete coverage than a single intermediary, although a single intermediary might expand its range of coverage through the use of subcontractors with special areas of expertise. However, though there may be some advantages to multiple intermediaries, many disadvantages may arise if they are used, such as duplication of costs for contract management, and marketing and market research. Also, multiple intermediaries run the risk of confusing potential users about who represents NASA and what the agency may be offering. They will also find it difficult to conduct a coherent awareness program or recognize opportunities to merge developing technologies of new users. Multiple intermediaries will also place a large burden on the NASA program office to coordinate contacts which the intermediaries are meant to simplify.

In the short to middle term a single intermediary, or a prime intermediary employing subcontractors, can most effectively organize a coherent and efficient effort to contact and stimulate new users on behalf of NASA. However, as the market matures, multiple intermediaries could develop with multiple sponsors. As users assume the burden of funding, multiple intermediaries will become essential to avoid a conflict of interest for intermediaries with competing clients. Subcontractors in the single-intermediary period are likely candidates to become independent intermediaries in the late-middle or long term.

EXHIBIT III-2

NUMBER OF INTERMEDIARIES

	SINGLE	MULTIPLE
DESCRIPTION	SINGLE OR PRIME INTERMEDIARY	MULTIPLE INTERMEDIARIES OPERATING INDEPENDENTLY OR UNDER SIMILAR CONTRACTS
DISCUSSION	• SINGLE REPRESENTATIVE OF NASA • ABLE TO COORDINATE AND CONDUCT COHERENT AWARENESS PROGRAM • MAY NOT GUARANTEE COMPLETE COVERAGE; MAY BE ALLEVIATED BY USE OF SUBCONTRACTS. • INAPPROPRIATE WHERE INTERMEDIARY BIAS IS A CONCERN, EX. USER FUNDING • INTERMEDIARY MAY ACQUIRE AN ADVANTAGE IN OFFERING POST-INTERMEDIARY SERVICES - MAY BE MITIGATED THROUGH USE OF SUBCONTRACTS	• POTENTIAL FOR MORE COMPLETE COVERAGE. • CONFUSION ARISES FROM MULTIPLE SOLICITATIONS, MULTIPLE REPRESENTATION AND LACK OF "IDENTIFIABLE AND ACCESSIBLE POINT OF CONTACT." • DIFFICULTY CONDUCTING COHERENT AWARENESS PROGRAM • MAY BE UNABLE TO RECOGNIZE OPPORTUNITIES FOR MERGING TECHNOLOGIES • IMPOSES COORDINATION BURDEN ON NASA.
CONCLUSIONS	• PREFERABLE FOR UNDEVELOPED MARKET	• MAY DEVELOP AS MARKET MATURES AND NON-NASA SPONSORSHIP BEGINS

(3) Performance Incentives

The following paragraphs show various incentives which could be used to motivate the performance of an intermediary, and evaluate the pros and cons of each option. Exhibit III-3 summarizes the issues associated with each option.

1. Cost Reimbursement Plus Fixed Fee

A cost plus fixed fee contract offers limited incentive for a contractor to expand the commercial level of activity in space. Since the fee is not related to the contractor's performance, the chief incentives for the contractor are contract renewal and enhancement of reputation.

2. Cost Reimbursement Plus Performance Reward

A performance reward such as a bonus, award fee (subjective evaluations), or incentive fee (objective evaluation) offers a direct incentive for the contractor to expand commercial development in space. Such an incentive structure could be used to encourage a single contractor to offer complete coverage of the potential user community.

3. Performance Fee

A performance fee without cost reimbursement is not likely to be an attractive arrangement to potential intermediaries in the short or middle terms, due to the high level of effort required to develop a single new user. This arrangement might also bias the intermediary toward prospects offering the greatest potential payoff at the lowest cost. This bias could affect the intermediary's credibility and ability to buffer proprietary information. In a mature market, however, this option could be the simplest way to support multiple intermediaries, due to the nature of the market in this stage of its development.

4. Participation in User Ventures

The intermediary(ies) could be allowed to become a partner in the ventures it arranges. This option allows the most rapid transition of intermediary support to the private sector. However, this arrangement may cause the intermediary to be overly aggressive in developing new users, especially where the potential payoff is great, with the result that credibility, and confidence in NASA, might suffer. If there are

EXHIBIT III-3

PERFORMANCE INCENTIVES

CONTINUED ➡

	COST REIMBURSEMENT PLUS FIXED FEE	COST REIMBURSEMENT PLUS PERFORMANCE REWARD
DESCRIPTION	COST-BASED CONTRACTUAL RELATIONSHIP	PERFORMANCE REWARDS COULD INVOLVE BONUSES, AWARD FEES, OR INCENTIVE FEES.
DISCUSSION	• NO DIRECT REWARD FOR EXPANDING LEVEL OF COMMERCIAL ACTIVITY IN SPACE BEYOND CONTRACT RENEWAL; LIMITED PERFORMANCE ENCOURAGEMENT • ENHANCEMENT OF REPUTATION CONSTITUTES INCENTIVE	• DIRECT INCENTIVE TO EXPAND COMMERCIAL ACTIVITY • MAY ENSURE THAT SINGLE CONTRACTOR INTERMEDIARY OFFERS COMPLETE COVERAGE
CONCLUSIONS	• NO DIRECT INCENTIVE	• EFFECTIVE INCENTIVE FOR CONTRACTOR

EXHIBIT III-3

PERFORMANCE INCENTIVES (CONT'D)

	PERFORMANCE FEE	PARTICIPATION IN USER VENTURES
DESCRIPTION	INTERMEDIARY IS ONLY REIMBURSED FOR SUCCESSFUL USER DEVELOPMENT; MAY OPERATE ON PERCENTAGE OF CONTRACT BASIS	INTERMEDIARY IS NOT REIMBURSED BUT BECOMES PARTNER IN PROPOSED VENTURE
DISCUSSION	• MAY OFFER MEANS OF SUPPORTING MULTIPLE INTERMEDIARIES • ENCOURAGES AGGRESSIVE INTERMEDIARY • MAY BE UNATTRACTIVE TO CONTRACTOR IN MIDDLE TERM DUE TO HIGH RISK • INTERMEDIARIES MAY BE BIASED TOWARD PROSPECTS WITH GREATEST POTENTIAL PAYOFF AT LOWEST COST • BIAS MAY DAMAGE INTERMEDIARIES' CREDIBILITY AND BUFFERING CAPABILITY, ESPECIALLY IF FUNDING IS NON-NASA • DIFFICULT TO ACHEIVE UNDER GOVERNMENT PROCUREMENT REGULATIONS	• ALLOWS MOST RAPID TRANSITION TO PRIVATE SECTOR SUPPORT • MAY ENCOURAGE OVERLY AGGRESSIVE INTERMEDIARY • INTERMEDIARY WILL BE CLEARLY BIASED TOWARD VENTURES OFFERING GREATEST LIKELY RETURN • POTENTIAL INTERMEDIARY STAKE IN VENTURES INHIBITS CREDIBILITY AND BUFFERING AND OVERALL EFFECTIVENESS IN OTHER VENTURES
CONCLUSION	• ONLY POSSIBLE IN MIDDLE OR LONG TERM	• POSSIBLE IN LONG TERM WITH MULTIPLE INTERMEDIARIES

multiple intermediaries, this might encourage direct competition among them for the right to participate in particular ventures. Furthermore, such participation restricts the intermediary's reliability and credibility to act as a buffer for proprietary information - potential new users might fear that the intermediary will only be responsive to new ventures with the greatest probability of a high payoff, and they may be reluctant to deal with or confide in them. Also, as noted, it would represent a conflict of interest for a wholly or partially NASA funded intermediary.

A cost plus fixed fee contract offers no direct incentive for increased activity to promote commercialization beyond the desire to preserve and enhance the reputation of the contractor. Performance rewards such as award fees offer direct and effective incentives in the short term. Performance fees without cost reimbursement offer greater motivation for success but are inappropriate in the short to middle term when stimulation of user interest is still a long and difficult process. Finally, in the long term, the intermediary may be motivated by participation in user ventures with its own capital at risk, but in the short or middle terms this would produce an intermediary whose stake in proposed ventures is so great as to jeopardize its credibility.

(4) Relationship to NASA:

The following paragraphs discuss various relationships which could exist between the intermediary and NASA and evaluates the pros and cons of each. Exhibit III-4 shows the various issues associated with each option.

1. Component of NASA

Although the Statement of Work directs that only commercial intermediaries be examined, it is useful to include an organic NASA office in this section of the analysis for purposes of comparison. A NASA office obviously offers the most direct access to NASA personnel and the most direct NASA control of any approach to providing an intermediary. It also facilitates intra-government or regulatory coordination. However, there is a perception in the private sector that NASA is unable to adequately protect proprietary information thus, "buffered access" could not credibly be offered by a NASA office. NASA also lacks substantial knowledge of business practices and market analysis, and may have manpower limits, restrictions on marketing activities, or an improper

EXHIBIT III-4

RELATIONSHIP TO NASA

	COMPONENT	CONTRACT	COOPERATIVE	INDEPENDENT
DESCRIPTION	NASA OFFICE	A PRIVATE SECTOR INTERMEDIARY UNDER CONTRACT TO NASA	INDEPENDENT PRIVATE INTERMEDIARY PARTLY FUNDED, LICENSED OR OTHERWISE SANCTIONED BY NASA	INDEPENDENT PRIVATE SECTOR INTERMEDIARY WITH NO NASA SANCTION
DISCUSSION	• MOST DIRECT ACCESS TO NASA TECHNICAL RESOURCES AND PERSONNEL • DIRECT NASA CONTROL • PERCEPTION IN PRIVATE SECTOR THAT CONTROL OF PROPRIETARY INFO. IS WEAK • NO "BUFFERED ACCESS" • ADVANTAGES FOR INTRA-GOVT. OR REGULATORY COORDINATION. • LIMITED UNDERSTANDING OF BUSINESS PRACTICES AND MARKET ANALYSIS	• DIRECT ACCESS TO NASA PERSONNEL AND RESOURCES • DIRECT NASA CONTROL • CAN PROVIDE BUFFERED ACCESS • INTRA-GOVT. OR REGULATORY COORDINATION FACILITATED THROUGH NASA	• ACCESS TO NASA PERSONNEL AND RESOURCES ON COOPERATIVE BASIS • NASA INFLUENCE BUT NO DIRECT CONTROL • CAN PROVIDE BUFFERED ACCESS	• IMPLIES MULTIPLE INTERMEDIARIES • LIMITED ACCESS TO NASA PERSONNEL AND RESOURCES • NO NASA CONTROL • SOURCES OF TECHNICAL EXPERTISE CHIEFLY INTERNAL OR BY SPECIAL ARRANGEMENT LIKELY TO VARY AMONG INTERMEDIARIES • NO ASSURANCE OF CREDIBILITY

CONTINUED ↓

EXHIBIT III-4

RELATIONSHIP TO NASA (CONTINUED)

	COMPONENT	CONTRACT	COOPERATIVE	INDEPENDENT
	• LIMITED MARKETING CAPABILITIES • MAY HAVE MANPOWER LIMITS AND IMPROPER SKILL MIX			
CONCLUSIONS	• UNDESIRABLE EXCEPT AS TEMPORARY ARRANGEMENT	• POSSIBLE FOR SHORT TO MIDDLE TERMS	• POSSIBLE MIDDLE TERM OPTION.	• POSSIBLE IN LONG TERM

skill mix as a consequence of being a civil service office.

2. Contract with NASA

A NASA contractor has direct access to NASA personnel and resources, and this arrangement also allows NASA to exercise direct control over the intermediary. The contractor can provide effective and credible buffering between NASA and the private sector and can use NASA to facilitate intra-government and regulatory coordination. In addition, it would bring a set of personnel and skills tailored to the markets to be addressed, along with a corresponding understanding of and familiarity with private sector business practices.

3. Cooperative Arrangement with NASA

Cooperation with NASA is important for any intermediary to operate effectively, since the intermediary's job is to facilitate private sector interaction with NASA. Thus, a cooperative arrangement -- a private sector intermediary partly funded, licenced, or otherwise sanctioned by NASA -- allows access to NASA personnel and resources, and offers NASA influence but no direct control over intermediary activities. The ability of the intermediary to provide buffering services is, if anything, enhanced in this arrangement.

4. Independent Intermediaries

In the case where one or more intermediaries operate independently of NASA funding or formal cooperation, NASA would have no control over their activities. In this scenario, each intermediary would probably make its own arrangements for technical expertise and resources, and there will be no assurance of intermediary credibility in each case.

A private entity under contract to NASA permits direct NASA control and access to NASA personnel and allows NASA to facilitate intra-government coordination while still providing buffered access. As the market matures, a contractual relationship could become simply cooperative, with private funding supplementing and then replacing NASA funds. NASA cooperation is still important to assure that the intermediaries remain credible as they approach potential new users. In the long term, as multiple intermediaries become feasible, intermediaries are likely to become more independent, with NASA able to

exercise little if any control over their activities. In the long term, however, the mature market is likely to decide which intermediaries will succeed, or eliminate the need for them entirely.

7. INTERMEDIARY EVOLUTION

The preceding analysis of intermediary characteristics suggests a clear evolution of these characteristics as the market proceeds through its three phases of maturity. The evolution of these characteristics would be as follows, and is summarized in Exhibit III-5. Funding would come initially from NASA and gradually be shared and then assumed by the private sector. There would initially be one intermediary, possibly involving other parties as subcontractors, but eventually multiple intermediaries may act independently or may not be needed at all. The initial contractor incentives are performance rewards on top of cost reimbursement, but over time the intermediary would no longer require assured cost reimbursement and might participate as a equity partner in user ventures. The intermediary would initially be under contract to NASA, but would evolve through a cooperative arrangement with NASA to an independent operation.

This evolution of characteristics implies that the intermediary can be represented by a particular model in each of the three market phases. In the short term, the intermediary would be a single NASA contractor operating on a cost plus award fee basis, possibly employing one or more subcontractors. In the middle term, the intermediary would be funded cooperatively by NASA and either an industry association or owner/operators, perhaps as a condition of their space station or other NASA involvement. There could be more than one intermediary, and they might operate under a number of different performance incentives. In the long term, the intermediaries will probably be funded wholly by users or owner/operators, and might participate in the ventures they organize. As activity continues in this phase, many users or owner/operators may internalize the intermediary functions as part of their marketing effort, and the need for intermediaries (as such) might disappear.

8. NEXT STEPS:

The establishment of a space station intermediary will require that NASA take the following steps:

- Review and approve an intermediary approach
- Develop and initiate an implementation plan for the selected approach

EXHIBIT III-5

SUMMARY: INTERMEDIARY EVOLUTION

SHORT TERM	MIDDLE TERM	LONG TERM
• NASA FUNDED	• NASA/PRIVATE FUNDED	• PRIVATE FUNDED
• SINGLE, WITH BROAD INVOLVEMENT	• SINGLE OR MULTIPLE	• MULTIPLE OR NONE
• COST PLUS AWARD FEE	• COST PLUS PERFORMANCE REWARD OR PERFORMANCE FEE ONLY	• PERFORMANCE FEE OR PARTICIPATION IN VENTURES
• NASA CONTRACT	• NASA COOPERATION	• NASA COOPERATION BUT GROWING INDEPENDENCE
• NASA CONTRACT: PRIVATE, PRIME CONTRACTOR	• OWNER/OPERATOR CONTRACT: FUNDED BY OWNER/OPERATORS OF SPACE SERVICES AND EQUIPMENT • INDUSTRY ASSOCIATION CONTRACT: FUNDED BY INDUSTRY GROUPS	• OWNER/OPERATOR CONTRACT(S) • USER CONTRACTS: MULTIPLE INTERMEDIARIES SUPPORTED BY USERS • NO INTERMEDIARY: SERVICES NO LONGER NECESSARY OR INTERNALIZED BY PARTICIPANTS

- Procure the services of a qualified firm to serve as an intermediary

Booz, Allen's analysis indicates that in order to provide the services defined for the intermediary, a suitably qualified firm should have the following attributes:

- Knowledge of NASA's organization and procedures
- Understanding of space attributes and limitations
- Understanding of new ventures, business practices, and financial requirements
- Understanding of basic science, technology, and manufacturing
- Market analysis capabilities
- Experience in conducting awareness programs
- Credibility with industry, access to business leaders, and a reputation for objectivity
- Ability to control and protect proprietary information.

NASA's solicitation should require that interested parties meet at least this set of qualifications. Consideration should also be given to the degree to which NASA would benefit from having an intermediary demonstrably capable of operating in the international community, with the necessary qualifications added to the solicitation.

IV. ISSUES

IV. ISSUES

Based on its experience to date in commercial user development, Booz, Allen believes that there are several issues which NASA must recognize and begin to address. These issues include:

- Program status: The private sector will remain reluctant to invest resources in space and space station applications until the government commits itself to a space station program. Such a government commitment would send a clear signal to American industry that their space applications would be supported by an adequate initial increment of space infrastructure. This would set off a surge of interest, and at the appropriate time, investment, on the part of the private sector, and lead to the development of a significant number of additional commercial space ventures

- International participation: There is a need to clarify the role of foreign entities as possible developers, users, and investors in a U.S. space station program, and as participants in Joint Endeavor and Technical Exchange Agreements with NASA related to such roles. The private sector needs to understand what the ground rules will be with respect to foreign competitors, and will be reluctant to invest its own resources if the arrangements do not seem fair

- Commercialization support: NASA's present support of commercialization is viewed by industry as needing clearer policy direction and better internal coordination. Early evidence of organized support on a broad front will help change this perception, and the proposed Office of Space Commerce appears to be a significant step towards bringing this about. In particular, the planned coordination of commercialization activities within NASA should make NASA's user development efforts significantly more productive

- Intermediary implementation: An early commitment by NASA to the implementation of an intermediary concept will return benefits in terms of continuity and success in user development, and in terms of NASA's perceived commitment to commercialization

- Space station user charge policy: Until some basis is established for estimating the cost of private sector use of the space station, potential users and investors will be unable to perform useful investment/benefit analyses. The designs of both the space

station and its user charge policy should take into account the need for rates which will make commercial use of the station attractive to private sector users who must consider alternative investments.

When a space station program start is approved, NASA must take action which indicates that it has carefully considered these issues and is committed to making the space station an attractive focus for private sector activity and investment. If NASA can examine these issues and develop policies which recognize the needs of industry and the significant contribution which private sector investment can make, it would be a step toward securing America's place at the forefront of the development of space as the next economic frontier.