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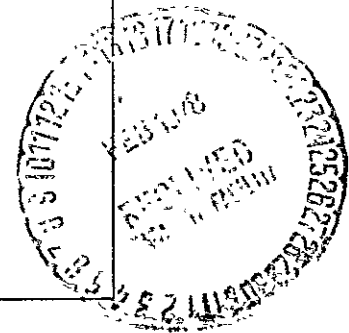
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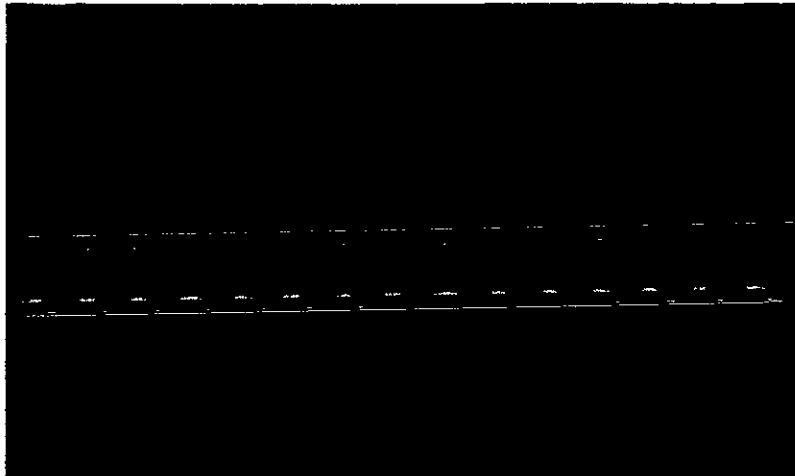
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RESEARCH REPORT



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FINAL REPORT
on the
STS PILOT USER DEVELOPMENT PROGRAM
to
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
HEADQUARTERS, WASHINGTON, D. C.

March 30, 1977
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PREFACE

This Battelle report, entitled "Final Report on the STS Pilot User Development Program", is submitted under NASA Contract No. NASw-2964. The report describes the approach taken and how the nine month program was accomplished by Battelle's Columbus Laboratories. The report summarizes the results of the program and lists conclusions and recommendations associated with the entire Pilot Program.

Battelle would like to acknowledge the efforts of Jon Michael Smith of NASA Headquarters, Code MOP, as the Contracting Officer Representative for the Pilot Program. The following BCL staff are recognized for their contribution to this report:

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FINAL REPORT

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INTRODUCTION

The Space Transportation System (STS) of the 1980's will be the culmination of two decades of intensive launch systems development and will form the foundation underlying the future space activities of this nation. The operation of the STS cannot be viewed merely as an extension of NASA's current launch vehicle operations. Both the genesis and the concepts of the STS are without precedent. Expendable launch systems have been, for the most part, either evolutionary developments of military ballistic missiles or have been designed to satisfy the particular requirements of the manned lunar landing program. The STS, on the other hand, is neither evolutionary nor dedicated to a single purpose; on the contrary, it is a revolutionary concept configured to meet the space transportation requirements of very diverse users for the foreseeable future.

While the exploitation of space has always been constrained by the combined impediments of technical difficulty and cost, the earlier conquests necessarily required submergence of economic considerations. Now, the spectacular successes of the past have fostered,

perhaps unfairly, an almost complete reversal of traditional attitudes among the Congress and the public at large. Technical success is taken for granted; return on investment has become the touchstone of achievement.

In view of this environment, the boldness of the STS concept is unprecedented, representing a systems development aimed at a magnification of performance capability while simultaneously offering promise of cost reductions to the user. Of these objectives, the impact of the STS on user economics is the more crucial, since the pace of future space operations will be directly related to the economic benefits of the STS regardless of the excellence of the technology which it represents.

It is recognized that the development of the STS has been accompanied by some skepticism and controversy regarding its promised economic benefits. A key issue has been the credence of the projected utilization, i.e., total number of missions, flight rates and the number of reimbursable launches.

In just three years, the STS will become an operational reality. Then, the validity of the STS concept will be decided; not by debate, but by measurable factual criteria.

Since the integrity and credibility of NASA are dependent upon the economic viability of the STS, the development of STS users should be approached with the same vigor that NASA has demonstrated in the development of the STS hardware. Full exploitation of the STS capabilities will be not only dependent on the extensive use of the STS for known space applications and research, but also on new, innovative ideas of use originating with both current and new users. In recognition of this, NASA has been engaged in a User Development Program for the STS over the past 4 years. The program began (Phase I) with four small studies*. Each study addressed a separate sector of potential new users to identify techniques and methodologies for user development. The collective results established that a user development function was not only feasible, but necessary for NASA to realize the full potential of the STS.

* Phase I User Development Studies:

- Battelle's Columbus Laboratories (Contract No. NAS8-30529)
- Stanford Research Institute (Contract No. NAS8-30533)
- University of Alabama at Huntsville (Contract No. NAS8-30737)
- A. D. Little (Contract No. NAS8-30739)

With the Phase I results as a basis, Battelle's Columbus Laboratories was awarded a competitive (Phase II) contract to further explore the concept of a new user development activity and to structure an approach for carrying out such a program. The overall approach was evaluated and verified by conducting a series of test cases with selected potential user organizations.

The Phase II study pointed toward an analogy between the function of product marketing and sales in industry and the required function of the new user development activity within NASA for the STS. Just as the industrial marketing function must not only know the product but must understand the customers' needs as well, the innovative ideas for new STS utilization will evolve from effective coordination of user ideas, needs and problems back to the STS operation and technology development areas of NASA. The full discussion of the recommended STS new user development function is included in the Battelle final report.^{(1)*}

Subsequent to the completion of the Phase II study, NASA awarded a contract to Battelle for the current study, oriented toward a Pilot User Development Program involving pilot contacts to a selected sample of current space users and potential users. The primary objectives of this study were to:

- (1) Conduct a pilot user development program with a selected sample of current space users to determine how the STS can accommodate their expected needs and to encourage early transition to the STS
- (2) Develop a detailed plan for implementing the full-scale STS User Development Program for all potential space users.

This narrative final report is intended as a factual documentation of the activities which, collectively, constituted the Pilot User Development Program, while the implementation plan for the full-scale program is documented separately in two parts.⁽²⁾

* Superscript numbers refer to references at the end of this report.

This final report begins with a description of the overall pilot program plan, which involved five specific tasks defined in the contract Statement of Work. Each task is then discussed separately; but two subjects, the development of principal investigators and space processing users, are discussed separately for improved continuity of thought. These discussions are followed by a summary of the primary results and conclusions of the Pilot User Development Program. Specific recommendations of the study are contained in Reference 2.

In addition, the contract Statement of Work required that, during the performance of the major program tasks, several factors relevant to full-scale user development should be continually assessed. These factors were:

- Evaluation of the barriers to user development identified in previous user development studies (Phases I and II of the New User Development Program)
- Evaluation of the effectiveness and role of agency/space/STS advertising (promotional) activities relative to the STS user development effort
- Evaluation of the roles and effectiveness of team effort and individual efforts considering NASA and outside NASA participants in STS user development
- Identification of the need, type and roles of consultants required to support user development
- Identification of NASA organizational alternatives for implementing the Full-Scale User Development Program
- Estimation of the annual costs of the full-scale program.

The results of the assessment of the first four of the above factors are included in the Appendix of this final report. The assessments associated with the last two factors are incorporated into the

Implementation Plan portion of the Full-Scale STS User Development Program Plan.

PROGRAM APPROACH

The spectrum of the potential overall users of the STS can be segregated into three major categories, i.e., current users of space/ELV's; users familiar with space benefits and space programs, but who are not yet directly using space; and potential users who are unfamiliar with space benefits and programs. The recommended full-scale user development plan, which was a major output of this pilot contact program, addresses the uniqueness, the complexities and the barriers associated with all three categories of users. While the pilot program primarily involved the current users, it also included pilot contacts with non-ELV users. Results were obtained from the contacts which provided the insight as to how and when to develop the users in all three major user categories. The pilot contacts were designed to not only stimulate the user's interest in transitioning to the STS, but were also designed to obtain information relevant to full-scale user development.

The program was implemented through the accomplishment of five major tasks:

- Task I - Identify Users to be Contacted
- Task II - Develop a Contact Plan
- Task III - Contact Selected Users
- Task IV - Evaluate the Results of Contacts
- Task V - Recommend a Full-Scale User Development Plan

The initial program was defined as one of 8 months duration but was subsequently extended to 9 months. The overall approach to accomplishing the five tasks is shown in Figure 1. As shown, a Program Plan was prepared and issued on July 28, 1976 and NASA was briefed on it on August 17, 1976. The plan and schedule shown in Figure 1 was subsequently followed. A narrative description of the work performed under each task is included in the following sections of this report.

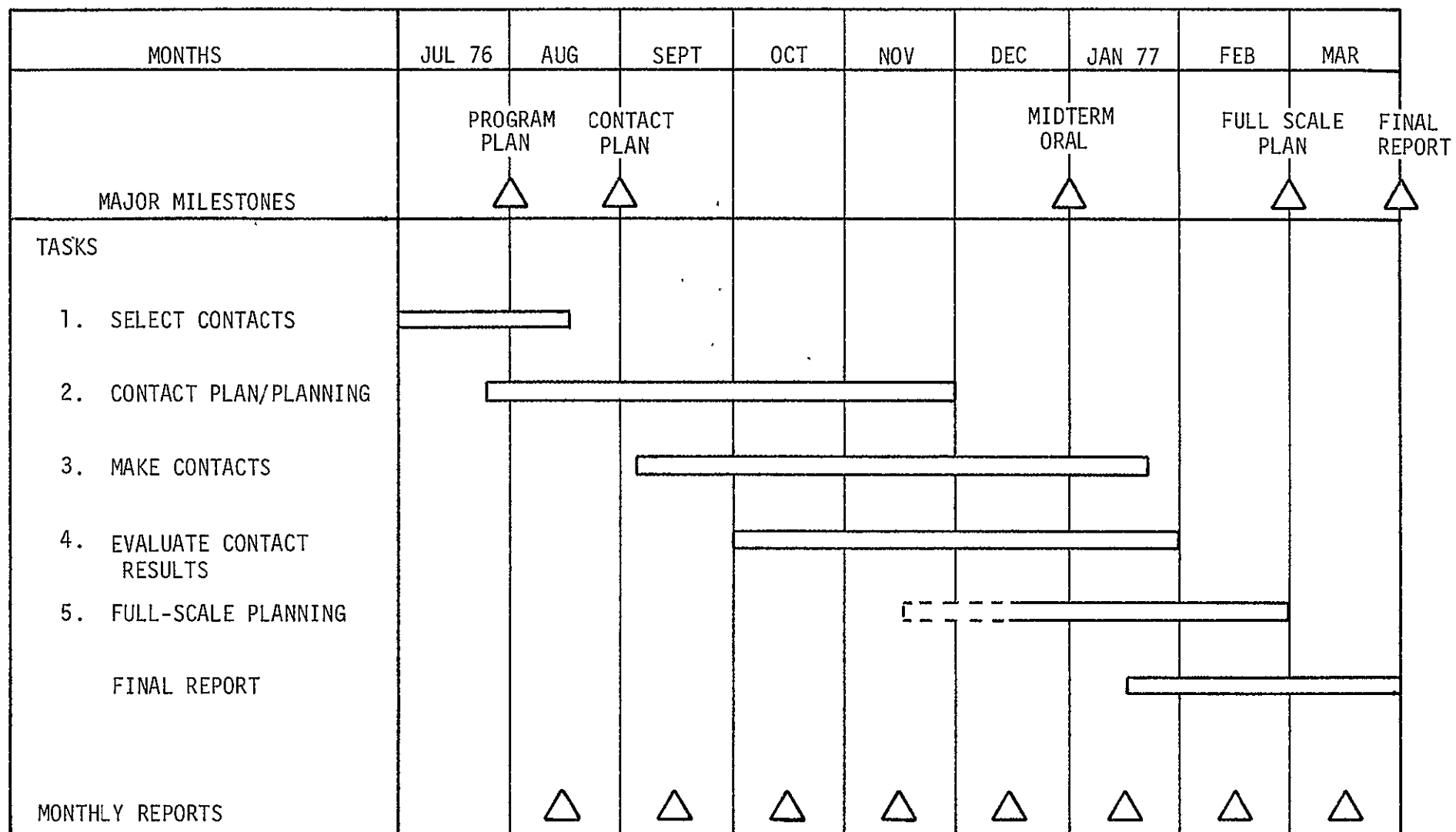


FIGURE 1. STS PILOT USER DEVELOPMENT PROGRAM APPROACH

TASK I - IDENTIFY SPACE USERS TO BE CONTACTED

Objective

The objective of Task I was to identify the organizations to be contacted during the Pilot User Development Program, and to develop a rationale for their selection.

Procedure and Results

As initially proposed by Battelle, the coverage during the Pilot Program would have been limited to current space users; that is, organizations which are current users of expendable launch vehicles (ELV's), or which have the potential of becoming ELV users prior to the STS operational period.

As a result of meeting with NASA on July 12-13, 1976, the coverage was modified to provide a broader data base for the later definition of a full-scale user development plan. Although emphasis was to remain on current space users (both domestic and foreign), limited coverage would be provided to:

- (1) Organizations which are not current space users
- (2) Independently funded Principal Investigators (PI's) relative to the use of the small, self-contained research package.

A preliminary selection of pilot contacts was completed and contained in the User Contact Plan submitted on July 28 and revised on September 21, 1976.⁽³⁾ Although these selections were modified during the latter portion of the program, they are presented here to provide a chronology of selection development.

Preliminary Contact Plan Selections

The User Contact Plan⁽³⁾ provided for both the current space users (including spacecraft manufacturers) and a limited number of non-current users.

A comprehensive listing of current space users was established early in the program and is given in Table 1, which segregates the 59 users into eight major segments. It was from this list that the current space user contacts were selected. The selection process is illustrated in Figure 2, proceeding from the total population of Table 1 at the top of the diagram to the selected pilot contact organizations at the bottom. The selection of current users involved an evaluation of such factors as:

- Each organization's near term need to be contacted
- The potential benefit of each proposed contact as a contribution to the pilot program objectives
- The practical recognition of past/current communications, and exchange of information between NASA and each organization
- An awareness of the appropriateness and sensitivity of duplicating on-going government agency STS payload development activities.

As shown in Figure 2, three user segments (NASA, other U.S. Government agencies, and international manufacturing consortia) were eliminated in their entirety. In the cases of NASA and other U.S. agencies, particularly NOAA, it is recognized that there is a broad need for current, consistent STS information. On the other hand, the need for active user development is not as great with these agencies as compared to non-government users in the U.S. The development of NASA payload planning for STS is being actively pursued within NASA, thus minimizing the need for pilot contacts at this time. These users are also considered to be "captive" to eventual STS use, by policy, as the STS evolves. Overall, the payoff of a pilot contact to NOAA or within NASA appeared to be questionable at this time.

In the case of the international manufacturing consortia (European), available information was not sufficient to identify a single, representative contact point within each group. In any given system development, the lead organization is apparently chosen on an ad hoc basis.

As a result of following the previously described selection process, a preliminary selection of 17 entities was made for the

TABLE 1. CURRENT SPACE USERS

User Segment	Organization
U.S. Spacecraft Manufacturers	Aeronutronic Ford Boeing Aircraft Co. Fairchild Aircraft Co. General Electric Co. Hughes Aircraft Co. Lockheed Martin Marietta RCA Astro-Electronics Rockwell International TRW
Domestic U.S. Commercial Organizations	COMSAT General Western Union RCA Americom/Globcom American Telephone & Telegraph American Satellite Corp. Satellite Business Systems
NASA	Office of Space Flight Office of Space Science Office of Applications Office of Aeronautical & Space Technology Ames Research Center Marshall Space Flight Center Lewis Research Center Langley Research Center Goddard Space Flight Center Johnson Space Center Jet Propulsion Laboratory
Non-NASA/Non-DoD Federal Agencies	National Oceanic & Atmospheric Administration U.S. Geological Survey U.S. Dept. of Health, Education, and Welfare Federal Aviation Administration Environmental Protection Agency
International Organizations	INTELSAT INMARSAT FAA/ESA/Canada (AEROSAT) European Space Agency NATO
Foreign Governments	Canada West Germany-France Japan Brazil Indonesia Italy Arab States United Kingdom
Foreign Spacecraft Manufacturers	France MATRA SNIAS COSMOS Italy CIA Japan Mitsubishi Nippon Electric Co. Tokyo Shibaura Electric Co. United Kingdom Marconi Space & Defense Systems Hawker-Siddeley Dynamics West Germany Messerschmitt-Buelkow-Blöhm Fokker-VFW/ERNO
International Consortia	CIFAS Cosmos Consortium MESH Consortium STAR Consortium

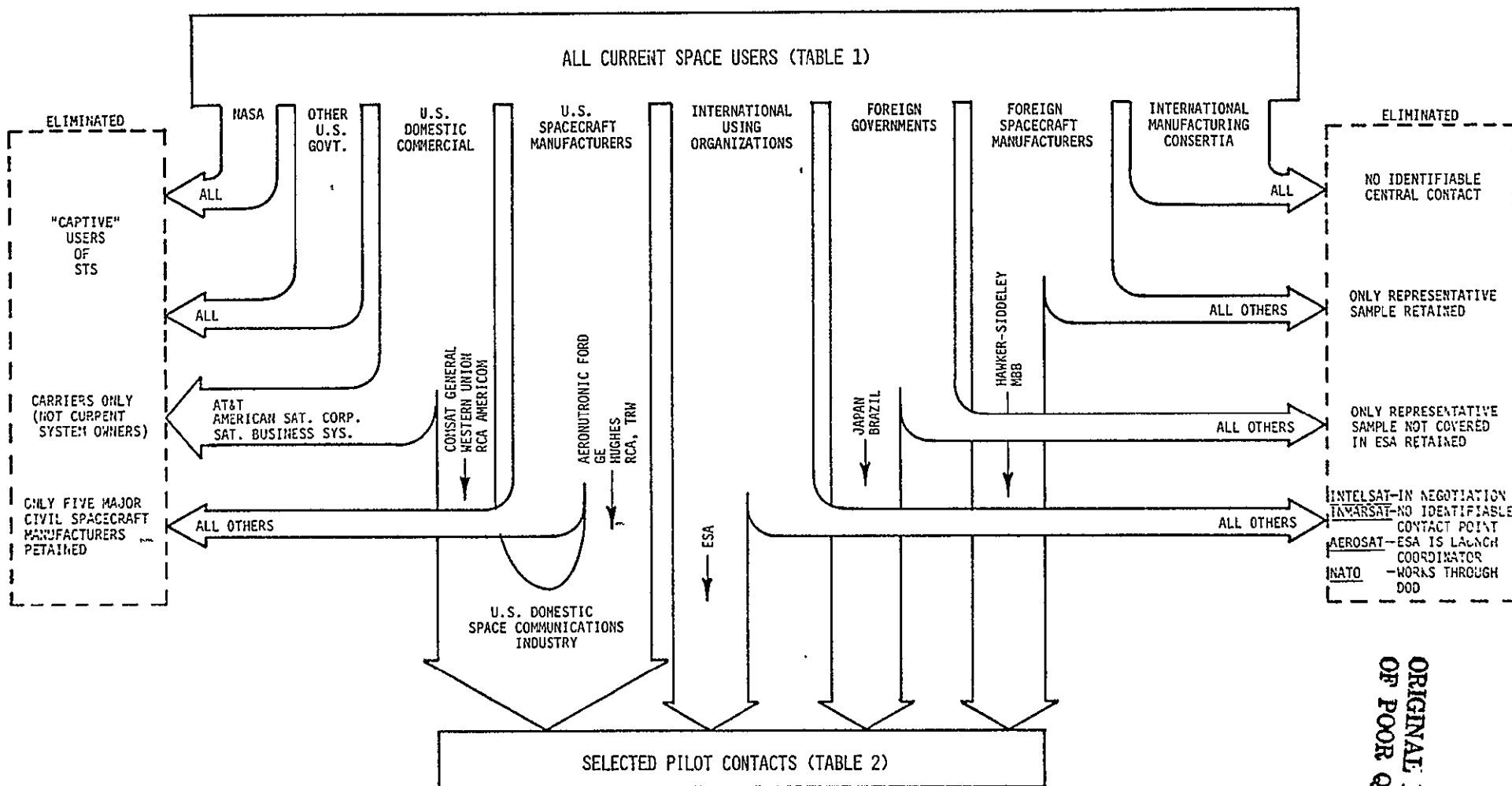


FIGURE 2. ILLUSTRATION OF PILOT USER CONTACT SELECTION (CURRENT USERS)

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recommended pilot contacts. These are listed in Table 2. As shown, the selected pilot contacts are grouped by Current ELV Users and Non-ELV Users.

Most of the selected entities, 13, were current users of ELV's and were segregated into five Current ELV User segments, as shown in Table 2. The user segments are listed in descending order of priority, based upon a perceived need for specific attention during the Pilot User Development Program to expedite transition to the STS. U.S. spacecraft manufacturers and domestic U.S. commercial organizations were given a priority over foreign organizations/countries since foreign responses will benefit significantly from previous and favorable U.S. responses. The contacts with U.S. domestic organizations were expected to provide a valuable insight into the user development and transitioning problems which should facilitate the inherently more difficult foreign user developments. Within the domestic U.S. users, it was believed that there would be an advantage to contacting the spacecraft manufacturers before contacting the system operator/owners. This is, primarily, in recognition of the broad awareness of the design implications and options evidenced by all the major spacecraft manufacturers and the influence this may have on space communication systems owner decisions. The process of the selection of specific organizations/agencies/countries within the five Current ELV User segments will be discussed by user segment.

U.S. Spacecraft Manufacturers. Spacecraft manufacturers have an obvious and strong influence on customer systems, particularly in those procurements which do not specify the launch vehicle. To facilitate transition to the STS, and to maximize STS utilization for direct follow-on spacecraft and for more advanced space systems, it is imperative that manufacturers become intimately familiar with the terms and conditions of STS use as well as the technical capabilities and interface requirements. Recent contacts with several spacecraft manufacturers had indicated a need for improved communication with NASA, although all had a considerable background of experience in studies relating to STS usage. Pilot contacts with the spacecraft manufacturers were also

TABLE 2. SELECTED PILOT CONTACTS (PRELIMINARY)

Current ELV Users

U. S. Spacecraft Manufacturers

- (1) Hughes Aircraft Company
- (2) Aeronutronic Ford
- (3) RCA Astro-Electronics
- (4) General Electric Company
- (5) TRW

Domestic U. S. Commercial Organizations

- (1) RCA Americom
- (2) Comsat General
- (3) Western Union

International Organizations

- (1) European Space Agency (ESA)

Foreign Governments

- (1) Japan
- (2) Brazil

Foreign Spacecraft Manufacturers

- (1) Hawker-Siddeley Dynamics (Mesh Consortium)
- (2) Messerschmitt-Boelkow-Blohm (Cosmos Consortium)

Non-ELV Users

- (1) Stanford Research Institute
 - (2) McDonnell Douglas Astronautics
 - (3) General Electric Space Division
 - (4) Battelle's Columbus Laboratories/Principal Investigators
-
-

intended to explore the interest in initiating advanced satellite designs for commercial sales which take advantage of the STS unique capabilities.

The five selected manufacturers had historically been the most active in civil spacecraft design for both domestic and foreign users. In addition, useful contacts had been established within each company, since the five selectees were participants in a Battelle contract to NASA for obtaining manufacturers' inputs for the forthcoming SSUS development. It was, therefore, proposed that all five organizations be included as pilot contacts based upon a common data need and projected interest in the STS. Also, the risk of alienating any one of the major five was eliminated.

Domestic U.S. Commercial Organizations. All current ELV users in this user segment were members of the communications industry. The three selectees were the operators of all domestic satellite communications systems for the United States. Two of these, RCA Americom and Western Union, were also common carriers. Other possible candidates (AT&T, American Satellite Corporation, and Satellite Business Systems) were carriers only, and currently did not actually procure and operate space systems.

The organizations in this user segment are obviously profit-motivated. Not only is it conceivable that they could obtain other launch services, but in the case of RCA and Western Union, they need economic justification for satellite service as opposed to other communication modes. As an additional consideration, the capture of the domestic commercial operators by the STS would appear to be mandatory for successful marketing of services among similar foreign organizations. It was felt to be essential that the selected contacts be fully cognizant of the benefits of STS utilization and that any impediments, real or perceived, be identified and resolved as early as possible.

International Organizations. INTELSAT was eliminated as a pilot contact since extensive discussions have been held, and certain agreements reached, with NASA relative to INTELSAT V compatibility with and utilization of the STS.

In the case of INMARSAT, the current status of the organization did not permit the identification of a viable central contact organization.

The AEROSAT members are FAA, ESA, and the Canadian government. Since ESA has the responsibility of contracting for AEROSAT launch services, and is included in this user segment, AEROSAT was eliminated from consideration as a separate entity, at this time.

NATO was excluded because NASA launches for this organization are arranged through the U.S. Department of Defense.

ESA spends about one-half of the total space budgets of its member nations and, therefore, is an important source of potential business for the STS. ESA is utilizing NASA ELV services for several current space systems and has historical precedents for cooperative programs with NASA in scientific payloads as well as the Spacelab programs. As the European Space Agency, ESA represents an effective, convenient coordinating point for an STS interface to achieve the objectives of the pilot contacts and to provide data needed for full-scale planning.

Foreign Governments. Canada has no central national space agency. The only current active programs are those of TELESAT in the communications field. A recent briefing by NASA to TELESAT had stimulated their long range interest in STS to a point of initiating detailed mission and design planning with NASA, thus precluding a pilot contact at this point.

Since the European countries were well represented by ESA in the previous user segment, Japan was given first priority in this group because of its active national space program and considering its expendable launch vehicle development interests. In addition, Brazil was chosen as representative of a class of non-space-oriented countries with a domestic satellite system under development. Brazil has specified the Delta launch vehicle for the two launches in 1978 and 1979, but will have a third satellite on 180-day call-up commencing in December 1978. All follow-on satellites are logical candidates for STS launches. Dual compatibility (ELV and STS) options in the spacecraft design specifications should be considered.

Foreign Spacecraft Manufacturers. Since the Japanese are still relying heavily on U.S. manufacturers for assistance in spacecraft design technology, it seemed most fruitful to concentrate on the more fully developed and independent capabilities represented by European spacecraft manufacturers. The choice of contacts in Europe was complicated, however, by the fact that European manufacturers operate almost exclusively as members of various consortia in bidding on specific space systems. Some question remained concerning the extent to which a particular consortium could be considered as an entity in itself for contact purposes. In view of this uncertainty, representative spacecraft manufacturers were chosen who are major members of different consortia. The selected contacts were Hawker-Siddeley Dynamics of the MESH consortium, and Messerschmitt-Boelkow-Blohm representing COSMOS.

Non-ELV Users. The reason for selecting contacts outside the community of current space users was to obtain a data/experience base to develop a plan for a subsequent full-scale STS user development program. The pilot contacts to be made with non-ELV users reflected selections of organizations that were knowledgeable of space benefits and are, perhaps, involved in space programs, but had not, as an organization, committed to the use of space for research or commercial purposes.

Stanford Research Institute (SRI) was chosen as a potential user of the STS for contract research across a spectrum of disciplines. The potential SRI interest could range from representing industrial space research needs using a NASA space facility to the ownership or lease of a space facility by SRI for that purpose.

McDonnell Douglas Astronautics (MDAC) was selected for its background and potential to design, develop, manufacture, sell and/or lease free-flyers to commercial space users in such fields as commercial space manufacturing and processing.

The General Electric Space Division was chosen because it has been involved in studies related to beneficial uses of space and space processing facility designs. The intent was to capitalize on this experience to expedite further development of new uses of space made possible by the STS and the ultimate role of GE using a space manufacturing facility.

The Principal Investigator (PI) has traditionally played a significant and valuable role in NASA-sponsored science payload development and utilization. Emerging STS charge policies for small self-contained research payloads may make possible the exploitation of the space environment independent of NASA programs, yielding a new class of space user, the privately funded PI. This new user category was to be explored through contacts with diverse specialists within Battelle's Columbus Laboratories. These initial contacts were intended to identify other individuals, outside of BCL, who would represent potential privately funded PI's across a wide spectrum of disciplines.

Final Contact Selections

The final selection of contact organizations followed the review of the Contact Plan developed under Task II. The evolution of the final selections is discussed under Task III.

TASK II - DEVELOP A CONTACT PLAN

Objective

The objective of Task II was to develop an integrated plan to conduct pilot contacts with the organizations identified in Task I.

Procedure and Results

The Contact Plan is documented in Reference (3). It describes the selection rationale, the general characteristics of the proposed contacts, specific preliminary contact strategies, and a contact schedule. The preliminary selection of contact organizations and the selection rationale have previously been discussed under Task I; the remaining topics are outlined briefly below.

General Contact Characteristics

Five elements were considered to be essential for effective pilot contact meetings. These were:

- A customer-oriented presentation
- New information for the participants
- Substantive information
- Authoritative information
- Adequate follow-on to any response.

The principal intent of the contacts was to introduce the business aspects of STS, to make appropriate comparisons to the current ELV's and to set up (or reinforce) lines of communication for further involvement in STS utilization. The suggested approach was to make an active first contact and then provide an effective response to identified subjects of interest.

Preliminary Contact Strategies

Preliminary strategies were developed for each of the selected contacts, to form the basis for more detailed strategy development by project team members assigned to each organization.

U.S. Spacecraft Manufacturers and System Operators. All commercial space operators are, at the present time, members of the space communications industry. Furthermore, since the final determination of the space segment design is made by the system operators in concert with the spacecraft manufacturers, the basic strategies and approaches for each subsegment were similar.

For the spacecraft manufacturers, the objectives of the pilot contacts were to encourage the manufacturer's support to transitioning the current ELV users at the earliest time possible and to encourage new design concepts afforded by the Shuttle system. Since the manufacturers were currently involved in the technical aspects of STS utilization, no detailed technical presentation was suggested, aside from an assessment of the adequacy of the technical information flow.

Similarly, the overall objective of pilot contacts with the domestic system operators was to determine the development effort required to obtain a commitment to use the STS in the next new segment of space missions launched within the STS time frame, and/or to strive for dual compatibility for programs initialized on ELV's in the 1977-1980 time frame.

An essential first step in contact planning was an assembly and analysis of background information on each organization. Specific items of information included:

- Company location
- Key individuals for initial contact
- Nature of business
 - Charter
 - Market
 - Spacecraft/systems history.

Based on extensive contact with the candidate organization through other space-related work at Battelle, it was recognized that the major obstacles had been the unavailability of a clear set of policies regarding STS and the lack of a customer-oriented organization within NASA to respond to specific issues. Accordingly, the pilot contacts were planned to deal with the major business issues and the specific plans of each user. Key points for discussion would be user charge policy; comparison of STS operations and costs to those of ELV's; incentives for early transitioning and dual compatibility; terms and conditions of use; STS availability; overall mission planning; and general interfacing with STS operations.

Foreign Contacts. In the Contact Plan, five foreign contacts were envisioned. These were:

- ESA
- Japan
- Brazil
- Messerschmitt-Boelkow-Blohm (MBB)
- Hawker-Siddely Dynamics, Ltd. (HSD).

Foreign contacts posed special problems over and above those of domestic users because of potential political sensitivity. It was recognized that any foreign contacts would need to be coordinated through the International Plans and Programs Office (Code I) of NASA to obtain guidance on protocol and to assist in identifying key individuals.

Non-ELV Users. The pilot contacts to be made with non-ELV users reflected selection of organizations which were knowledgeable of space benefits and were, perhaps, involved in space programs, but had not, as an organization, committed to the use of space for research or commercial ventures.

The objectives were to explore the issues related to each organization's potential long-range interests in space and to identify the conditions, timing, and motives under which each might consider, plan or implement a business venture utilizing the STS.

Battelle had existing contacts at each of the selected organizations (SRI, MDAC, and GE) to enable an effective preliminary exploration of the basic concept and purpose of the proposed pilot contacts. Preliminary contacts were planned, by telephone, to reach agreement on subsequent, formal presentations and to recommend the appropriate level of individual participants at the selected organization.

The initial part of each presentation would provide an STS overview in terms of performance capabilities, operations, policy of use, availability, status, etc. The remaining portion of each presentation would be specifically tailored to the STS application projected for each organization, i.e.:

- SRI - use of STS for contract research across a spectrum of disciplines
- MDAC - development of free-flyers for commercial use and use of STS for research
- GE - long-range interest in space manufacturing in support of company product lines.

Contact Preparation. In the Contact Plan developed under Task II, it was envisioned that three teams would be formed to develop the detailed strategy, contact planning, and presentation design for each of the three categories of users. The schedule of activities was planned to follow the procedures outlined in Figure 3.

WEEK ENDING	SEPT	3	10	17	24	OCT	1	8	15	22	29	NOV	5	12	19	26	DEC	3	10	17	24	31
PRELIMINARY PLAN TO NASA	△		△	SCHEDULING CONTACTS BEGIN				△	PRESENTATIONS BEGIN			△	MID-TERM ORAL			(NOV 25) THANKSGIVING			CONTACTS COMPLETED	△	(DEC 25) CHRISTMAS	
OBTAIN NASA CONCURRENCE AND MAKE NECESSARY ADJUSTMENTS																						
DETERMINE SPECIFIC CONTENT AND FORMAT FOR EACH CONTACT																						
ASSIGN RESPONSIBILITY FOR CONTENT PREPARATION. BCL/NASA																						
PREPARE BASIC MATERIALS																						
IDENTIFY CONTACT AND SUPPORT TEAMS																						
CONTACT EACH ORGANIZATION TO SCHEDULE PRESENTATION	TEAM 1																					
	TEAM 2																					
	TEAM 3																					
PREPARE SPECIFIC MATERIALS																						
DRY RUN AND BRIEFING																						
CONDUCT PRESENTATIONS	TEAM 1																					
	TEAM 2																					
	TEAM 3																					
DOCUMENTATION & ANALYSIS																						

FIGURE 3. CONTACT SCHEDULE AS DEFINED FOR THE CONTACT PLAN OF SEPTEMBER 21, 1976

TASK III - OBTAIN NASA CONCURRENCE AND
IMPLEMENT THE CONTACT PLAN

Objective

The objective of Task III was to obtain NASA concurrence and to implement the Contact Plan of Task II.

Procedure and Results

NASA Concurrence

The Contact Plan of Task II was reviewed in two meetings with NASA. The first meeting was held with the Office of International Affairs (Code I) on September 10, 1976, to review the proposed foreign contacts⁽³⁾. This meeting resulted in the following key comments and recommendations:

- The foreign pilot contacts selected were reasonable.
- An invitation approach was recommended to set up foreign briefings. Letters would be sent by Code I informing the users of what Battelle is doing domestically and offering briefings if desired.
- A high-level NASA team leader was not recommended.
- No direct comparison to Ariane was recommended.
- Indonesia was recommended as an additional contact or as a replacement for Brazil.
- The possibility of establishing an STS user workshop at the International Astronautical Federation Congress in October was suggested.

A second User Contact Plan meeting was held as the first session of the NASA STS User Development Council (UDC) on September 24, 1976. The primary objectives of the meeting were to review the Contact Plan and to obtain the concurrence of the UDC to implement the plan. These objectives were achieved.

With NASA concurrence obtained on the general plan, specific detailed contact planning was initiated in October 1976. A detailed contact plan was prepared for the domestic space communication industry (both space system operators and spacecraft manufacturers), defining the overall strategy for this segment and specific strategies and planning for each organization. This detailed contact plan was delivered to NASA, Code MOP, on October 26. A summary of the plan was also prepared and was used in a meeting on October 28, 1976, with Code M. At the meeting, the Associate Administrator reviewed the contact plan summary, the proposed presentation Vu-Graphs, and approved the implementation of the proposed domestic contacts with the understanding that NASA would be an active participant in the presentations.

A detailed contact plan for the foreign organizations was prepared and submitted to NASA on November 12. NASA direction received on November 22 requested, however, that a revised foreign contact plan be prepared to center on a briefing to the International Maritime Satellite Organization, INMARSAT, in January 1977. (The inclusion of INMARSAT was largely in response to a suggestion made by Mr. John Johnson, the President of Comsat General, following the pilot briefing to Comsat General on November 17.) The revised foreign contact plan was prepared, proposing additional pilot contacts in the United Kingdom, West Germany and Switzerland, to take advantage of the economy of combining those with the primary briefing to INMARSAT in London. This plan was submitted on December 1, 1976, but was not implemented, at NASA's direction.

As a result of decisions within NASA, Battelle was unable to undertake the international and foreign portions of the planned pilot program. Formal contacts with international users were limited to attending, but not participating in, NASA Shuttle briefings to Telesat of Canada on August 5, and to Japan on October 25-27, 1976.

With the deferral of all foreign contacts, Code MOP directed that Battelle expand the coverage of domestic organizations. Consequently, plans were formulated and briefings presented to the following domestic organizations, in addition to those contained in Table 2:

Battelle Memorial Institute (BMI)
 Lockheed Missile & Space Company
 McDonnell Douglas - West
 Boeing - Kent Space Center
 Illinois Institute of Technology Research Institute (IITRI)
 Martin-Marietta Corporation.

With the exception of BMI and IITRI, these firms have been heavily involved in space design support roles to NASA and DoD, but not in the development of commercial spacecraft. BMI and IITRI, on the other hand, were selected as private research organizations (in addition to SRI) with the potential for conducting contract research in space.

Contact Plan Implementation

Detailed Preparation. As depicted in Figure 3, the actual presentations to the selected organizations were preceded by several preparatory steps to explore the background of each candidate organization, identify key contact individuals, and prepare specific briefing materials.

The preliminary contacts were by telephone. The purposes of the preliminary contact conversations were to:

- (1) Identify the correct individual, if not the preliminary contact, to act as the interface for the organization
- (2) Explore the overall interest and need for a business-oriented briefing on STS
- (3) Establish a tentative date for the presentation.

A follow-up letter was mailed to each contact with an outline of the proposed presentation. In the letter, specific user questions and suggested areas for discussion were solicited.

The responses from the initial contacts were uniformly favorable. Every contact individual verified that the organization was interested and that the suggested topics were both timely and relevant. Most had seen preliminary drafts of the STS pricing policy, and had questions which indicated very specific interest in a wide range of

business and policy issues. Frequently mentioned issues were price, standard services, risk, terms and conditions of use, sharing policy, and SSUS questions. Frequently, the need for closer interaction with STS Operations was either stated or implied.

From background research and the preliminary telephone conversations, two basic presentation outlines were developed which could serve, with minor changes in emphasis, for a wide range of users. The basic presentation outlines are shown in Figure 4.

For spacecraft manufacturers and system operators, the emphasis was given to the features of the pricing policy (which had not been published at that time), whereas the emphasis for the private research organizations was placed on the space facilities and research opportunities made possible by the STS.

Presentations. The presentation team usually consisted of two or three Battelle personnel and a representative of NASA Code MO. Each briefing was thoroughly documented in a BCL project Meeting Memorandum (MM).

Table 3 is a listing of all pilot contact briefings given to the selected organizations.

Primary Observations from Pilot Contact Meetings

The pilot contact presentation meetings are completely documented in the respective project meeting memoranda listed in Table 3. This section is intended to review only the more general and significant observations from these meetings.

High-level management participation was achieved in all the briefings. For the current commercial users, this is clear evidence of the perceived need, on the part of the users, to maintain an awareness of NASA intentions with regard to external users of the STS; and of the need for cooperation for mutual benefit in transitioning to the STS. Candid discussions were achieved which indicate that current users have reservations about NASA's willingness or ability to adopt a business-oriented point of view. On the other hand, the fact that NASA had initiated a user development and service function was well

CURRENT SPACE USERS	POTENTIAL PRIVATE SPACE RESEARCH USERS
<ul style="list-style-type: none"> ● OVERVIEW OF STS (9 MINUTE FILM) ● TRANSITION PLANNING ● UPPER STAGES ● PRICING POLICY ● TERMS AND CONDITIONS OF USE ● COST CONSIDERATIONS/COMPARISONS ● WORKING WITH STS 	<ul style="list-style-type: none"> ● OVERVIEW OF STS (9 MINUTE FILM) ● STS IMPACT ON SPACE RESEARCH ● STS STATUS, PRICING, PROPRIETARY RIGHTS ● SPACE RESEARCH FACILITIES <ul style="list-style-type: none"> - LDEF - SMALL SELF CONTAINED PAYLOADS - SPACELAB ● SPACE PROCESSING ● SPACE RESEARCH OPPORTUNITIES/OPTIONS <ul style="list-style-type: none"> - BALLPARK PAYLOAD/COST DATA - CURRENT SPACE RESEARCH OPPORTUNITIES - RESEARCH ROLE FORMULATION - FUNDING SPECTRUM - INDUSTRY RESEARCH OPPORTUNITIES

FIGURE 4. BASIC PILOT CONTACT PRESENTATIONS

TABLE 3. LISTING OF PILOT CONTACT PRESENTATIONS
TO SELECTED ORGANIZATIONS (1976-1977)

User Category	Organization	Contact Date	Documentation
<u>U.S. Domestic Commercial</u>			
S/C Manufacturers	Hughes	11/2 (Follow-up 12/9)	BCL-SPUD-MM-76-10 (76-18)
	TRW	11/3 (Follow-up 12/8)	" 76-10 (76-18)
	Ford Aerospace	11/4 (Follow-up 12/7)	" 76-10 (76-18)
	G.E. Space Division	11/10	" 76-12
	RCA Astro Electronics	11/11	" 76-12
System Operators	COMSAT General	11/17	" 76-16
	RCA Americom	11/18	" 76-16
	Western Union	11/23	" 76-16
<u>Aerospace Manufacturers</u>			
NASA & DoD S/C	Lockheed	12/8	" 76-18
	McDonnell Douglas-West	12/9	" 76-18
	Boeing-Kent Space Center	12/10	" 76-18
	Martin Marietta	1/12	" 77-20
<u>Non-Current ELV Users</u>			
Contract Research	Stanford Research Institute	12/7 (Revisit 1/13)	" 76-18
	Battelle Memorial Institute	12/16	" 76-17
	Illinois Institute of Technology Research Institute	1/11	" 77-20
Space Processing	McDonnell Douglas-East	12/22	" 76-19

received, and seen as a valid first step in developing a working relationship with the STS. It was also evident that all of the current user organizations accepted the reality of the STS and were actively engaged in planning for STS utilization as a logical extension of their commercial activities.

The Shuttle pricing policy had not been approved or published during the time period of the presentations; consequently, the features of the policy were of greatest interest to the current users. The fixed-price contract feature was endorsed by all, and recognized as a substantial forward step as compared to the pricing policies applicable to expendable launch vehicles.

Among the current users, the concerns which were identified in the Pilot Program can be sorted into three broad generic types.

First, accessibility of timely, authoritative information was identified as the single most serious problem area from the current users' standpoint. In some cases, the information exists but is not readily obtained; in others, the information does not exist and must be generated by NASA. Examples most frequently cited as critical information deficiencies are:

- (1) Difficulty in obtaining timely, authoritative technical information (e.g., guaranteed integrated spacecraft environmental design parameters)
- (2) Incomplete policy formulation/interpretation (pricing of auxiliary services, retrieval scenarios, liability scenarios).

The second type of current user concern reflects on the users' perception of NASA's ability to achieve its stated objectives in three areas:

- (1) Shuttle Initial Operational Capability date (primarily concerned over reliance on one orbiter for the Orbital Flight Tests)
- (2) Price stability after transition (general belief that the STS traffic model is optimistic)

- (3) Ability of NASA (KSC) to effectively integrate large numbers of multiple payload flights required to maintain low-cost services.

Lastly, some of the concerns expressed by the users are caused by factors which cannot be eliminated but must eventually be accepted by the users. Among these are:

- (1) Loss of autonomy in launch scheduling (STS flight sharing concept as opposed to dedicated ELV experience)
- (2) Availability and cost of back-up ELV's in the transition era. (If the STS is delayed, or if a previously planned STS launch must be accelerated to a point prior to Shuttle availability, launch costs will increase drastically.)

At this point, it should be mentioned that the direct participation of a NASA representative was very beneficial for the presentations given to the current space users. Since these organizations are accustomed to dealing directly with NASA, the NASA representative lent credibility and demonstrated NASA's sincerity in soliciting the users' points of view.

The direct participation of NASA personnel was found to be less critical with the non-current ELV user organizations, particularly the private research institutions. Whereas the small self-contained research package concept generated considerable interest, a serious commitment to pursue space research will require considerable user development effort. The point was expressed that the Shuttle policies, as they now exist, offer no incentives to new space users. The implication was that the STS is a direct benefit to established commercial space users (communications industry) as an extension and improvement of their operations. With new users, however, and with unproven technologies, innovative approaches will be required to mitigate the otherwise prohibitive financial risks to industrial users.

TASK IV - EVALUATE THE RESULTS OF CONTACTS

Objective

The objective of Task IV was to review the observations made during the pilot contact meetings to determine how the STS can best accommodate the 'users' needs.

Procedure and Results

The pilot contact meetings provided an opportunity for each prospective STS user to identify his concerns and needs. The needs are summarized below and form a basis for the User Development Plan of Task V.

Current Commercial Users

The Pilot User Development Program has demonstrated that the manufacturers and operators of commercial spacecraft have already begun serious efforts to transition to the STS and to exploit its capabilities. To a large extent, this group would transition to the STS eventually, whether or not a concerted user development activity beyond the pilot contacts were established within NASA.

Consequently, this category of user requires services from NASA, as opposed to development activities, per se, to permit them to conduct rational planning activities. In particular, a need was identified for timely, authoritative and consistent information with regard to both technical and STS policy matters.

Specific informational needs are:

- A guaranteed payload bay environment for system designs now underway
- Refined definitions of standard and optional services
- Cost information on optional STS services
- Technical and cost data on upper stages

- A better understanding of liability questions with regard to:
 - first party and third party
 - damages between sharees
 - damages to orbiter
 - business interruption insurance
 - possible legislation to establish upper liability limit
- Clarification of retrieval policy.

While the specific items of information required by these users will change with time as the STS matures, the primary theme is the requirement for a central, authoritative contact point within NASA which has the ability and motivation to respond to informational needs in a timely manner.

With regard to technical information, NASA must be able to provide reliable, consistent information on a variety of interface questions. The involvement of STS contractors (orbiter, upper stages, etc.) is probably a necessity to insure accuracy of information. The inclusion of these contractors in the user informational process will, however, require safeguards for the proprietary interests of the users. No agent of NASA's user service activity must ever be perceived by the user as a potential competitor.

The concept and philosophy of the STS User's Handbook are viewed favorably by the current users, and this publication should, in the future, provide much of the routine technical information required by commercial planners. From their experiences with the use of expendable launch vehicles, current users indicated Delta Restraints Manual as an example of a good, workable user handbook, with the proper depth and organization.

Non-ELV Users

The development of non-current space users is a fundamentally different and more difficult problem than the transitioning of current

users; it is necessary to stimulate the basic interest in the benefits of space in addition to promoting the beneficial applications of the STS. User development activities must take place over an extended period of time. Each potential user segment will present unique attitudes, interests and barriers to STS user development.

Aerospace Organizations. Following their current business interests, the aerospace companies will continue in a support role to NASA and DoD, regardless of STS user development efforts. The challenge, then, is to encourage these organizations to undertake space brokering or to develop space facilities for other users. It follows that these hoped-for activities are dependent upon a sufficient volume of business from other industrial organizations. None of the aerospace organizations contacted during the pilot program indicated a current interest in non-government-supported business ventures involving the STS.

Private Domestic Industry. There is a dearth of technically credible and economically attractive technologies matched to the needs of new users. A necessary first step for NASA is to assess its current space technology development areas to identify high potential technologies that can be economically attractive to private industry. These technologies should then be developed as a product line which would include a candid appraisal of the technical potential, problems, options and applications.

Each of the space technology areas selected for development should be promoted in conjunction with the space facilities applicable to the technology (LDEF, free-flyers, Spacelab, small self-contained package, etc.).

NASA should also determine the options it may have to provide government funding to stimulate industry involvement in space. Cost-sharing concepts should be evaluated.

In addition to economics, proprietary rights and confidentiality of data are major concerns to industry. While this subject is addressed in the current "Policy on Reimbursement for Shuttle Services Provided to

Non-U.S. Government Users", NASA should consider additional policy statements to cover cost-sharing situations.

Private Research Institutions. The private, non-profit research institute derives its income from research projects conducted for industry and government. The participation of such institutions in research activities involving space flight is thus completely dependent upon funding from external sources. For industrial sponsorship, a market will only exist if private industry is willing to commit itself to space research; consequently, the user development problems previously mentioned for private industry are of equal importance here. Projections of the space research market should be made universally available to research organizations as a part of the user development effort.

The research facility options available for private use should be promoted. Basic capabilities, reimbursement charges, availabilities, policies, etc., must be presented in contacts with the private research laboratories.

TASK V - RECOMMEND A FULL-SCALE STS USER
DEVELOPMENT PROGRAM PLAN

Objective

The objective of Task V was to develop a detailed plan for implementing the full-scale STS User Development Program for all potential space users.

Procedure and Results

The basic procedure for Task V was to evaluate the results of the contacts made during the Pilot User Development Program; assess the service and development needs for all user categories as well as the capability of NASA to meet these needs; and develop a plan for implementing a full-scale STS User Development Program.

The plan was structured to perform three fundamental functions:

- (1) Maintain and support the on-going user
- (2) Expand the activity of established users and develop new users in established areas of space use
- (3) Stimulate new uses of space by fostering the development of new technologies.

The recommended plan reflects the view of Battelle that a passive, non-aggressive approach to the development of new space users will significantly compromise the possibilities for realizing the full objectives of the STS. This opinion is founded upon current and past STS user development activities, long experience with NASA and the space program, in-house experience in dealing with research for industry and government, and from extensive observation and analyses of high technology industries. Further views of Battelle are that:

- (1) While the current users of expendable launch vehicles can be expected, in time, to transition to the STS, the achievement of the projected flight rates demands the development of new uses and new users.

- (2) The STS does not represent a monopolistic product to most potential new users because space transportation, in any form, is not pertinent to their perceived need at the present time.
- (3) The involvement of new STS users must be stimulated through a continuing program which provides high visibility for credible and beneficial space technologies.
- (4) The STS and related facilities (LDEF, small self-contained payloads, free-flyers, Spacelab), as well as high potential space technologies, should be offered to new users as an integrated space product line.

A centralized focal point for STS user development is recommended in the Implementation Plan to minimize the fragmented information source situation which currently exists. Furthermore, it is recommended that the full-scale user development program should utilize the expertise and flexibility of support contractors. The central organization within NASA, with contractor support, can serve to focus agency programs and technology developments on the major, common goal of satisfying user technology needs through broad applications of the STS. The cooperation of all elements of NASA is essential to an effort which means so much to the future of the entire agency and to the nation which has invested its resources in development of the STS.

The full-scale development plan is documented in two volumes. Volume I, the "Executive Summary of the Full-Scale STS User Development Program Plan", contains a synopsis of the plan; while Volume II, "Full-Scale User Development Program Plan" contains the full discussion of the background, results of previous user contacts, approaches recommended for specific user groups and organizational considerations. The plan is intended as a guideline for future near-term and far-term user development and includes a monograph on the general user development approach.

A synopsis of each section of Volume II was prepared for the executive summary of Volume I to provide a rapid overview of the entire plan and to provide concise data for reference. These synopses are included on the following pages. It should be noted that a page number reference is included on each synopsis to provide a correlation to the applicable page number in Volume II.

INTRODUCTION (pp. 1-5)

Premise - - A *passive* user development strategy, which *assumes* that new users will come to NASA, *will not be adequate* to fully exploit the *full capabilities* of the Shuttle.

"- - -requires an active, coordinated, agency-wide user development approach to stimulate the interest in users."

"- - -*immediate concern* is the early *transitioning* of current users of expendable launch vehicles for space use to *the STS*."

"-- -potentially (there is a) *broad spectrum* of new users *not presently involved* in space."

" - (the user development plan) - a *guide* for use by NASA in the area of marketing the STS." - "covers the *entire scope* of STS user development:

- U.S. commercial organizations
 - U.S. Government agencies (except DoD)
 - Foreign organizations
 - Principal investigators."
-

HISTORY OF USER DEVELOPMENT PROGRAM (PP. 6-7)

NASA's User Development Program represents a four-year effort:

- **Phase I – Feasibility Study**
 - Four contractors
 - Industrial segment
 - U.S. Government agencies (other than NASA/DoD)
 - International segment
 - Educational segment
 - *Concluded* user development *was feasible and necessary* for NASA
 - **Phase II – Definition Study – New User Development Program**
 - Battelle refined concept and developed approaches for user development activity
 - Developed structure for program and conducted a series of test cases
 - “- - - (there is an) analogy between industrial product marketing and sales and the required functions of the new user development activity within NASA for the STS
 - **Phase III – Implementation – Pilot User Development Program**
 - Contacted a selected sample of current space users and potential users
 - Developed a plan for full-scale user development program
-

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NEED FOR CONTINUED USER DEVELOPMENT (pp. 8-12)

• User Development:

"- - - the *underpinning* for building a viable STS operational business plan, derived from realistic assessment of the user market."

"- - - *provides budgeting support* for the NASA operational STS business."

"- - - main source of new uses and users is in the area of private enterprise conducted for a profit."

• User Development Program Provides:

- Inputs to STS operations planning
- Inputs to user services planning
- Inputs to actual flight operations
- Validation of the traffic requirements for STS
- Expanded interest for the use of space
- Basis for budget support
- Basis for Annual Report to Congress on business posture of STS operations
- Basis for maintaining technological balance of payments relationship
- Basis for cooperative ventures between U.S. Government/U.S. business that should be pursued
- Assessment of competitive posture.

"- - - focus on development of potential business interests, their needs and their expectations from the government in order for them to invest in new space technology ventures."

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ASSESSMENT OF PILOT USER DEVELOPMENT ACTIVITIES (pp.12-16)

Overall, pilot contacts have *verified* the wide spectrum of potential new users and *validated* the need for user development strategy tailored to each user organization.

- Assisted NASA by

- Determining user's information requirements
- Contributing to User Handbook activities
- Contributing to user pricing policies
- Providing insight into user interest in:
 - *Space research
 - *Space applications
 - *Space operations.

Specifically (Pilot Program)

- Current Space Users (operators and manufacturers)

- Were *supportive* of the idea of a NASA user development activity
- Were *concerned* about the business risk aspects of committing to STS
- *Want NASA* to maintain and expand these pilot contacts.

- Non-Current Space Users

- Provided insight as to effective approaches to developing space-knowledgeable potential new users
- Aerospace firms:
 - *Appreciated and expressed a need for the STS information provided in the briefings
 - *Liked the fact that *NASA STS was interacting with* their community.

- Private Research Institutes

- "— —fascinated with the near- and far-term *opportunities* available to them in various roles."
- "— —impressed with the space research *facilities* being developed and available to private research."

- Principal Investigators

- "— —the development of *independently funded principal investigators* can stimulate space research in areas perhaps not otherwise covered under NASA programs."

OVERALL FULL-SCALE USER DEVELOPMENT (pp. 17-22)

- **Overview**

- Full-scale user development will initially involve the community of space operators and spacecraft manufacturers *currently using* expendable launch vehicles (ELVs)
- Development of new users will encompass the promotion of a broad *spectrum* of new STS *applications*

- **Three-Phase Approach**

- *Near Term* (1977-1983)
 - * Transition of ELV to STS
 - * User services — dependent upon initial and preliminary lines of communication developed during Pilot User Development Program
 - * Major NASA effort — current ELV users
 - * Major contractor effort — new users
- *Mid Term* (1983-1987)
 - * Maintain current users
 - * Emphasize new uses and new users
 - * Develop use of space research capabilities
 - * Develop utilization of space research facilities
 - Spacelab
 - LDEF
 - Small, self-contained payloads
 - * Provide technology assessments
 - New applications
 - New research activities
- *Long Term* (1987-1992)
 - * Maintain current users
 - * Continue development of Principal Investigators
 - * Monitor emerging technology and capabilities (i.e., large structure activities)
 - * Monitor industry technological interests

- **Space Technology Emphases —**

- A commitment to use STS will be made when the new user understands and accepts the benefits and application of a demonstrated space technology.
-

OVERVIEW

- "-- --has *essentially implemented* the first steps of developing the current domestic commercial users."
- "-- --a *working relationship* between the STS Operations Office and these organizations has been *established* -- providing a *focal point* for obtaining consistent authoritative information."
- "-- --(current domestic commercial users) -- have *already begun* serious efforts to *transition* to the STS and to fully exploit its capabilities."
- "-- --these efforts are *compromised by uncertainties* which *must be resolved* -- to expedite the transitions -- to minimize difficulties which could lead to consideration of competitive ELV systems such as Ariane."

Principal Observations

Current space users include space system operators and spacecraft manufacturers, who expressed views on:

- **Information problems:**
 - Accessibility
 - Completeness of policy formulation (i.e., confidentiality, liability)
 - Consistency.
- **Credibility problems:**
 - Initial operational capability date
 - Price stability after transition
 - Integration ability (multiple payloads)
- **Ability to accept**
 - Loss of autonomy
 - Availability and cost of back-up ELV

Needed User Development Activities

-- Provide information, strengthen credibility of NASA.

- **Recognize information needs of user:**
 - Information exists, implies central point of contact

- Information must be generated, implies broadly qualified staff
- Confidentiality, implies non-potential competitor

● **Information transfer:**

- Formal presentations, exchange of viewpoints and information
- Follow-up communications:
 - * Additional briefings as required
 - * Regular visits
 - * Letters/telephone calls.

Action Plans

- "-- --it is recommended -- establishment of a highly visible, effective user service operation which will be responsive to the continuing needs of the space system operators and spacecraft manufacturers."

● **Central contact:**

- Identify sources of information
- Output of requests for information through U/D central contact
- Inform users of central contact
- Ensure timeliness and consistency of information

● **Utilize STS contractor support -- orbiter and upper stage source of technical interface information**

● **Contact remaining current users -- first domestic, then foreign and international**

● **Define optional services and costs**

● **Develop and distribute policies and costs**

● **Address policy interpretation issues (i.e., liability, retrieval of spacecraft)**

● **Interaction program of NASA with operators and manufacturers:**

- Regular -- changes, action items, input to mission models, possible problem areas, opportunities to increase STS utilization
- Exceptional -- request for information, input to STS planning, major changes.

NON-CURRENT SPACE USER DEVELOPMENT (pp.34-44)

• Scope

- Aerospace industry
- Non-aerospace industry
- Educational institutions
- Private research institutions
- Private investors
- Consortia.

• User Development

- Assess on-going space technology development areas
- Identify and match high potential space technology opportunities and STS use concepts to a user
- Identify and develop user roles
- Help the potential user to assess the business opportunity and risk.

• Aerospace Organizations (Roles)

- Will continue in a design support role to NASA & DoD
- Can be developed to undertake roles of:
 - * Space brokering
 - * Development of space facilities for other users.

• Private Research Institutions (Roles)

- Use STS transportation for small research facilities and different configurations of Spacelab (leased or owned)
- Promote all space research facilities available for private use
- Organize laboratories into a part of national space research capability – third party represents NASA & industry
- Government-owned/contractor-operated (GOCO) role.

• Private Domestic Industry (Roles)

- Sensitive to STS economics
- Stimulation through technical and economic potential of space-related technologies
- Interest industry in actual experimental results having commercial potential.

• Approach

- Assessment of NASA relationship with industry – – needs more effective communications and working relationships – – firsthand knowledge of methods of operations, motivations for R&D, etc.
- *Policy options* should be explored concerning:
 - * Financial assistance to stimulate industry
 - * Proprietary rights
 - * Confidentiality
- *Confidentiality in operations* – needs descriptions of policies, procedures, operations and safeguards to assure user protection
- *Liability/risk* – NASA should analyze this issue
- *Space technology assessment*
 - * Assess high potential technologies
 - * Develop into product line
 - * Promote in conjunction with all space facilities applicable.

CIVIL U.S. GOVERNMENT (NON-NASA) AGENCY DEVELOPMENT (pp. 45-53)

- **U.S. Government agency categories:**
 - Current ELV users
 - Non-current users.
 - **Follow-up on SRI study**
 - Contact the initial seven agencies
 - Contact remaining agencies
 - Approach in supporting role
 - Know users' goals, priorities, needs, etc.
 - Know limitations on R&D budget.
 - **Recommend the initiation of a program to make potential R&S'er aware of STS, etc.**
 - **Relationship:**
 - Image of support *for other government agencies' space-related budgets*
 - *Scenario* — space helps improve their capabilities — provides Congressional and Administration support for obtaining funds for their space activity.
 - **Approach for development of user — NASA in consultation role:**
 - Find principal R&D motivator in other government agency
 - Determine R&D budget situation
 - Review Congressional testimony for R&D plans
 - Determine benefit of space application
 - Develop approach and contact strategy
 - Initial contact:
 - * Allay fears of costs
 - * Service to user rather than involved in their problems.
 - **Contact point (NASA and the agency interface)**
 - People on same plane and not prior competitors
 - Understand background of person being contacted.
-

FOREIGN USER DEVELOPMENT (pp. 54-63)

- Recommends that a *pilot program* be undertaken.
 - *Size* of foreign market (relative and absolute magnitude) is *large if* 1976 National Payload Model is reasonable.
 - **Need for foreign marketing:**
 - Increase/protect market share
 - Counter the competitor's marketing activity (Ariane)
 - Validate payload models.
 - **Generalized Approach:**
 - *Market Assessment* – initiate prior to marketing effort
 - *Institutional Marketing* – arouse and sustain interest in Shuttle, aimed at highlighting benefits and credibility of Shuttle
 - *Targeted Marketing* – specific objectives (i.e., given communication satellite, an industry, a technology).
 - * *Selling* STS directly
 - * *Supporting* firms selling to third party
 - * Long-Term *development* of third party
 - **Approach to Specific Markets:**
 - *Multinational Organizations* –
 - * At technical/economic level; to technical/economic decision-makers
 - * At political level; institutional approach to member states, etc.; targeted marketing with U.S. delegations to multinational organizations.
 - *National Governments* –
 - * European Nations – institutional marketing through formal channels
 - * Japan – provide information to permit determination of Japanese role vis-a-vis STS
 - * Other Nations – regard as "targets of opportunity"
 - *Private Industry* – focus on market assessment and institutional marketing.
-

PRINCIPAL INVESTIGATOR (P.I.) DEVELOPMENT (pp.64-86)

- Prior P.I.'s in space funded *exclusively* by NASA; this should continue under existing AO approach.
- NASA should develop independently funded principal investigators
 - Cost of a ticket into space (as low as \$3000 for small, self-contained payloads) provides *new opportunity for attracting* independent PI's
- Advantages of small self-contained payload concept for P.I.:
 - Payload privacy
 - Research not tied to NASA's scientific programs
 - Protection of proprietary rights
 - Low-cost space transportation
 - Minimum NASA interface and paperwork.
- Sources of P.I.'s
 - Government agencies
 - Universities and colleges
 - Industry
 - * R&D is sole product
 - * R&D supports products.
- Impediments
 - *Source of funding* not apparent -- NASA should cultivate new P.I.'s and discover new sources of funding
 - *Lack of demonstrated successes* in space -- needs a few products or processes that are successful
 - *Lack of development/provisions for equipment* -- some P.I.'s won't develop equipment/instrumentation; prior precedent is NASA supplied

- Approach
 - *Maintain existing AO system* for NASA's P.I.'s
 - *Start new program* for attracting and developing independent investigators:
 - * Develop and promote a set of research facilities (product lines)
 - * Develop brochures and handbooks
 - * Publicize facilities
 - * Management support for P.I.'s.
- Plan (based upon small, self-contained payloads)
 - *Define role of small self-contained payloads* -- set policy as a means of attracting new, independently funded investigators, including:
 - * Flexibility
 - * "Great public value" clause for limited manufacturing
 - * Develop equipment facility
 - * Simplified integration-safety procedures
 - *Define physically* (handbook approach)
 - *Flexibility in policy* (weight, volume, power, pilot production)
 - *Develop equipment* -- NASA-developed equipment available gratis/rental/use-rate basis to P.I.; maintain catalog
 - *Attract* independently funded P.I. -- publicity, co-authors, general audiences, speakers, industry-university program
 - *Establish NASA single-point contact* for P.I. -- brochures, follow-up, handbook, equipment catalog, tariff catalog, launch schedules, procedure flow chart, liaison, contractual arrangements, investigate other options.

IMPLEMENTATION PLAN FOR FULL-SCALE USER DEVELOPMENT (pp. 87-108)

Functional Approach

"- - *recommended* that the plan be based on a *functional operation*."

"- - *serves* to coordinate the benefits and opportunities associated with appropriate space technology areas, *utilizing STS Applications*, to potential user communities through market research and user development efforts."

● Administration Function

Determines and administers policy; focal point for supplying operations data, information material, legal and contractual arrangements

● Technology Management Function

Coordinates technical information flow (to user development activity), provides technical support as required, overall assessment of high potential technology areas

● Market Research Function

- Selects highest potential user areas for STS
- Analyzes potential user community
- Identifies most likely user, provides detailed user analysis and STS applications, develops a profile of user community showing interrelationships of markets, financial conditions, etc.

● User Development Function

Interface between potential user and the STS User Development Program. Formulates specific marketing strategy - addresses three specific problem areas:

- Focusing on highest potential areas
- Strategy development
- Strategy implementation

Organization

● Present Situation

"- - existing decentralized user contact activity can have a major impact (negative) on the acceptability of the STS program to various users being contacted."

● Options Evaluated

- *Centralized User Development*: Office of Space Flight would be focal point for user development and user services. The implementation of the Functional Approach is estimated to require 10-15 people including marketing specialists.

- *Contractor - Supported User Development*: "- - it would be more cost effective for NASA to obtain the experienced, qualified personnel who would be required to do the market research and user development functions from outside NASA." Focal point would still remain the Office of Space Flight and manpower requirements would only be 5-6 individuals.

● Recommendations

It is *recommended* that NASA establish the overall user development function and employ industry resources to accomplish the Market Research and User Development functions.

● Conclusions

"- - *it is the view of Battelle* that taking a passive non-aggressive approach to the development of users other than the current ELV users will significantly compromise the possibilities for realizing the full objectives of STS."

- Mid-term and long-term future of STS - highly dependent upon *new* uses and users
- STS *does not* represent a monopolistic product to new users
- Interest of potential STS user *must be stimulated*.

DEVELOPMENT OF PRINCIPAL INVESTIGATOR USERS

Although the Pilot User Development Program concentrated on current commercial users of space and selected non space users, a secondary emphasis was placed on principal investigators (PI's), particularly those PI's with a potential for being privately funded.

The pilot contact activities for PI's were carried out under the scope of the five major project tasks previously discussed; but because the development of these potential users required a somewhat different approach than that used for the current corporate users, the pilot program activity is discussed separately in this section of the report.

While NASA-funded programs of interest to PI's will continue in the Shuttle era, there could be innumerable potential investigators with ideas for experiments not solicited by a conventional Announcement of Opportunity (AO). With the reduced costs of the Space Shuttle operations of the 1980's, it is likely that many potential PI's can find independent (non-NASA) funding.

Objectives

The objectives of the independently funded PI portion of the STS Pilot User Development Program were as follows:

- (1) To assess interest on the part of potential PI's in taking part in research in space
- (2) To determine potential problems facing NASA in developing the area of independently funded PI's
- (3) To formulate an approach and implementation plan for use in developing independently funded PI's as users of the STS and its space research capabilities.

Approach

The approach used in this part of the study was predicated upon the assumption that the small self-contained payload, designated a SARP (Small Autonomous Research Package) by Battelle, would be the preferred vehicle for most independently funded PI's to begin their space research and development ventures. This assumption was based upon two facts: (1) the SARP transportation charges are considerably lower than other means of getting into space (see Table 4) and (2) the concept of the small self-contained payloads, described in the NASA reimbursement policy, implies that it is aimed at the independently funded PI. With this in mind, a three-step approach was formulated:

- (1) Generate a preliminary description of the SARP that could be used in talking to potential PI's
- (2) Contact potential PI's in such a manner as to ascertain interest in the SARP concept and elicit comments to assist in formulating a development plan for independently funded PI's
- (3) Use the information collected from contacts with potential PI's, along with other inputs, to draw up a suggested way of effectively developing independent researchers as principal investigators.

Each of these steps is discussed in more detail in the following paragraphs.

Preliminary Definition of SARP

The total official definition of the SARP concept to date is contained in a single paragraph of the Shuttle User Charge Policy⁽⁴⁾:

"Small Self-Contained Payloads. Packages under 200 pounds and smaller than five cubic feet which require no Shuttle services (power, deployment, etc.), and are for R&D purposes, will be flown on a space-available basis during both phases of

TABLE 4. ACCOMMODATIONS FOR SMALL EXPERIMENTS

	SPACELAB MODULE	SPACELAB PALLET	LDEF	SMALL SELF-CONTAINED PACKAGE (SARP)	SOUNDING ROCKET
TRANSPORTATION COST	Medium-to-High (Includes shared Spacelab cost)	Medium-to-High	Medium (\$150-200,000)	Low (\$10,000)	Low-Medium* (\$50-60,000)
WEIGHT	{ Not so critical as for LDEF, SARP and sounding rocket }		< 175 lb	< 200 lb	< 150 lb
SIZE			50 x 38 x 12 in.	< 5 ft ³	< 17" dia.
DURATION OF MISSION	7 or 30 days	7 or 30 days	6-9 months	~1-2 days	5-7 min.
MAN TENDED	Yes	Yes	No	No	No
HOW SCHEDULED	Firm	Firm	Firm	Space available	Firm
ENVIRONMENT	Shirt sleeve	Full space from shuttle bay	Full space	μ -g (3.3g launch)	10 ⁻⁵ - 10 ⁻⁴ g (25g launch and recovery)
SHUTTLE SERVICES	Full (pro-rate)	Full (pro-rate)	Deployment, retrieval	None	Power, telemetry, Environ. monitors
ORIENTATION IN SPACE	Negotiable	Negotiable	As desired (within LDEF limits)	Arbitrary	Dependent on Rocket Trajectory

* Based on 5-6 experiments per rocket as in SPAR program.

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Shuttle operations. The price for this service will be negotiated based on size and weight, but will not exceed \$10,000 in 1975 dollars. A minimum charge of \$3,000 in 1975 dollars will be made. If Shuttle services are required, the price will be individually negotiated. Reimbursement to NASA will be made at the time the package is scheduled for flight."

It was felt that some potential users might want additional information to help them determine whether ideas that they have would be SARP-compatible. In order to help with this determination, several types of information were prepared to use with potential SARP users. These included:

- A description of the Shuttle payload bay environment
- A description of several types of peripheral equipment that could be required by many types of payloads. This description included information on batteries, data-recording equipment, data-conditioning equipment, and controllers. Information included cost, volume and weight as functions of needed capacity.

This information was not intended to be definitive; merely to give a potential PI an idea of what he would have to cope with in terms of his SARP box. (In the development plan, it has been recommended that more work be devoted to defining both the SARP concept and its physical parameters and constraints.)

Contact Potential Principal Investigators

The major thrust of this portion of the program was to contact a variety of potential independently funded PI's to (1) see how much interest there is in the PI community in doing research in space and (2) determine what problem areas might be in the way of developing

potential users of space into actual users. As stated previously, it was decided to define this portion of the work in terms of the SARP package, partly because NASA-funded PI's would be likely to put their experiments aboard Spacelab, or a free-flyer.

Two major categories of potential PI's were contacted. The first included scientists inside Battelle's Columbus Laboratories; the second consisted of PI's outside BCL who had already shown interest in the SARP concept or who had a past history of space flight experimentation.

The contacts made within BCL were informal and followed the following sequence:

- (1) A meeting would be held with one or more scientists who might have some interest in space research. At this meeting, the various ways of obtaining access to space (Spacelab, sounding rockets, SARP, etc.) were presented along with their characteristics (previously shown in Table 4). The SARP concept was presented and ideas for SARP-compatible experiments were solicited.
- (2) Initial SARP ideas were submitted by about 50 percent of those BCL scientists interviewed. (Some scientists felt that SARP size and power constraints were too restrictive for the experiments they had in mind. Others felt that the problem of obtaining funding for their experiment, particularly from other Government agencies, presented too formidable an obstacle. Others were too busy to cooperate at the time ideas were solicited.)
- (3) In some cases, ideas were sent back to be amplified upon.

A listing of the ideas submitted during this process is included in the next subsection of this report.

With PI's outside Battelle, a somewhat different approach was used, with a different objective in mind. It was decided to talk to (1) persons already committed to the SARP concept and (2) persons with a background of working with NASA on previous programs. In this way it was hoped to discover (1) what was attractive about the SARP concept, (2) ideas about how the SARP concept could be promoted effectively, and (3) advantages and disadvantages of previous NASA programs that could be used as "lessons learned" in preparing for the STS era in general and in implementing the SARP concept in particular. As with the potential BCL PI's, the approach to the outside PI's was made on an informal, individual basis.

Analyze Results of the Contacts

The final step of the approach was to refine and analyze the results of the contacts with the potential independently funded principal investigators to produce a development plan for this portion of the space-using community. A brief summary of the highlights of this development plan is presented next.

Results

As a result of work performed in accordance with the approach just described, the following results were achieved:

- A conclusion was reached that the SARP appears to be a feasible concept and has attracted significant interest in those potential PI's who have been exposed to it.
- A number of problems were uncovered which will have to be dealt with in a positive and innovative manner to encourage a number of potential independently funded PI's to begin space research (either on the SARP or on other available opportunities).

- A development plan was drawn up that presents an orderly approach to be followed in developing independently funded PI's as active participants in the space program.

These results are presented at further length in the following paragraphs.

Interest in SARP

As a result of the pilot contacts made in this area, a considerable amount of interest in the SARP concept was discovered. Table 5 provides a listing of the pilot contacts that were made. It should be noted that the SARP concept was also presented in the course of the more formal contacts made to current space users and space manufacturers, as well as in the formal contacts made with the contract research institutes (Battelle Memorial Institute, Illinois Institute of Technology Research Institute and Stanford Research Institute).

TABLE 5. PILOT CONTACTS FOR POTENTIAL INDEPENDENTLY FUNDED PI'S

Individual	Organization
Dale Devore	Battelle's Columbus Laboratories (BCL)
Allen Markworth	BCL
R. E. Schwerzel	BCL
Verle Hale	BCL
David Fink	BCL
L. R. Megill	Utah State University
R. G. Moore	Thiokol, Wasatch Division
Grant Barlow	Abbott Laboratories
John Vanderhoff	Lehigh University

} contacted together

As a result of the presentation to Battelle, Battelle management has taken options on two 5-cubic-foot SARP's. The following is extracted from the meeting memorandum of that presentation:

"Battelle has established an Institute-wide focal point for space processing, and management feels that several applications of space processing utilizing the small self-contained payloads could be made throughout the Institute. There may be applications in both the private and public sectors involving experimentation for which Battelle is uniquely suited. Additionally, since proprietary results could later be sold to private users as concepts, finished products, or processes, internally funded speculative research is possible as well. It was pointed out, however, that though the cost of transportation (\$10,000 maximum per payload) was low, this represents only the tip of the iceberg when compared to experiment development, equipment design, and other development costs."

The following potential SARP experiment ideas were generated by Battelle scientists in a relatively short period of time:

- (1) Growth of single-crystal materials (Si, GaAs, $\beta\text{-Al}_2\text{O}_3$)
- (2) Translocation of solutes in plants under weightless conditions
- (3) Effects of microgravity on rhodopsin-mediated proton transport in biological membranes
- (4) Gas-utilizing reactions in space
- (5) Second-phase nucleation and growth
- (6) Analysis of convection currents at low gravity.

Three pilot contacts were made with persons representative of the outside principal investigator (PI) community. The individuals involved were:

- (1) R. Gilbert Moore of Thiokol and Dr. L. R. Megill of Utah State University

- (2) Dr. L. Grant Barlow of Abbott Laboratories
- (3) Dr. John W. Vanderhoff of Lehigh University.

Each of these contacts yielded a different perspective on the role of the PI and the utility of the SARP in Shuttle-era research. Vanderhoff represents the point of view of the university scientist with a corporate background (Dow Chemical Company). Barlow is a pharmaceutical company researcher and research administrator, and was a principal investigator on an ASTP experiment. Moore and Megill have been associated with aerospace activities for a long time, have an interest in promoting the use of space, and have generated and promoted an idea to use the SARP's as a way of giving selected undergraduate students hands-on experience in space research.

The major topics discussed with Mr. Moore and Dr. Megill included their idea of using the SARP as an experimental laboratory tool in an aerospace-oriented academic curriculum, and ways in which NASA can make the SARP concept more attractive to any potential user. Major points brought up included NASA consideration and determination of:

- Cost of nonstandard services such as :
 - SARP deployment and retrieval
 - SARP use of orbiter telemetry
 - Activation and deactivation of SARP experiments
 - Preferred location and orientation of a SARP within the payload bay.
- Whether dimension limitations will be placed upon a SARP other than the general 5 cubic foot limitation (or whether NASA might design or build a family of SARP sizes and shapes).
- Whether a "super-SARP" of maybe 7.5 cubic feet or 300 pounds could fall generally within the definition of a SARP.
- How much NASA oversight of a SARP package is required.
- What is the minimum amount of review, test and documentation necessary to satisfy NASA that a SARP meets its safety requirements.

- How many SARP's per year NASA can reasonably expect to fly.
- Whether there should be a single point of contact within NASA for persons with actual or potential SARP payloads ; this individual could significantly reduce the normal complexity of a payload user interfacing with NASA.

This contact demonstrated that there are individuals who are both interested in the use of space as a research and educational resource and are innovative in their thinking about how to use it and promote its further use.

Additional points coming out of all the contacts were as follows:

- Pharmaceutical companies are very much concerned about proprietary rights to processes and products.
- SARP represents a potential way of securing an approved facility for space manufacture of drugs (such approval is in accordance with very strict criteria administered by the FDA's Bureau of Biologics).
- Pharmaceutical companies are not interested in developing and building flight equipment, nor in developing the needed experimental equipment and instrumentation. They would be interested in renting or leasing such equipment developed by others or by the government.
- The Pharmaceutical Manufacturers Association (PMA) would be an acceptable and effective organization to coordinate NASA's development of the pharmaceutical community and individual scientists.
- The SARP is big enough to perform significant research.
- NASA sometimes funds and flies less than optimum experiments as a result of overruling recommendations made by their scientific advisory committees.

- In general, industry will not become interested in utilizing space until they can be shown that there are good prospects of short-term payoffs.
- The big question is who will supply money to PI's to perform research and furnish them with the tools and instruments for performing research in space.
- NASA needs to communicate with the individual PI in order to acquaint him with the capabilities and opportunities for research in space. This can best be done by means of informative articles in both professional scientific and trade journals in appropriate scientific areas.
- Formal presentations to corporate management levels are not likely to have much influence until scientists within the corporation have been acquainted with space research ideas and have started to promote the concept that there are products (and money) to be made in space.

Potential Problems

The pilot contacts with potential independently funded PI's brought forth a number of possible problems and concerns of these PI's.⁽²⁾ Some of the more pertinent of these problems and concerns (some of which were raised by more than one contact) are presented here:

- (1) A number of potential PI's feel that NASA does not understand their particular industries, situations, and research concerns.
- (2) NASA has little real credibility with other Federal research organizations that fund much PI work, particularly in the health and biology areas.
- (3) There has not yet been the demonstration of any R&D in space that promises fairly immediate commercial returns. Space R&D needs several success stories to serve as an impetus to spur interest (and investment) in space research.

- (4) The major roadblock to the development of independently funded PI's is the general lack of funds for space R&D. There is great competition for the research dollar, and most industrial concerns feel that the near-term payoff potential is higher in other research areas.
- (5) Most PI's are not interested in developing test and experimental equipment. Those who have participated in previous NASA programs (Apollo, Skylab, ASTP, sounding rocket) are used to having the experimental and peripheral equipment developed by others and made available to them by NASA.
- (6) SARP boxes and the means of their attachment to the Shuttle payload bay need more attention.
- (7) Many of NASA's communications to potential PI's are made in the wrong forums and present information that may be of more interest to NASA than to the PI's. This enlarges upon Item (1) above.

Development Plan

The Full-Scale STS User Development Plan (Reference 2) includes a number of recommendations for tasks that should be accomplished in order to develop independently funded PI's as users of space and the STS. These recommendations are summarized here:

- Define the role of SARP
- Define SARP physically
- Add flexibility to that portion of the User Charge Policy dealing with small self-contained payloads
- Determine what role NASA should play in developing and providing standard experimental, peripheral and attachment equipment for SARP

- Develop an effective method of getting the attention of potential new PI's and getting them interested in space research as a logical extension of, and complementary to, ground-based research
- Set up a single-point contact for persons interested in SARP as a research tool and for those who have already determined to use it.

In addition, it is recommended that NASA continue to rely on the present AO system to attract PI's to propose and carry out experimentation related to specific NASA program objectives and scientific thrusts. This system has worked well for NASA in the past, and there appear to be no good reasons for making major changes in it for the Shuttle era.

STS NEW USER DEVELOPMENT - SPACE PROCESSINGIntroduction

Past user development activities have substantiated an observation that the key to new user development will be through the stimulation of user interest in a beneficial space technology which is in some way related to STS applications and operations. In recognition of this it was determined to be necessary to address the need for understanding the complexity and implications of developing new STS users through an initial and basic interest at a space technology level. Space processing was chosen as an area of technology development which has high potential for commercial applications. Projections indicate that high potential prospective STS users include those related to industries which would benefit from space processing. A study was, therefore, conducted to assess the current space processing program from the views of selected individuals in industry, NASA and educational institutions.

A consultant to Battelle, S. H. Gelles Associates, was asked to conduct the subject study and to define an approach to effectively develop industrial user interests and user participation in STS space processing programs. Dr. Gelles is an internationally known specialist in materials research and development and has himself been a principal investigator in space processing research and sounding rocket experiments. The study dealt with problem areas and obstacles associated with developing industrial users, recommended solutions and specifically identified methods which can be taken by NASA, in conjunction with industry, to develop industrial interest and participation in space processing specifically and the STS broadly. Dr. Gelles' evaluation was accomplished by consultations with both industrial organizations and NASA personnel. Industrial organizations included those which have been involved in space as well as those that have had little or no contact with space. Most of the study information was obtained either from the literature or from conversations with several individuals representing organizations that are active in the space program.

Visits were also made to NASA Headquarters, General Electric Space Center and McDonnell Douglas Astronautics Company-East where additional background data was obtained. A few telephone conversations were also held with persons and organizations with little or no contact or experience with the space program. The latter type of contact yielded little information except an assessment of potential future interest. As had been previously found, "cold" contacts with organizations not familiar with the space program and the space environment usually require a gestation period before a fertile interchange can be effected.

The detailed study conducted by Dr. Gelles has been documented and is available at Battelle in the Pilot Program files (Reference BCL-SPUD-TR-77-1). In addition, a position paper was prepared during the program based partially on the results of Dr. Gelles' study effort. That paper (Reference BCL-SPUD-IL-77-47) discussed space processing and emphasized some industry views and identifiable factors contributing to industry reluctance to participate, with their resources, in the space processing program. The following discussion summarizes the results of Dr. Gelles' report, the referenced position paper and additional background derived from contacts with industry organizations during past user development efforts.

Impediments in Space Processing

Although space processing is considered to be in an exploratory stage by many with fascinating potentials for industrial applications, there is limited interest and actual involvement by the non-aerospace industries at the present time. There is also an indicated general reluctance on industry's part to become involved in the near future. Commercial industry does not appear to be ready to pursue space manufacturing at this time. The basis for this reluctance includes the following major factors:

- Technical credibility of space processing and related space products is lacking
- All economic benefit projections assume yet to be demonstrated technical feasibility

- Commercial space manufacturing will involve relatively long term return on investment
- Routine space manufacturing by industry will be completely dependent on a government controlled transportation system and facilities. Industry, if given the choice, does not want to run a business, portions of which they cannot control
- Basis for determining business risk is lacking
 - costs of space research are uncertain
 - capital investment in pilot space manufacturing operations is difficult to project
 - competition from Earth-based processes is unknown
 - pricing policy on Spacelab has not been developed
- NASA policy on patent rights, proprietary data and confidentiality of research by industry is of great concern. They question its enforceability and control, especially on an international basis
- Liability associated with industry use of the Shuttle and multiuser operations is of concern
- Limited product markets.

In addition to the general issues contributing to industry reluctance to involvement in space processing, many organizations and individuals have expressed concern over the R&D approach to space processing. This concern can be summarized as follows:

- The level of past funding (\$4M to \$5M per year) is not comparable to the potential benefits and importance associated with space processing.
- There is no indication of strong, adequate R&D support by NASA to bring the technology development to a point comparable to the development point achieved in the space communications

development by NASA. (Dave Keller of General Electric has stated that,⁽⁵⁾ "the long-term R&D role properly belongs to government" and that, "NASA can duplicate the success of COMSAT in space processing if it is properly funded and charged with the task of facilitating broad-scale industrial involvement". Keller went further to state that, "no industrial concern that we know of will assume the front end technical and financial risks associated with the current R&D phase of space processing which is based upon a few limited space experiments".)

- NASA space processing does not adequately reflect industry needs/views/problems.
- NASA does not understand the industries for which it is conducting research.
- The balance between scientific and applications oriented research is not consistently maintained.
- While it is recognized that credible research involves a careful approach to the development of new technology, care must be taken that this careful approach does not result in an appearance (to industry) of pessimism. Some industries, close to space processing, have the view that this may be occurring. This pessimism is not apparent in West German industry relative to their involvement in their country's space processing. A major contributing factor to that situation is government funding and government/business inter-relationships.

General Comments

A number of impressions were obtained as a result of Dr. Gelles' telephone conversations and visits. The small, self-contained package

concept for conducting research experiments was of interest, although none of the individuals interviewed had specific experiments to suggest at this time. (One of the individuals contacted thought that the pricing was unrealistically low.)

Organizations and individuals that had little or no exposure to the Space Transportation System and space processing could not contribute very much in the way of suggestions for encouraging the use of the Space Transportation System in the space processing and manufacturing areas. However, these individuals were enthusiastic about the program and in most cases would invite further exploration in this field in the form of visits by NASA or NASA representatives.

During the interviews a number of suggestions were offered for alleviating some of the problems/impediments delineated above. These included the following.

Program Publicity

Space processing and the Space Transportation System should be well publicized both to the public at large as well as to commercial organizations who would be potential users of the Space Shuttle. A newsletter which provides current information on the results of space processing experiments, on STS pricing policy, on decisions concerning proprietary rights and other pertinent subjects should be issued periodically. Pricing policy on optional STS services and Spacelab should be published when available. The newsletter should be designed to accentuate the merits of the program and to encourage participation by industrial organizations. The creation of other visual aids in the space processing field should also be supported in order to educate the public and potential STS users on the benefits of space processing and manufacturing.

Program Support

There is a great need for NASA to support well scrutinized ideas in the space processing area. These should be both basic support

studies as well as research activities specifically designed to develop space manufacturing processes.

Dialogs with Industry

NASA or a NASA contractor should carry on conversations with industrial organizations to encourage development of ideas for products to be manufactured in space. Such ideas should be at least partially supported by NASA in the early, high risk stage. The idea of a COMSAT type of development has been suggested.

Long Range Realistic Program

The development of a space manufacturing process could easily require a long time period (on the order of 15 years). Accordingly, a long range program with consistent funding should be planned to develop space manufacturing technology.

Conclusions

It appears at this time that no segment of industry is willing to pay for the complete development of a space manufacturing process. However, there are a few that are now willing to share in the costs in exchange for a patent position. In many ways the situation is akin to the development of the space communications industry. In that case, the feasibility of space communications was demonstrated through government support. As space communications matured, industrial participation and private funds have gone into further investments in this field. This has been a highly successful development and has led to great social and economic benefits. A similar course of events ought to take place now with space processing.

Review of the space processing program and its supporting efforts allow us to reach the following conclusions:

- Relatively few low gravity experiments have been conducted up to the present time, thus the technical base on which the space processing and space manufacturing program of the future is being built is very limited.
- Low gravity results obtained thus far and the many ideas for space products provide incentive for expanded work in this area.
- Space experimentation is difficult, time consuming and requires greater resources than terrestrial experimentation.
- New ideas for potential space products have been suggested but there is very little current activity aimed at their development.
- Some significant economic studies on potential space products have been conducted but these unfortunately are based on limited technical data. Thus, they appear to be based on unfounded technical assumptions and are not believed by the technical community. This tends to damage the credibility of the space processing program. The redeeming feature of such studies is that they provide a "feel" for important parameters that affect the viability of a venture. It appears that, at this point in time, it would be better to pursue the establishment of technical viability instead of, or, at the very least, in conjunction with further economic studies.
- Methods for interesting potential industrial users in the space program and for creating ideas for space products appear to be well developed. Some damage to the program, however, may arise from "on-again off-again" inconsistent efforts. Sufficient resources are needed to pursue in-depth

studies to attract as many potential space manufacturers as possible.

To counteract some of the problems associated with developing new users for the Space Shuttle in the space processing area, the following actions are recommended:

- (1) An active campaign to disseminate information on space processing to industry and other potential STS users should be waged. A quarterly space processing newsletter is recommended as one of the methods to be used. It should be interestingly written, well illustrated and should be addressed to a broad audience which includes both the industrial and scientific communities. Visual aids describing space processing and its potential should be developed for educating the layman as well as potential STS users.
- (2) A program should be initiated to encourage various industries to develop economically promising space processing/manufacturing programs of direct interest. These programs should be well supported by NASA either exclusively or on a cost-shared basis. As the ideas mature and the risks become more reasonable, it is anticipated that the pertinent industrial organization will assume all of the additional costs.
- (3) A flexible proprietary rights and patent policy for the situation described above should be developed.
- (4) Expanded and continuing support to both basic and applied research dealing with the development of space processing technology and space manufacturing should be actively sought.

AUXILIARY ACTIVITIES

Information Materials

A key portion of the pilot program was the development of an information package to be presented to each pilot contact organization. Two tiers of information were assembled. The first tier consisted of a basic information package applicable to any user community, consisting of STS overview, charge policy, terms and conditions of use, program status, upper stage summaries, transition planning, a review of known use areas, mission/service capabilities, STS user handbook information (objectives and organization), and other data to the degree available. Many brochures already produced by NASA's hardware contractors and by ESA were useful for material used in generating interest and providing background. The basic information package took advantage of existing materials to the extent possible, with modifications as necessary for effectiveness.

The second tier of information represented a customized user information package and consisted of details on the portion of STS with which the particular user might interface, projected use area, cost/benefit data and information responsive to anticipated resistance and issues of concern.

The development of information materials during the pilot program was based on the recommendations outlined in the previous Phase II New User Development Study and on suggestions by those who were intimately aware of user requirements for the Space Shuttle and the STS system.

Early in the program there was an aggressive effort to collect and review all existing available information on the STS system. Contributions for this review came from NASA, Battelle's space library, and aerospace organizations. The collection process provided the core team with a prime source of resources for information materials development. Examples of materials obtained include:

- (1) Written progress reports
- (2) Finished art work
- (3) Slides (35 mm)

- (4) Photographs
- (5) Concept and special reports
- (6) 16-mm films and film productions
- (7) Color video tapes
- (8) Public relations materials
- (9) Marketing information
- (10) Briefing materials

Special credit should be given to three organizations--NASA's STS Headquarters Office, Johnson Space Center, and Rockwell International's Space Division--for their continuous support throughout the program in the monitoring and forwarding of new materials. Frequent changes and updates of basic information were forwarded to our attention without delay. Such cooperation is essential to the development of information materials which address user needs.

One of the successful items prepared during the course of the program was the film, "Space Transportation System". This was an overview film report presenting a review of the present status of the STS system. The film satisfied a need identified early in the pilot contact study program by the user organization top management (who are responsible for allocating the necessary budgets for program activities) and by the appropriate user technical staff (from heads of R&D down to the line engineers). They preferred a document designed to stimulate the interest both of those who are present space users (who understand and deal constantly with the requirements of using space) and those who are nonusers but who will help make the decisions for the involvement of their organizations in the utilization of space. Many user contact presentations included personnel from finance, contracts and other support areas, who were only generally familiar with the STS. A positive reaction was received to this type of film reporting technique from the users because it was more timely than reports and documentation prepared by individual contractors.

The success of this 9 minute film report was achieved by incorporating creative film techniques in showing the latest finished art work and animated sequences of newly developed space applications.

In addition, new art work specifically designed for the presentation was prepared to demonstrate the total system profile. (These graphics have had additional applications in other briefing packages as color still photographs and as 35-mm color slides.) Film segments from NASA's Johnson Space Center and the European Space Agency were added to footage showing the Orbiter 101 rollout and Rockwell's test activity to demonstrate the reality of the development activities by the major contributors to the program.

It is strongly recommended that this film report be updated every quarter to keep pace with rapidly changing developments in the program. Through these up-to-date film reports the STS user community will become familiar with the contents and objectives of the entire program. The length of the film report should remain fixed at 9 to 13 minutes, and every effort should be made to control this production time. (Many users of the present film feel its length is well designed for a 30-minute briefing.) It is important to consider that a significant advantage of the film over other reporting techniques is the compression factor of time for presenting identical bodies of information. Normally, a film requires only half or a third of the time that would be required for a similar oral report. In other words, material which normally requires a half hour to present may be reduced to 10 minutes with a film report.

The STS user community has been preconditioned to visual communication through the impact of television news and documentary programs. Therefore, percentages are in favor of higher comprehension on all levels if a series of film reports can be developed with properly selected narrative and supporting graphics. Most importantly, the series must be kept up to date and provide new information.

Another advantage of the film reporting mechanism as it was originally demonstrated was that information could be presented in a factual context--free of political platforming. This characteristic impressed industrial organizations such as RCA and The Thiokol Corporation so much that they obtained copies of the film report to generate interest and awareness by top management and other potential STS users within

their own companies. These organizations strongly supported continuation of this reporting technique. A typical comment was, "The film report is the easiest and least expensive technique for presenting information on the STS program to our organization."

STS User Workshop at IAF Congress

The International Astronautical Federation Congress at Anaheim, California, October 11-15, 1976, afforded an opportunity to provide an initial familiarization of participants, especially foreign, with the STS.

A workshop was established in the Imperial Room of the Grand Hotel (convention headquarters) to provide a forum for informal discussions with those seeking information on potential use of the STS. In addition, a table was set up in the lobby of the Anaheim convention center for the same purpose. These facilities were manned by Battelle personnel.

Although the convention center lobby table attracted a large number of convention delegates, most of the more serious discussions took place in the Grand Hotel. Almost 500 copies of NASA SP 407, "Space Shuttle", were distributed, with most of these being handed out at the lobby table. This booklet was extremely popular with those delegates with only a general interest in the STS, including many representatives of the Soviet Union.

The small autonomous research package concept, described by Mr. Yardley in the opening session of the Congress as the STS's equivalent to the airlines' "Get Away Special", aroused considerable interest among the convention delegates, most of whom were scientifically oriented. Mr. Gilbert Moore, General Manager of the Astro-Met Plant of Thiokol, was particularly enthusiastic about the concept as an extension of their atmospheric research sounding rocket experiments. Extensive discussions with Mr. Moore explored several potential variations of use and reasonable optional services which might be provided by the STS at negotiated extra costs. Mr. Moore has subsequently initiated correspondence with NASA to be among the first users of the small package concept.

Among the notable foreign contacts was Mr. Jeffry Crowder, / Chief Design Engineer of the British Aircraft Corporation in Bristol, England. Mr. Crowder's interest is in the low-cost delivery of smaller spacecraft to orbit (the larger ones are handled through ESA).

NASA STS Briefing in Japan

On October 25-27, 1976, a detailed briefing on STS was held in Tokyo, Japan. Three NASA personnel made the presentation and two Battelle employees acted as observers. The primary briefing was made to the Keidanren (Federation of Economic Organizations), a private and nation-wide body representing all branches of economic activities in Japan. The briefing was coordinated by the Science and Technology Agency (STA).

The Battelle observations are completely documented in BCL-SPUD-MM-76-15. Some of the more general observations were:

- (1) A large audience was in attendance at all meetings, which necessarily limited the dialog with any one individual or organization. Overall, the briefings appeared to have been an active effort on the part of NASA to present the STS program to the Japanese nation, not individuals or organizations.
- (2) The general tone conveyed was one of a factual report more than a marketing venture. No specific next steps with Japanese organizations were identified.
- (3) It appears that there is a strong element of central planning in the entire Japanese space effort. To this extent, it appears likely that the decisions regarding initial use of STS may be more influenced by government policy than by corporate decisions.
- (4) Overall, the presentations were clear, direct, and effective.

Comments on Shuttle Pricing Policy

The Shuttle user charge policy "Reimbursement for Shuttle Services Provided to Non-U.S. Government Users", was officially published on January 21, 1977. For most of the time period of the Pilot User Development Program, therefore, the policy had not been written in final form and was subject to numerous suggestions for revision and/or clarification as a result of the pilot contact meetings.

Comments and suggestions relative to the user charge policy were submitted to NASA, Code MO, both in the form of written memoranda and in informal discussions.

CONCLUSIONS

The Pilot User Development Program, through briefings, follow-up meetings and analysis, has:

- (1) Helped to implement the first step in transitioning current domestic users from ELV's to the STS
- (2) Provided insight as to effective approaches to developing space-knowledgeable new users
- (3) Introduced private research institutions to the opportunities available to them for in-space research
- (4) Initiated the development of independently funded PI's to utilize the STS in areas not otherwise covered under NASA programs
- (5) Developed an implementation plan for a full-scale STS user development program.

Although some reservations and concerns persist among the current commercial users of space, they have already accepted the STS as an eventual replacement for expendable launch vehicles and have initiated positive steps towards transition. While some indicate that they want to keep their options open, they seem to view competitive launch systems, e.g., Ariane, as a greater business risk than the STS. As long as the STS price remains competitive, the additional competitive features of the STS (i.e., more frequent flight opportunities, proven and extensive launch facilities, potential retrieval and on-orbit checkout, and the dedication of the U.S. Government to the STS) will tend to assure that current users of space will be STS users.

The demonstrated interest in early availability of STS missions by an increasing number of current space users could lead to an erroneous conclusion that STS user development can be conducted from a monopolistic viewpoint, with only a passive, low-level development program. While it may be true that the current domestic users of ELV's

would probably transition to the STS eventually whether or not a concerted user development activity were carried out, all evidence indicates that new users and uses, vital to the attainment of projected flight rates upon which projections of the STS economic benefits as well as the pricing policy are based, will not evolve without an aggressive and extensive marketing effort.

In summary, it is the view of Battelle that a passive, non-aggressive approach to the development of users, other than the current. ELV users, will significantly compromise the realization of the full objectives of the STS. Further views of Battelle are that:

- (1) The mid- and long-term future of the STS (related to achievement of the projected flight rates and full exploitation of potential STS capabilities) will be highly dependent upon new uses and new users .
- (2) The STS does not represent a monopolistic product to the broad spectrum of potential new users who need to be developed because space transportation, in any form, is not a primary consideration in satisfying their needs at the present time.
- (3) The interests of potential new STS users, and the subsequent generation of new, innovative applications of the STS by those users, should be stimulated through a continuing program which provides high visibility for credible and beneficial space technologies.
- (4) The possibilities for full exploitation of all of NASA's high potential space technologies to new users can be greatly enhanced by the coordinated exploitation of the STS, and related space facilities being developed (e.g., LDEF, small self-contained payloads, free-flyers, and Spacelab facilities) as an available space product line.

A full-scale STS user development program plan, as developed in this study, gives full consideration to the overall objectives and the unique requirements associated with the many different categories of potential users. It is essential that NASA make all potential users fully aware of the beneficial features of the combined STS and space technology use areas as the basis for user development beyond the scope of the needs of current space users, i.e., transportation to space. The centralized organization at the OSF level recommended in the Implementation Plan can minimize current fragmented contacts with users by providing a focal point for STS user development. The full-scale user development should utilize the expertise and flexibility of support contractors and can serve to focus the purpose of the agency programs and technology developments on the major, common goal of satisfying user technology needs through broad applications of the STS. The cooperation of all elements of NASA is essential to an effort which means so much to the future of the entire agency and to the nation which has invested its resources in development of the STS.

RECOMMENDATIONS

The Full-Scale STS User Development Program Plan⁽²⁾ contains a complete discussion of the recommendations for the STS Pilot User Development Program. These recommendations are founded on an underlying conclusion that NASA should not stop with the physical development of the STS; but should participate with the users in the process of developing expanded uses and new uses that will fully utilize the capability afforded by the STS.

To implement the Full-Scale STS User Development Program Plan, Battelle recommends that NASA:

- Establish an STS User Development Program
- Organizationally focus the program at NASA Headquarters, Office of Space Flight
- Identify the STS User Development Program as a line item of the OSF budget
- Support the program with a staff of 5 civil service personnel and 10 contractor personnel at a level of approximately \$1 million per year.

REFERENCES

- (1) "Final Report on Phase II STS New User Development Program", Battelle Columbus Laboratories, Contract No. NAS8-31621, March 26, 1976.
- (2) "Full-Scale STS User Development Program Plan", Battelle Columbus Laboratories, Contract No. NASw-2964:
Volume I - "Executive Summary of the Full-Scale STS User Development Program Plan, Revision 1", March 25, 1977.
Volume II - "Full-Scale User Development Plan for the STS Pilot User Development Program", March 8, 1977.
- (3) "User Contact Plan for the STS Pilot User Development Program", Battelle Columbus Laboratories, Contract No. NASw-2964, September 21, 1976.
- (4) "Reimbursement for Shuttle Services Provided to Non-U.S. Government Users", NASA Management Instruction (NMI 8610.8), January 21, 1977.
- (5) National Space Institute Newsletter, February, 1977.

APPENDIX

EVALUATION OF USER DEVELOPMENT FACTORS

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EVALUATION OF USER DEVELOPMENT FACTORS

INTRODUCTION

In addition to the five specific study tasks, the contract Statement of Work identified a number of specific user development factors to be explored and reported upon during the performance of the five tasks. These factors are relevant to achieving a thorough understanding of full-scale user development and an appreciation of the complexities associated with each user segment. Specifically, the factors assessed during the pilot program are the following:

- Evaluation of the barriers to user development identified in previous user development studies (Phases I and II of the New User Development Program and Beneficial Uses of Space Study)
- Evaluation of the effectiveness and role of agency/ space program/STS advertising (promotional) activities relative to the STS user development effort
- Evaluation of the roles and effectiveness of team effort and individual efforts considering NASA and outside NASA participants in STS user development
- Identification of the need, type and roles of consultants required to support user development

EVALUATION OF USER DEVELOPMENT BARRIERS

The validity of many of the barriers reported in the Phase I and Phase II user development studies was reinforced during the conduct of the Pilot User Development Program. Several initial barriers, however, such as those arising from the need for a tariff model (pricing policy and terms and conditions of use), as reported by Arthur D. Little (ADL), have been essentially eliminated as policies and procedures have been developed and instituted

by the STS Operations Office. The development and issuance of a pricing policy for the STS and policy on proprietary data have had a very favorable impact on the development of current users. The solicitation of user inputs on the critique of these policies was also well received by the users. Remaining policy on optional services, upper stages and Spacelab, when published, will further facilitate user development efforts. During the pilot program, an effort was made to review all of the initially reported barriers for reality and current applicability. Barriers which appear to have continued significance to the STS User Development effort are discussed below.

Commercial Sector

Both the Battelle and ADL Phase I studies addressed the commercial sector through major multinational organizations. Aside from specific problem areas indigenous to the foreign market, such as the resolution of international patent policy issues and proprietary rights, many barriers critical to both the U.S. and foreign commercial markets are nearly identical. Key barriers to current STS marketing in the commercial sector include NASA image, incompatibility of government and business objectives, information gaps, NASA unfamiliarity with marketing, NASA monopoly, STS access, potential user priorities, finances, and product complexity. These are discussed below. Other barriers arising from the user's sophistication, or lack thereof, in space are also addressed as a still relevant set of barriers as outlined in Battelle's Phase II effort.

NASA Image

NASA has been perceived by some to have based the Shuttle program on its own goals and technology rather than on a market need. Some potential customers, therefore, view the Shuttle program as a means to perpetuate NASA, not serve customers. Another problem with image is the NASA history of large, high-technology projects, which could tend to intimidate the economically constrained commercial user. Coupled with these difficulties is NASA's position as a government agency. Over the years, industry has developed an

inherent mistrust of involvement with the U.S. Government. Primarily, this mistrust has grown out of fear of increasing governmental control of private industry. This control takes such forms as antitrust actions, price controls, punitive taxes, accounting and business practices. While these actions generally have been within the established laws of the land, they nevertheless have caused problems in the conduct of business and have contributed to this overall wariness which has caused some companies to avoid doing direct business with the government.

Incompatibility of Government and Business. NASA is technology and politically oriented, while the majority of potential customers in the commercial sector are business oriented. NASA methodology is based on government rules, while potential customers have other methods of doing business, equally rigid. NASA's objectives are to serve the public and advance science. The objectives of potential commercial customers are to make a profit and/or achieve growth. These different objectives contribute to interaction problems. The various government agencies are set up to serve the best interests of the general public. Industrial organizations are established primarily to provide maximum return on the stockholders' investments. In many instances, these objectives can be in opposition. One specific example related to the STS involves ownership of data or proprietary rights. If industry invests its own money, it generally wants exclusive use of any data/product that might result. However, in some instances this may be in conflict with established policies of the government.

Information Gaps. There are two kinds of information gaps; a communications gap, which indicates that what is known about the STS is not getting across to potential users, and a knowledge gap, which indicates that very little is actually known about potential STS applicability to a variety of users. Because of the communications gap, neither the general public nor potential new customers understand what the Shuttle might do for them. NASA has to gear up and address the market for Space Shuttle in terms potential customers would understand, i.e., cost/benefit of specific applications. The knowledge gap arises because neither NASA nor the industry fully understand potential uses for the Shuttle. The evolution of sound, demonstrated, economically feasible applications will therefore be necessary in order to develop users.

NASA Marketing. NASA has limited experience as a marketer and has a limited base of market intelligence information, thus making it very difficult to understand the potential market. Additionally, potential markets for the STS are very diverse and scattered, requiring a large effort to obtain coverage. Distribution channels do not currently exist and will be required. Both the Battelle and the ADL studies addressed the need for a middleman organization to develop the industrial market, given the barriers and difficulty NASA would have in gearing up for the effort. This observation is still valid.

NASA Monopoly. There are no foreseeable alternates to many applications of STS. Potential customers will resist, to the extent possible, putting themselves at the mercy of a single service over which they may exercise only the most limited control.

STS Access. The shared system concept of STS to achieve economies will demand some user flexibility and impede access. To some extent, long lead times, scheduling requirements, etc., will seem burdensome to some users.

Potential User Priorities. Many potential STS users will have a more immediate need to solve other problems such as environmental and energy problems, shortages of materials, and so on, than to consider use of the Shuttle. Potential users rationalize that they have not needed the Shuttle to date, and NASA has not demonstrated a need or an economic potential to them. There will be a negative momentum until economic and technically feasible uses are made of the STS by more aggressive organizations. Because of this lack of urgency to consider the use of the STS in the face of their day-to-day problems, a strong and well-directed promotional effort will be required to prepare the commercial sector for commercial utilization in the 1980's.

Finances. Compared to ground based facilities, space is very expensive to most potential commercial users. Potential customers will view the STS as an unusual, very expensive, previously unnecessary cost item. Costs of adapting processes, procedures, and experiments to the STS also will be high.

Operating costs associated with Shuttle will be high by existing standards. The normal business of potential users will be a strong competitor for funds. Not only will the STS seem to be an expensive alternative to other projects undertaken by a commercial firm, but the available dollars may be small to begin with.

Complex Product. There are many problems in using the Shuttle, including scheduling, procedures, regulations, etc. To potential users not familiar with NASA, this complexity makes use of the STS seem difficult. A great deal of system procedure streamlining and potential user "handholding" will be required to attract new commercial users.

Temporary Barriers. There are many other barriers in addition to the major ones outlined above which are no less real, but are of a more temporary nature. These include lack of risk assessment, unavailability of insurance and risk scenarios, and concern over confidentiality of information and patent rights in subsidized situations. Additionally, there is concern over future STS program cost escalation, and factors such as dependency on one orbiter, to meet program timetables. Once the system is operating, the experience gained will minimize or obviate these barriers.

Barriers Dependent on a Particular User's Sophistication in Space. In Battelle's Phase II New User Development study, it was shown that barriers and opportunities relate to the financial or market opportunities of a particular company and to the organization's sophistication with regard to space, and familiarity with NASA. These barriers will continue for the duration of the STS program. The spectrum of potential users of STS ranges from those in the space business, those on the verge of entering the space business, to those not in or knowledgeable of the space business. The identification of user organizations within each category will change with time as the STS becomes initially operational and evolves into a mature operation.

Current space users will view the STS as a potential means for product/system improvement, system expansion or variations, and product/system derivatives. Barriers to these users will be in terms of their

comparison of the STS to their current space operations and space transportation system, i.e., the expendable launch vehicles. Their resistance to or acceptance of the STS will be very dependent upon the competitiveness of the STS, not only as space transportation, but as a complete, competitively structured launch service. Their sensitivity to STS user charge policy and terms and conditions of use will be in direct comparison to those associated with their current space launch operations. Performance and system flexibility benefits to be provided by the STS will be evaluated or resisted in terms of the benefits/costs. Current users will be very sensitive to expendable vehicle-to-STS transition planning, availability of the STS, demonstrated reliability, implications of committing to STS and the availability of alternative (and competitive) launch systems.

Potential user organizations which have had little prior interest or involvement with the space program must be educated as to the benefits of space and the application of the STS. Initial barriers will be in terms of misunderstanding or lack of understanding of space/STS. Subsequent barriers could result from NASA's inability to relate STS benefits to a potential user's needs, problems, operation, and organization. Initially, another barrier will be lack of fully flight-demonstrated technology. The use of STS will depend upon the economic assessment of the projected market, cost of R&D, cost per flight, cost of total (Earth and space) processing, and facility and resource investments. Some indication of NASA initial funding, as a cost of marketing, may be needed to encourage the interest of some users who typically do applied research as compared to fundamental research.

Government Sector

While contacts to the government sector was not included in the pilot contact program, it is felt that many of the barriers faced in developing commercial users have analogs in the government sector as well. Barriers arising from industry interaction with the government will not exist, of course, since other government agencies are appreciative of governmental control and policy. The Phase I New User Development study conducted by SRI, however, indicates that other government agencies will resist a NASA approach that does not leave the direction and responsibility for the overall problem-solving program with the potential user. Battelle agrees. Further, interagency feelings on charter responsibilities, budget allocations, prestige and Congressional backing, etc., represent barriers to developing the STS user in other government agencies. Resistance to dealing with NASA may be influenced (more or less) by agencies which have had previous program involvement with NASA. Sensitivities to STS launch costs and charge policy will be just as real (considering budget constraints) as commercial users' concerns considering profit incentives. As discussed in the commercial sector above, information barriers, agency priorities, limited budget, STS complexity, and other barriers apply similarly to the government sector. The SRI study indicates the need for user development activities within the government sector similar to those in the commercial sector:

"The interface must provide currently valid input to NASA regarding the goals, needs, and priorities of potential STS users within the domestic government sector, (and) the interface shall provide a means to develop interest within the potential user agency for transforming a potential use into a reality."

Education Sector

Though the education sector was not specifically a part of the pilot contact program, Battelle feels that many of the barriers outlined above have analogs in this sector as well. The Phase I study conducted by the

University of Alabama at Huntsville calls out two critical areas to educational sector participation in STS. The need for awareness, and the need for involvement:

"The need for awareness -- It is imperative that educational decision-makers be made aware of Space Shuttle/Spacelab capabilities as soon as NASA decisions are made regarding SS/SL activities. A high percentage of the contacts sampled during the study were not aware of NASA capabilities which could be applied to their needs.

The need for involvement -- It will not be possible for NASA, even with a large (development program), to adequately plan for the application of SS/SL capabilities to the needs and purposes of the educational community without complete and continual involvement of education from the areas involved. It is deemed advisable that as planning progresses in each application program the results of that planning be disseminated as broadly as possible to the educational community so others may sense what aspects of it might be brought to bear on their own problems."

The study indicates that the major constraints on involvement of the educational community are finances, organization and communication. Similar to conclusions reached in studies of both the commercial sector and the government sector by Battelle, ADL, and SRI, the University of Alabama at Huntsville finds in the educational sector that the following considerations are critical to user development:

- Understanding user needs and priorities
- Technological assessment
- Cost effectiveness of STS use
- Finances (pricing)
- Clear communication channels
- Motivational aspects (incentives).

Each of these considerations, as with users in other sectors, represents a barrier if not properly addressed, and collectively are viewed by Battelle as currently valid.

International User Development

Many barriers to developing the commercial sector, as discussed above, apply to both domestic and foreign businesses. The development of users in the international sector is further complicated, however, by a variety of business, finance, legal, regulatory, and political factors not present in the domestic market for STS. Business factors include understanding of foreign business systems and international intermediaries. Financial considerations include credit and insurance, foreign exchange, and investments. Legal policies vary from country to country, with resultant contractual difficulty. Regulatory factors vary widely among countries in industries such as the drug industry. Political considerations range from protocol to balance of payments, and even to ELV systems operated by foreign governments. Adding to these complications is the difficulty in understanding user needs and objectives in a foreign environment and extensive communication and travel requirements. U.S. regulations on the export of technology and the involvement of the Department of State will further complicate international user development.

Though actual pilot foreign contacts were limited to the Japanese briefing, the foreign market was extensively reviewed during the pilot program, including discussions with Battelle's Frankfurt Laboratories, active in the German space effort. The barriers noted above indicated the need for international expertise in interfacing with the European aerospace and R&D communities.

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Role of Promotional Activities in
the STS User Development Effort

During the Pilot User Development program, the roles of various promotional activities in the STS user development effort were considered. Typically, the more complex, costly, and technologically advanced a product is, the more important personal interaction with the potential user becomes to the overall marketing effort as opposed to promotional activities. IBM, as an example, concentrates its marketing effort almost entirely on personal selling, and affords advertising only a minor role compared to the overall sales effort. Similarly, because the STS represents a sophisticated technological product, it is recognized that the user development effort will require personal contact with potential users as a baseline activity. Stimulation of the potential user to consider STS will require individual attention to specific user needs and conviction of the user as to economic and technical feasibility, possible only through personal interaction with the potential user.

Though promotional efforts will therefore be secondary to direct potential user interaction, they are nevertheless necessary to perform an essential information transfer function. Promotional efforts are required in order to generate awareness of STS and its capabilities in a diverse range of potential users, and nurture attitudes which make them susceptible to further development. As the program reaches out beyond current space users to embrace those potential users not familiar with STS and space applications, the need for generating awareness and positive associations (e.g., cost/benefit) increases tremendously. The user development program should rely heavily on personal interaction to obtain potential user commitment, but must employ a mix of promotional activities aimed at creating awareness and positive attitudes.

Potential Activities

The range of promotional activities available to the New User Development Program is extensive, and candidate activities include:

- Advertising
- News publicity
- Films
- Brochures
- Newsletter

- Displays and exhibitions
- Scientific publications
- Seminars
- Small payload opportunities
- Non-NASA scientific community involvement.

Each of these activities is discussed below.

Advertising. Advertising can be defined as the use of paid-for media space to present a specific message to a targeted audience. The scope of advertising is broad, ranging from simple newspaper ads to sophisticated television commercials. Nearly every business includes advertising as part of the overall marketing program, because advertising has generally been shown to have the more impact on awareness per dollar expended than any other single marketing activity. NASA should employ advertising for two general purposes: (1) to project an image of the STS program and resulting potential benefits to the public to increase general awareness of the STS and enhance public acceptability; and (2) to direct information on STS capabilities or results to specific target audiences.

To increase general public awareness of the STS and to project a positive image of the STS program and NASA in general, key benefits derived from space in the past and future opportunities could be presented in a combination of media having wide reach. Such a campaign could follow NASA's "Spinoff '76" concept, emphasizing new products, processes, and materials affecting everyone and developed as a result of the Space Program. Future possibilities such as new medical materials and solar power should be keynoted as well. The primary medium would be television, supported by magazine and perhaps radio. Selected business publications such as Fortune, Forbes, and the Wall Street Journal will be useful in creating awareness in key executives of major corporations having potential STS applications.

Specific groups of potential users may be targeted for advertising of a more technical nature. As an example, various scientific publications could be employed to advertise specific hardware capabilities on Spacelab, or the range of opportunities at various price levels. Advertising to this group may also be used to create awareness of various forms of information and assistance available from within NASA.

News Publicity. News publicity has a major advantage over paid advertising and other promotional activities in that it is virtually free. While absolute control cannot be maintained over content or audience, properly prepared news releases to both the general media and the scientific and business literature provide a mechanism of increasing awareness of new capabilities and recently achieved promising results. This form of promotion is event oriented, by its nature, and will best be employed to increase awareness of an accomplishment, rather than scientific detail. News releases can be tailored to have different appeals. For example, a financially significant or business-oriented item could be designed for the financial literature or a scientific aspect of the same event tailored to the scientific literature.

Films. Films will have significant value as STS promotional tools. The Phase II New User Development program demonstrated that among those potential users unfamiliar with STS, a brief film overview of the system, components, and possible use opportunities was essential for clear understanding and subsequent discussion of the STS. Especially useful in reaching high-level audiences where time is limited, a properly designed film allows the viewers to quickly grasp concepts that could require a very lengthy oral presentation.

As with other promotional devices, no one film will perform satisfactorily for all purposes. A documentary film, for example, might be prepared for television to create awareness of the system and potential benefits and gain support of the general public. The same film would probably not serve as a good brief overview of the system in sufficient detail to educate new potential users. Neither of these films would be useful in disseminating information on research results or detailed hardware utilization data, both good applications for visual media. Films will, for the most part, be used in conjunction with other promotional activities, ranging from trade shows, to specific user development, to addressing the scientific community on research opportunities and results. The design and selection of films for those various applications must carefully consider the message and the target audience, and should form an integrated part of the overall promotional activity.

Brochures. A series of brochures covering each of the major STS payload opportunities or hardware interfaces would be a useful promotion tool to the new user development effort. These could be mass mailed to specific categories of potential users by the use of computerized mailing lists which are commercially available for almost any particular potential user community. They could also be maintained as flyers or handout material at trade shows, or as inexpensive material to handle requests for information. Typically the brochure would be a one or two page glossy folded sheet which contained:

- (1) An illustration of the hardware (e.g., LDEF tray, electric furnace, biology rack)
- (2) Brief capability & limitation highlights (e.g., size of specimen, power, micro-gravity)
- (3) Typical applications (semiconductor homogeneity, crystal growth, etc.)
- (4) Contact for further information

The brochure series would supplement the STS handbook program by providing an inexpensive mechanism to give a quick overview of a specific piece of equipment or capability to a broad base of potential users. By using brochures to cover a broad base of scientists and researchers, a variety of potential users could be stimulated into considering STS applications as related to their specific requirements.

Newsletter. A list of potential principal investigators and other researchers in various industrial organizations and universities could be developed as the basis for a newsletter circulation on STS experimentation. A similar format to the NASA Technology for Aviation and Space published by the Office of Aeronautics and Space Technology is envisioned. Proposed experiments and results are reported in brief format with the principal investigator's name, address, and phone number included so that an interested person can obtain further information. Battelle feels that such a newsletter could promote an exchange of scientific ideas regarding potential applications of STS, and current direction of technology efforts. An attractive title such as "STS Experimenter" could improve readership.

Displays and Exhibitions. Displays and exhibitions at trade shows provide a unique opportunity to the overall promotional program in that they bring together a large number of individuals whose awareness of the STS and its capabilities can significantly influence the use of the system. Battelle found, during the Pilot Program participation in the IAF Congress, October 10-15, 1977, in Anaheim, California, that a tremendous base of interest in STS existed within the attendees. Though not high-level persons, attendees of such shows are generally in engineering, marketing, or middle management, and can carry ideas on potential applications back into their respective organizations. The show provides an opportunity to view and handle physical hardware and models, and present complicated graphic material. More importantly, however, it provides an opportunity for obtaining potential user inputs, for exchanging information, and for distributing carry-back material and determining possible leads for further development. A lead from the IAF Conference, for example, led to Gilbert Moore of Thiokol signing up for the first small self-contained payload.

Scientific Publication. During Battelle's Phase II study, a common complaint voiced in the pharmaceutical community was that they were not tuned in to potential STS applications, because their scientists did not review periodicals and other literature indigenous to the aerospace community where NASA typically publishes. Publication in the general scientific literature, as represented, for example, by Scientific American, would be useful in creating general awareness of STS, its capabilities, and significant research findings. Publication of research results or opportunities in the trade literature which reaches a very specific audience interested in a specific research area is a useful means of involving the scientific community in becoming familiar with the opportunities afforded by space and the STS. As a specific example, results or opportunities related to cancer research should be reported in Cancer Research or the Journal of the National Cancer Institute. Articles designed to stimulate scientific thought in the application of the space environment to cancer research would have to be published in these journals to reach the proper audience. Other uses of STS require a similar approach to each specific potential user community.

Seminars. As part of the overall user development effort, NASA should both host and also participate in non-NASA seminars covering topics ranging from general hardware applications and reimbursement policies to detailed treatments of scientific applications, for example, hosted by organizations such as the Pharmaceutical Manufacturers' Association. Seminars draw individuals with specific interest in the subject, and represent both an opportunity to create awareness of the STS in those unfamiliar with its potential, and an opportunity to treat specific topics in varying degrees of complexity with more advanced potential users. The opportunity for exchanging ideas and generating input to planning of further development activities can be significant if properly addressed.

Small Payload Opportunities. The small self-contained passive payload defined in the commercial reimbursement policy represents a strong promotional tool, and should be a significant part of the new user development program. The small package provides companies, universities, and private individuals with an inexpensive access to space. Further, it provides the researcher with autonomy over his experiment. NASA may, as part of the user development effort, fund PI's in selected areas of research to utilize the small package concept and widely disseminate the results. In this manner, NASA will gain experience with the small package concept and generate broad interest, overcoming two major problems encountered in the pilot contact program: (1) that not enough was known about the total cost of experimenting with the small package; and (2) that communication with potential PI's is currently very limited. Small payload opportunities are discussed in detail in the PI section of the full-scale user development plan.

Non-NASA Scientific Community Involvement. As part of the overall user development effort, some funding of external R&D, and non-NASA participation in NASA R&D, would be valuable in stimulating new user interest. Specific companies with demonstrated expertise in a particular area could be funded to perform space research in their field of excellence. In this manner, NASA would gain inputs from the industrial community and experience in working with private companies. Such an arrangement might involve patent protection

for the company's work on a reimbursable basis if positive results were achieved. As an example, NASA could perhaps interest a company like Parke-Davis in performing pioneering blood separation research under a shared-cost arrangement.

Another mechanism for insuring participation of industry in the STS program would be to actively interface with leading industrial scientists to discuss the value or potential application of proposed NASA experiments, and review results of previous experimentation. The involvement could extend to the academic community as well. The key feature of such an arrangement would be to design experiments so that the results can be readily applied to real industrial requirements, thereby stimulating potential STS use.

Promotional Activity Mix

In the above section, a variety of promotional activities applicable to the STS New User Development program were discussed. Determination of the proper mix of activities to employ is a very complex problem demanding sophisticated resolution. There is a broad range of options in choosing promotional mix, and though it is possible to choose various combinations which have a similar impact on STS revenues, they may be different in cost effectiveness by orders of magnitude.

Some considerations to be addressed in determining which promotional activities to employ are fairly straightforward: What is the status of development in each potential user community, and where is it going? What messages directed to the community will improve the rate of development? What significant events are occurring which might influence the selection of a promotional activity? What impact will the activity have on the overall program and the direct contact activity?

The promotional mix problem becomes rapidly complicated once several options or simultaneous activities are introduced. The problem can, however, be defined numerically by estimating key variables. Though

estimates may have considerable variance, the overall result of each activity can be examined in terms of marginal return. For each target potential user community, a realistic STS utilization goal must be established, and the cost of reaching that goal analyzed. The cost of each promotional activity and its likely contribution to reaching the goal must be estimated. In this manner, community by potential user community, an estimated cost of reaching a desired STS utilization through various promotional activities can be determined. The activities are then analyzed on their marginal worth to the STS program and selected accordingly. Without a great deal of qualification, it is very difficult to flatly state the types and levels of activities that should be employed and the types that should not. The numerical method, supported by expert consultation in the prospective markets and media, can provide a reasonable guide.

Role of NASA and Non-NASA Team
Participation in STS User Development

Current Users

During the pilot user development program , it was found that appropriate NASA participation in pilot user contacts to the current space user community can improve the credibility of the material being presented. Current users felt it was appropriate and desirable for NASA to be represented at a briefing primarily covering NASA user policy and STS planning. As to the role of NASA in a policy-oriented user contact, comparison of several contacts showed that results were similar whether a NASA representative presented the policy information or was present only to address questions. The major conclusion was that NASA's presence lent credibility to the material and authority to subsequent discussions.

The personality of the NASA representative was observed to have an impact on the quality of information gained from the user. More useful input was generated when a user-oriented NASA individual participated in the contact. The level of NASA representative did not seem to produce significant variation; all representatives in the pilot contacts were moderately high to high level. The representatives' experience with users, STS planning and policy, and the NASA system, however, was a factor in stimulating discussions with current users.

A disadvantage to NASA involvement in user contacts was noted in that the current user was less likely to discuss problem areas in the presence of NASA's representative. There are two valid reasons for this. First, the current user has a set of relationships with NASA essential to his business which he does not want to upset. Second, many current users are also suppliers to NASA and have a vested interest, therefore, to please NASA at the expense of candor. A contractor, acting as a disinterested third party, can depersonalize the situation to the extent that much valuable information can be obtained in the absence of NASA's representative which can be very helpful to the STS program. In contacts involving NASA, discussion was notably more restricted than when NASA did not participate. To illustrate the impact of NASA's presence, at one contact a current user said he had no hesitation to discuss problem areas face to face with NASA, but only after the NASA representative departed did he note several areas of concern.

Because NASA participation in a potential user contact can be both advantageous (improves credibility) and disadvantageous (decreases candor), the purpose of the contact should be clearly defined, and the contact planned accordingly. If the purpose is primarily to present policy and similar information, NASA should probably be involved in the contact. In fact, if information is the sole purpose of the contact, e.g., to present the latest policy information to a current user at the user's request, the skills of a contractor would probably not be required. If, on the other hand, the purpose is primarily to gain information, or to probe a user community for new uses/users, the relative advantages of NASA and non-NASA involvement must be carefully considered.

Non-Current Users

The development of the commercial sector will require a contractor experienced in broad-based high technology research for industry. The contractor will be required to identify and interface with potential new users in a variety of technology areas, and filter user needs and requirements back into the STS program. Key to success of the new user effort is a sensitivity to the potential user's business environment, a recognition of the opportunities and problems to be addressed, and development of an approach which will result in a potential user committing to STS.

The potential new user of space, unlike the current space user, will have to be convinced of the economic benefits of space and will require a demonstrated technical feasibility before heavily committing funds. The space opportunity will be viewed against other possible uses of funds and a variety of business as well as technical factors. While a limited amount of space R&D may be performed by the commercial sector on a speculative basis, full exploitation of STS will require economically feasible and technically proven concepts which fit market requirements.

The successful development approach to the commercial sector will therefore utilize a NASA/contractor team, where the contractor is primarily responsible for the activities related to potential user identification, development strategy formulation and actual interface with potential users, and NASA is responsible for technology development, and policy and planning aspects of STS.

As a key to developing the commercial sector, NASA and the contractor should aggressively involve industry in STS R&D to develop working relationships with industry, and provide direction to NASA internal R&D which will increase commercial applicability of results. The contractor should recommend technical activities to NASA as part of the user development effort, and NASA should then organize and conduct the technical programs. Possible approaches to industrial involvement in STS technical efforts include:

- (1) Organizing a steering committee of scientists within an industry to select and oversee one or two experiments to be performed by NASA having an impact on current industry requirements
- (2) Using trade organizations such as the Pharmaceutical Manufacturers Association to obtain technical direction and channel information back to individual companies
- (3) Using industrial scientists as paid consultants to stimulate technology transfer
- (4) Selecting leading companies in a particular field to perform NASA-funded research that may lead to commercialization
- (5) Making arrangements whereby companies could buy back patent rights to promising developments resulting from NASA-funded STS research that they performed.

The NASA/contractor team effort directed to developing the new potential commercial user must seek ways to transfer knowledge about STS opportunities to the diverse industrial sector, must actively involve the commercial sector in technical development, and must continually identify and technically demonstrate concepts which have commercial feasibility. Unlike the current users, potential new users now have little need for or interest in the detailed policy/planning aspects of STS. The STS represents an entirely new range of capabilities, and the potential new user must be shown how to take advantage of the STS and the opportunities it represents.

Team Approach to Functional Organization

In the full-scale user development plan submitted to NASA as part of this contract, the functional relationships required to implement a full-scale user development program were discussed in detail, as shown in Figure A-1. The overall operation of the program can be described as an effort to achieve initial user interest in the STS and applicable space technologies and stimulate subsequent idea generation within the potential user organization, leading to a commitment by the user to use the STS. The program consists of four major functional components; STS Administration, Technology Management, Market Research, and User Development.

Battelle feels, generally, that NASA's internal new user development efforts should be directed toward design and operation of the activities called out in the administration and technology management functions while utilizing contractor assistance in the conduct of market research and direct user development activities. This approach will generally minimize the barriers to user development and is particularly applicable to new users in the commercial sector. For current users and other government agencies, NASA's existing lines of communication may be organized internally for user development, supported by the contractor's market research inputs. Organizational recommendations are discussed further in the full-scale plan.

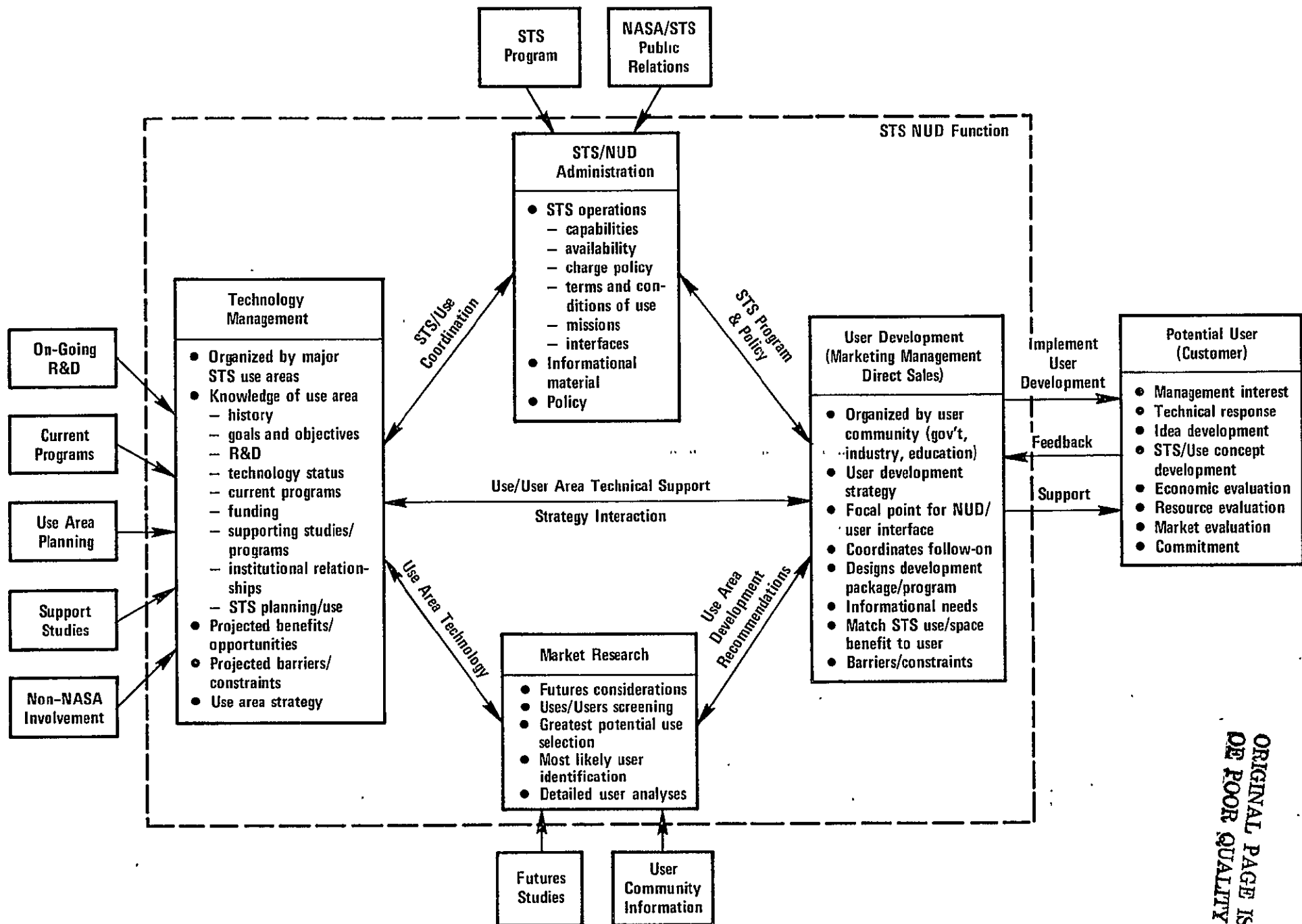


FIGURE A-1. STS USER DEVELOPMENT FUNCTION

Contractors and Consultants Required for the
Full-Scale User Development Program

Contractor Requirement

The organizational recommendations for a full-scale user development program are discussed in detail in the Full-Scale User Development Plan submitted to NASA as part of this contract. As discussed in the plan, Battelle feels that the most cost-effective way for NASA to perform the necessary market research and direct user development activities would be to utilize experienced, qualified personnel from outside NASA. A single contractor is recommended for these functions because of the interchange and coordination required among the many activities.

The nature of the new user development activity demands that the contractor's team have the following characteristics:

- (1) A broad and in-depth understanding of new user development as it relates to STS program goals
- (2) A working relationship with NASA Headquarters and the research centers
- (3) Active involvement in key user-interface aspects of STS, such as the charge policy working group and the user handbook program
- (4) Knowledge of, and ongoing relationship with, NASA research and technology development programs
- (5) Experience with, and understanding and appreciation of overall NASA operations and objectives.

Additionally, the contractor must have:

- (6) Working relationships with key commercial sector organizations and industry groups

- (7) Experience in recognizing and pursuing opportunities related to high-technology research and development in the commercial sector
- (8) Experience in the design and conduct of industrial marketing research and marketing programs
- (9) Sensitivity to, and awareness of, industrial procedures and requirements
- (10) Ability to translate needs and opportunities in the commercial sector into STS program activities.

Use of Outside Consultants

Battelle feels that outside consultants can be useful to the new user development program only if they have, or are provided with, a thorough background understanding of the STS NASA technology, and the objectives of user development as related to their participation. It is further recognized that tasks must be specific and well bounded in order for outside consultants to contribute meaningfully to the program. During the pilot program, Battelle used both internal and external consultants in order that the full-scale user development plan might encompass a broad understanding of views, interests, constraints, and motivations of user organizations. Experience during the pilot program showed that familiarity with the objectives and mechanisms of user development and the program background was essential to properly focus the consultant's effort.

A meeting with Management Analysis Center, Inc. (MAC), a resource for management consulting and practical business research, was attended by NASA and Battelle on July 20, 1976. Two MAC personnel and two university-oriented consultants in marketing, organizational behavior and business policy areas provided a discussion of STS user development. Primarily, the discussion covered typical critical "marketing" problems, organization implications and alternatives, and practical problems of

implementing the alternatives. Battelle's view of the meeting was that it represented a first step in a potentially meaningful input to the compilation of data/views on the STS user development task, but that it was compromised by a lack of background understanding. Battelle feels the meeting would have been more productive had it been preceded by the provision of a thorough briefing to the consultants of what STS user development encompasses, the influence of technology developments on user development, and the complexity and spectrum of NASA activities, potential uses, and user communities. The discussions generated only general academic concepts rather than specific inputs to the user development program, because the consultants were not given the benefit of a thorough prior understanding of STS and the objectives of user development.

During the pilot program, a consultant to Battelle, Dr. Gelles of S. H. Gelles Associates, was asked to define an approach to effectively develop industrial user interests and user participation in STS space processing programs. Dr. Gelles is an internationally known specialist in materials research and development and has himself been a principal investigator in space processing research and sounding rocket experiments. His report dealt with problem areas and obstacles associated with developing industrial users, and recommended methods whereby NASA, in conjunction with industry, can develop industrial interest and participation in space processing specifically and the STS broadly. Dr. Gelles' evaluation was accomplished by consultations with both industrial organizations and NASA personnel. It is felt that Dr. Gelles' experience in space processing, familiarity with NASA, and in-depth discussions with him regarding STS user development objectives during the course of the contract contributed significantly to the value of his report.

Types of Consultants

In certain areas requiring a high degree of specialization and unique skills, consultants can provide the most cost-effective means of performing a well-defined task requiring special skills not readily available within NASA or the contractor's organization. For example,

to select the proper media mix for an advertising campaign, an advertising agency should be employed. The results of their efforts will depend, however, on specific direction as to which target markets should be reached, with what messages, and within what budget constraints; that is, the agency must be provided with background on the STS and potential users sufficient to focus their efforts.

In addition to professional consultants skilled in specialized areas of marketing such as advertising, and having expertise in specific areas likely to impact user development efforts such as regulatory requirements on new drugs, both industry experts and technical specialists can be effectively utilized as consultants by NASA and its contractor in the new user development program. Typically, these experts and specialists will not be professional consultants per se, but will be working within an industry or technology area targeted for new user development efforts.

The industry expert may, for example, be a recently retired executive having a knowledge of the industry, key problems and opportunities as they relate to STS, and current management-level contacts. As a consultant, such an executive would be able to recommend effective approaches to potential user community involvement in STS and maintain a focus on user needs and requirements from an overall business viewpoint.

The technical specialist should be knowledgeable in a particular technological field as it relates to possibly several industries. Such a specialist's familiarity with technical problems and the ability to visualize applications of STS in terms of technological frontiers will be useful to the new user development program. Typically, a technical consultant will have established a reputation as a leader in a particular field, and will have contacts with key industry scientists and engineers in the technical area. The technical specialist will participate in the interaction between NASA's technical efforts and key industry scientists, and help focus NASA industry research efforts to reflect potential user requirements.