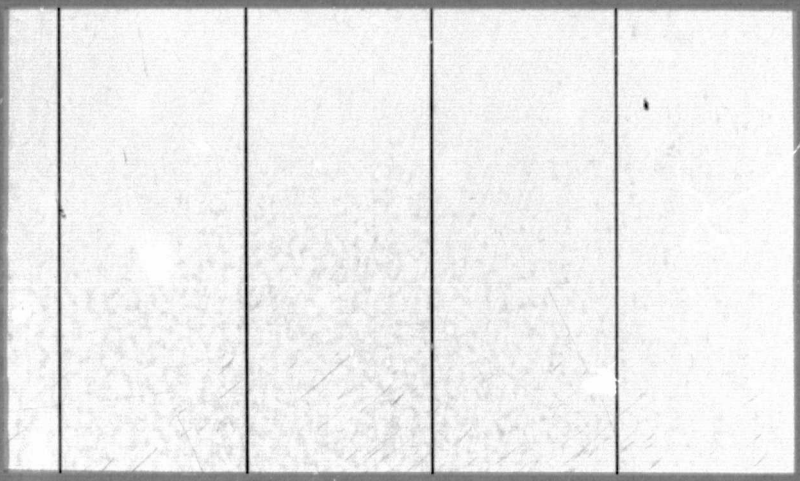
RESEARCH REPORT



Battelle

Columbus Laboratories

FINAL REPORT

on

PHASE II STS NEW USER DEVELOPMENT PROGRAM:

VOLUME III,
THE IMPLEMENTATION PLAN

to

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER

CONTRACT NUMBER NAS8-31621

March 24, 1976

by

J. R. McDowell, Project Manager

Approved by: B. W. Davis, Section Manager
Space Systems and Applications

BATTELLE
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

LIST OF FIGURES

LIST OF TABLES

PREFACE

This Battelle report, entitled "Phase II STS New User Development Program", is submitted under NASA Contract No. NAS8-31621 and consists of five volumes as specified below:

Volume I - Executive Summary
Volume II - Narrative Report
Volume III - The Implementation Plan
Volume IV - Guidance/Instructions for Representatives
Volume V - Informational Materials.

The five volumes make up the Phase II STS New User Development Program Final Report and summarize the results, conclusions and recommendations from the nine-month study performed by Battelle's Columbus Laboratories (BCL). This contract was administered by the NASA Marshall Space Flight Center, Huntsville, Alabama.

Battelle's Columbus Laboratories would like to acknowledge the efforts of W. Robert Mixon, Jr., of NASA/MSFC as the Contracting Officer Representative for the study program. The following BCL staff should be recognized for their technical contributions to this study:

P. E. Fisher
J. A. Madigan
A. M. White

FINAL REPORT

on

PHASE II STS NEW USER DEVELOPMENT PROGRAM:

VOLUME III,
THE IMPLEMENTATION PLAN

to

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER

from

BATTELLE
Columbus Laboratories

Contract Number NAS8-31621

March 24, 1976

INTRODUCTION

The Implementation Plan described in this volume of the final report presents a methodology for developing new users for STS other than NASA and DoD, thereby maximizing the use of the STS system. The diversity of potential uses of space and opportunities opened by the Space Shuttle expands many areas of space technology and presents a complex market development task. The status of technological development in potential STS use areas ranges from demonstrated technologies and commercially operated systems to concepts which have not yet been developed. The varying needs, opportunities and constraints of the user community are as diverse as the community itself; ranging from large, sophisticated international consortiums already participating in space, to less sophisticated industrial firms that may eventually benefit from the capabilities offered by STS, to various government agencies and the academic community. Other than broad use areas of space enhanced or newly opened by STS capabilities, specific end uses have generally not been characterized. Similarly, though a good deal of thought has been given to possible users of STS, and certain obvious end users have already been identified, the markets are yet largely undefined; and little planning has been directed toward developing the full potential of the non-NASA/non-DoD user community, especially in those areas of technology somewhat removed from current space use such as materials processing.

New user development is described in this volume as an iterative process dependent on (1) the ability of NASA to become aware of the real needs of the potential user and to respond with meaningful information inputs, and (2) the potential user's ability to absorb the information and generate internal responses leading to STS use. The New User Development (NUD) program is outlined as a set of functional components essential to the development effort: Administration, Technology Management, Market Research, and User Development (direct customer contact). Within this functional framework, a set of activities required for formulating and implementing a development strategy is developed, broadly consisting of selection of high potential use areas, detailed analysis of potential user communities and specific potential STS users, specific strategy formulation, and implementation of the strategy by user development. Finally, the application of current NASA and non-NASA resources to the New User Development Program is considered.

THE NEW USER DEVELOPMENT PROCESS

The new user development process is a function of both the state of technology in a given use area and the sophistication of the user in space technology, and is additionally constrained by the various acceptance/resistance criteria in the user market. Because of the broad spectrum of use areas, wide divergence in user sophistication, and different acceptance/resistance criteria in the different markets, although there are many common elements, the requirements of the development process are distinct for each individual case. The development activity will be paced by (1) the potential user's ability to absorb information and generate internal responses leading to concepts for STS use, and (2) the ability of NASA to respond with meaningful information inputs and become aware of the real needs of the user. The importance of the latter cannot be overemphasized.

To illustrate the complexity of the task to be addressed by the New User Development Program, the process by which a potential user determines whether or not to commit available resources is outlined. Figure 1 depicts a representative screening process used by a typical industrial organization to evaluate options for business development. The process is similar for any organization called upon to commit resources in return for perceived benefits. The first difficulty an outside agent faces in acting on the organization is the determination of an entry point. Secondly, information must be conveyed to the management of the organization which stimulates interest and invokes a commitment to seriously consider the merits of the concept within the potential user organization. Finally, once preliminary concepts are developed, sufficient information must be both acquired from and fed to the potential user at the proper points in time and at the proper levels in the organization to minimize barriers which may arise in any of the fundamental screening functions: resource analysis, technical feasibility, marketing, and economic evaluation. If the organization does not see the idea as compatible with its goals, the idea will be dropped. Similarly, if resources are not available or are unobtainable, if the organization's market is perceived as insufficient, if a pay-out is not realizable or not realizable within a required time frame, or if the idea is technically not feasible, the idea will be dropped. Inherent in this evaluation process is the option of modifying an idea, found to be deficient in one or more areas, to permit a reassessment for acceptance. Finally, even ideas which

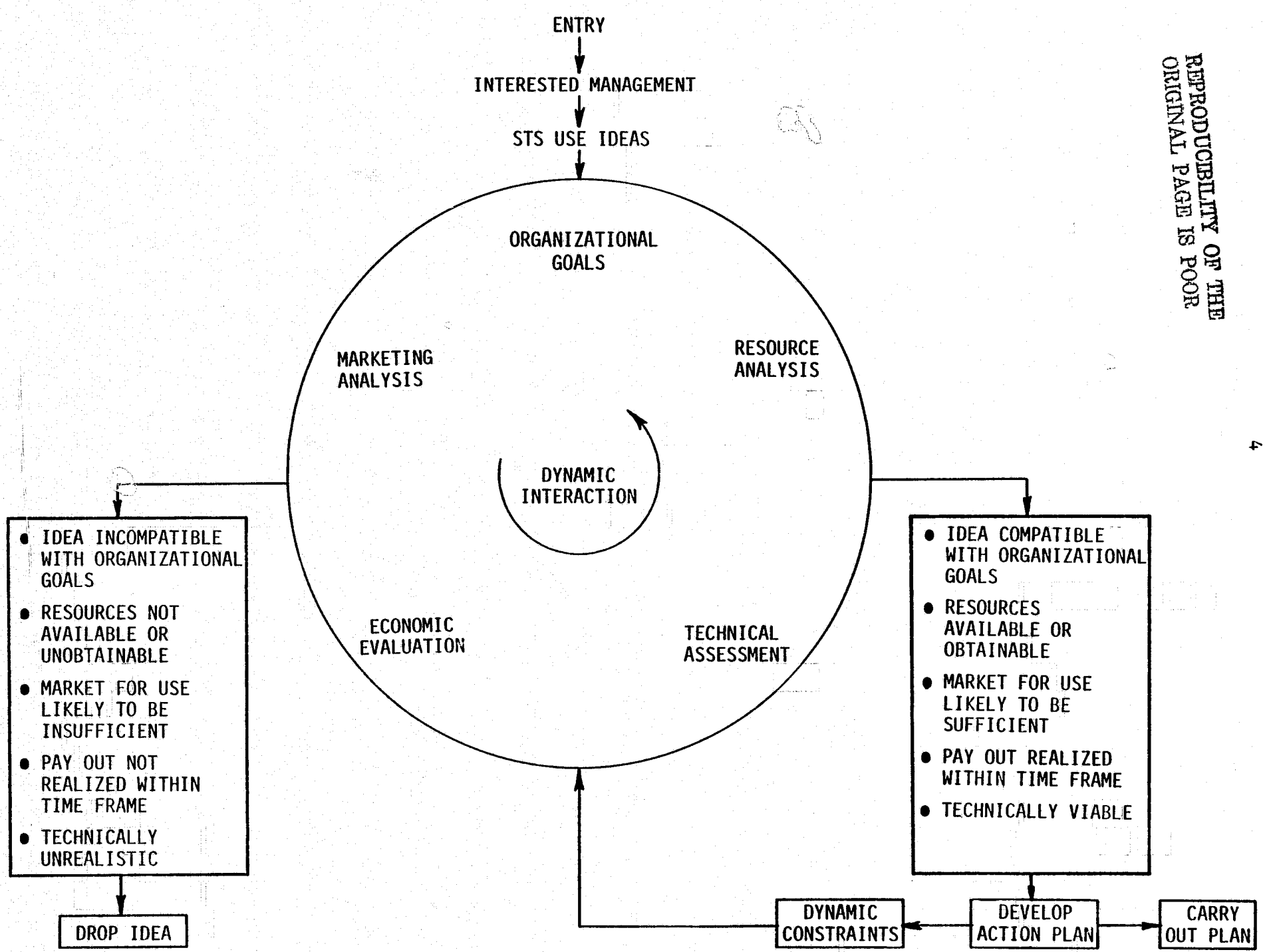


FIGURE 1. USER EVALUATION PROCESS

pass this rigorous procedure are subject both to competition from other ideas for resources and to a dynamic environment where the available resources and other screening criteria will certainly change over time. This, then, is the new idea assessment process which the new user development plan will typically interface with at a prospective user organization.

The iterative nature of the new idea assessment process shown in Figure 1 applies to the STS New User Development Program. The program develops through interaction with the marketplace where initial concepts are reinforced or modified, while new concepts are generated for further consideration. Since the opportunities and constraints are time-dependent variables, the implementation plan developed must incorporate a variety of feedback and feed-forward mechanisms to insure sensitivity to market requirements. The development strategy must function in a market environment of opportunities and constraints which are in a state of constant flux:

(1) Opportunities for use of STS within various market sectors are initially determined (market needs).

(2) Constraints on particular opportunities are initially identified (barriers).

(3) The opportunities and constraints are continually reinforced, or redefined, by interaction with the marketplace, and strategies to fill the market needs within the existing constraints are continually developed and modified through further interaction.

NEW USER DEVELOPMENT FUNCTIONAL OVERVIEW

The implementation plan for new user development is based on the functional operation of the NUD program as shown in Figure 2. The overall operation of the program can be described as an effort to achieve initial user interest and subsequent idea generation within the potential user organization, leading to a commitment by the user to use the STS. A specific user development plan is generated for each potential user which reflects the user's needs and overcomes major obstacles to utilization of STS. Throughout the development process, which is necessarily dynamic and iterative, the potential user is supported by the NUD team and other NASA offices. Information is supplied, and feedback on barriers/opportunities is channeled into the NUD program. As shown in Figure 2, the NUD program consists of four major functional components: STS/NUD Administration, Technology Management, Market Research, and User Development.

Administration Function

Overall STS user development policy is determined and administered by the STS/NUD Administration function. Additionally, this function serves as the focal point for supplying the user community with STS operations data, informational material, legal and contractual arrangements, and policy decisions arising from the development activity. This function is actively involved in review of STS capabilities, availability of the STS to the non-NASA/non-DoD community, and evolving user charge policy and terms and conditions of use. The function not only administers these policies within the new user program, but also channels key marketing information on the policies back into other responsible elements within NASA. The STS/NUD Administration function is a primary link to the STS Operations Office, and serves to coordinate mission operations data with the new user development effort. This function also has primary responsibility for development of information material ranging from that which is general on both STS and Spacelab to that which is very specific on a particular use area and user. Information efforts are coordinated with the NASA Office of Public Affairs as well. The informational requirements are detailed in Volume V of this report. The final area of responsibility is in the area of policy and legal matters, ranging from handling of proprietary arrangements on a use area, to coordinating contractual details with the NASA Office of General Counsel.

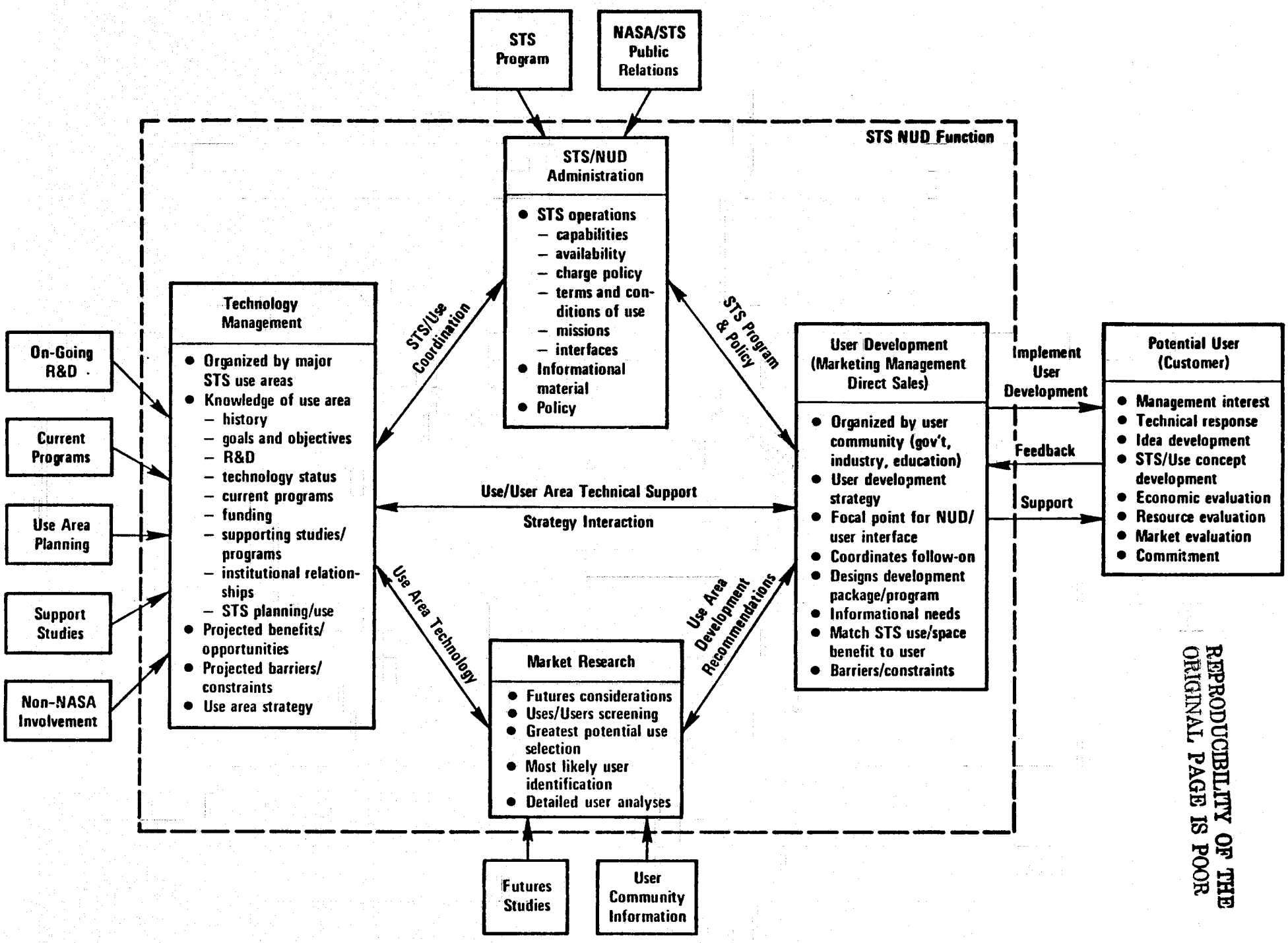


FIGURE 2. STS/NEW USER DEVELOPMENT PLAN

Technology Management Function

The Technology Management function of the STS/NUD operation has primary responsibility for coordinating technical information flow to the user development activity, and providing such technical support as the potential end user may require. A sensitivity is also maintained to marketing opportunities that can be influenced by technical development so that information flows into the technical components of NASA for use in planning future research and development programs to take advantage of market needs. Primarily, this function is organized by STS use areas; for example, by telecommunications, Earth resources, or one of the major divisions of space processing such as biological materials. The activities can be viewed as a program effort to develop the particular use area as it relates to specific market opportunities. The Technology Management function is responsible for supplying the user development activity with history of the use area, technological status, R&D programs and objectives, related programs, supporting studies, and institutional relationships. Technical input is provided on potential benefits of the use area in specific applications, and awareness of major constraints. This function is a major link with NASA ongoing R&D, current programs, use area planning, and support studies. It also remains in contact with the non-NASA community regarding scientific and technical matters. In addition to acting as a technical focal point, this function of the new user program also has sensitivity to marketing constraints and opportunities, and a general awareness of the barriers and opportunities in the markets served by the particular use area.

Market Research Function

The Market Research function is responsible for selection of highest potential use areas, analysis of the user community, identification of most likely users, and detailed analysis of the specific user and STS application. Drawing on the user community for information and familiar with marketing evaluation techniques, this function interacts with the technology management component to screen potential use areas for technical and marketing viability. At any point in time, a priority list is generated which indicates the order of importance of STS use areas with respect to technical and marketing considerations.

For any particular highly viable use area, the user community directly and indirectly related to the use area is determined and key companies/agencies selected for development. The Market Research function details or profiles the user community, that is, determines interrelationships among the various elements, markets, financial conditions and other significant factors. Level of current involvement in space is determined and recognition is given to key barriers and opportunities. This background is supplied to the User Development function for use in strategy formulation. The specific companies/agencies of importance to the use area are analyzed in detail. A profile of products and markets, financial data, technical and R&D orientation, organization, and specific problems and opportunities is constructed. Specific applications of the use area to known needs and problem areas are outlined. The Market Research function is also responsible for cost/benefit or business analysis of the specific application of STS. This information is provided to the development specialist as input to specific development strategy. The Market Research function also assesses future market conditions with respect to known and developing applications of STS, and highlights areas of market need that warrant technical development. This future analysis activity makes long range projections and performs technological forecasting.

User Development Function

The User Development function of the NUD program is the primary interface between the potential user and the new user development program. Organized by user community (e.g., specific segments of government, or industry), the User Development function is familiar with the major barriers and opportunities inherent in the market sector relative to interfacing with the NASA/NUD program. Specific marketing strategy is formulated drawing on the detailed user community analysis, detailed customer analysis, and technology summaries generated in the Market Research function and Technology Management function. A specific user development plan is required for each potential user which reflects the user's need, STS benefit and organization. The planned approach to the user will reflect a user development strategy dictated by:

- Projected STS use area (e.g., weather and climate, Earth resources, space processing, communications, etc.)

- User involvement in space (COMSAT vs. a pharmaceutical company)
- Technology status (space communications vs. space processing)
- STS use/service distribution structure
- Specific user organization (company vs. consortium)
- User community (government agency, industry, educational sector)
- Preliminary assessment of STS benefit to user's need.

Initial informational materials (both the basic information package and the customized package, Figure 6, Page 38), are assembled with the assistance of the STS/NUD Administration function.

The baseline information will include: (1) an overview of the STS and related information on flight rates, user charge and terms and conditions of use; (2) a film on Shuttle and Spacelab such as was prepared by editing/splicing and combining a Rockwell International film and an ESA film to use in conjunction with the test cases; and (3) a data brochure package of STS/Spacelab material to provide additional overview and detailed data to the potential user.

The User Development function also provides the potential user with information on the area of use/application of STS which matches his organization's needs or interests.

The User Development function will determine the correct entry level for initial contact with the particular organization and will conduct the initial discussions. After the initial meeting, the primary responsibilities of the User Development function will involve continuing coordination of communication between NASA and the potential user in technical and business areas to ensure continued interest and development. Returning to the discussion of Figure 1, above, a major responsibility of the User Development function is determination of actual potential user requirements and feedback into NASA of major barriers to be overcome in developing the potential user.

IMPLEMENTING THE NEW USER DEVELOPMENT PROGRAM

Functional requirements of the NUD program have been outlined above, and the interrelationships of the program within NASA and the user community identified. Broadly, the implementation plan operating within the functional framework described addresses three specific problem areas:

(1) With all the possible use areas and end users, how can the most viable use areas and users be meaningfully determined, so that detailed attention can be focused on those segments of highest potential?

(2) What information is needed about a high potential use area and the related companies and agencies in the use area who are likely to be users of STS, and how is this information obtained and organized for inputs to development strategy?

(3) What is the content of a development strategy for a potential user organization and how is that strategy implemented?

The implementation plan is organized in three sections corresponding to the above problem areas; (1) Selection of High Potential Use Areas and Users, (2) Detailed Analysis and Marketing Research, and (3) Strategy Development and Implementation.

Selection of High Potential Use Areas and Users

The screening and ranking procedure, developed as part of study Task II and presented in detail in Volume II of this final report, illustrated a methodology for identifying, in a cost-effective and realistic manner, those specific uses and users of Shuttle with high potential for development. The objective of the methodology is not to create a rigorous system for analysis, but to bring together the most current and accurate information on any use area in an organized manner so as to allow some degree of comparison of potential for development among the multitude of possible use areas. Note that the criteria used to "screen" and "rank" use areas are judgmental, that is, dependent on the inputs of technical experts in each use area and individuals familiar with particular markets. It should be further noted that the criteria are time-dependent variables, so that the ranking of high potential candidates is a dynamic function.

Screening Use Areas

There are a number of ways to establish marketing priorities, that is, to determine which use areas to develop and in what order of importance. At one extreme, a determination of needs in various markets that could take advantage of the space environment and the capabilities of Shuttle could dictate the direction of basic research leading to space technology serving the market need. On the other hand, it is also possible to pursue technically viable concepts without regard to existing market needs, and then "find" a market for the technology, once developed. Actually, neither of these extremes is particularly efficient, since both market and technical questions must be addressed to varying degrees in the development process. The first elements addressed by the screening methodology are necessarily:

(1) Determination of some identifiable market, i.e., it will fill a current or developing need in some user community

(2) Determination of technical viability, i.e., a known path of development from current stages to a technically demonstrated use is or can be established.

Those use areas which cannot pass these two immediate criteria are unlikely candidates for current user development.

Ranking Use Areas

Within those potential use areas that pass the screening procedure, there is a mixture of market and technical applicability that must be addressed to approximately determine the likely order of development of uses of STS. Criteria are applied in an attempt to determine the level of market need and technological viability to rank the use areas against each other. Factors include such items as:

(1) Level of technological development

(2) Timing to demonstrated feasibility

(3) Market need
- Cost/benefit
- Alternative systems

(4) Magnitude of investment likely

(5) Legal or regulatory obstacles

(6) Projected STS use (# of flights/timing).

Note that the analysis is not fully detailed, but represents sufficient judgment from technical and marketing experts as to which use areas probably have more potential for development than others. This level of refinement should suffice to choose the highest ranked areas for detailed analysis and development.

Preliminary Determination of Users

Once the use areas have been screened and the most viable use areas selected in order of likely development, it becomes possible to construct a preliminary picture of the user community. Beginning with a list of all companies and agencies potentially associated with the use area, it is possible to reduce the list to the most likely user community by a screening and ranking technique similar to that applied to the use area. The listing is screened by certain criteria related to financial condition and R&D orientation, and other measures appropriate to the particular use areas. A test of the screen is that users of "known" importance should pass through the screen. The commercial users are then ranked by one set of criteria and the government agencies by another set of criteria.

The end result of the process, which is outlined in Figure 3, is a tabulation of likely use areas for development in approximate order of importance, together with a preliminary listing of the major companies and agencies connected with the use area.

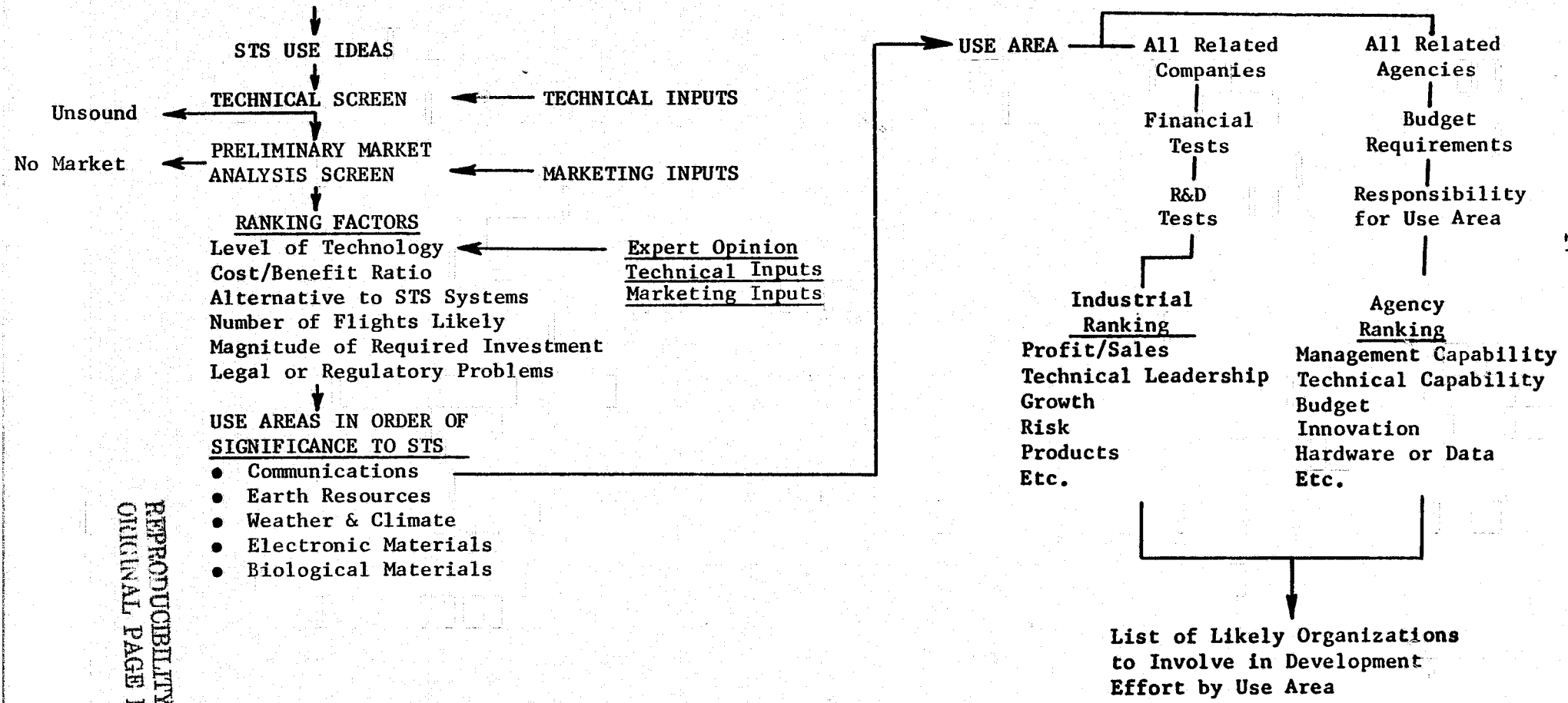


FIGURE 3. SCREENING AND RANKING METHODOLOGY

Detailed Analysis and Marketing Research

The screening and ranking procedure discussed above and presented in detail in Volume II of this report addresses the problem of determining which use areas and user communities to consider for development out of the many conceptual use areas and marketing opportunities. The resulting list of "highly viable" use areas and communities, however, lacks detailed background required as input to a development strategy in three areas (see Table 1):

(1) Use Area Technical Assessment

(2) User Community Marketing Research

(3) Specific Companies/Agencies Marketing Research

Use Area Technical Assessment

The use area technical summary is a key input to the marketing analysis and the development effort itself. Primarily stated in a level of detail for management review (as opposed to scientific rigor), the technical summary presents a description of the technology, the relationship to existing methods, and the status of technical development. Detailed scientific information is kept to a minimum, though major points must have scientific credibility with persons active in the field.

The description of the technology should include at least principles of operation, capabilities and potential applications, and limitations. A discussion of the relationship of space-based technologies and Earth-based technologies should be included to outline results possible in a space environment; that is, why the use of space is cheaper, better, more efficient, etc. If the use involves substitution of Shuttle for current ELV's, the rationale should be developed completely.

An example of the type of initial summary information required is given in "Electrophoresis in Space at Zero Gravity", by Bier (VA), and Snyder (MSFC).[1]* In this case, the use area is electrophoresis of biological materials. Further detail is provided in "Role of Gravity in Preparative Electrophoresis", by Bier, Binder, and Snyder.[2] Additional information on specific applications can be included from such references as "Preparative Electrophoresis of Living Lymphocytes", by van Oss, Bigazzi, Gillman, and Allen (MSFC).[3]

* References at end of volume.

TABLE 1. DETAILED ANALYSIS

Use Area Summary Technical Assessment	User Community Market Analysis	Specific Companies Market Analysis
• Description of technology - Principals of operation - Capabilities of potential application - Limitations • Relationship to existing methods - Results possible in non-space environment - Possibility of non-Shuttle transportation - Why is Shuttle/space cheaper, better, more efficient • Status of technical development - Summary of all related work to date by NASA and others - Outline of planned development effort: • what • when • by whom - Anticipated costs - Major obstacles	• Companies/agencies related to use area - Companies, agencies, trade organizations - Structure of community - Markets - Financial - Significant factors • Level of current involvement - In related technology - In space - Prior involvement with NASA in the Shuttle use area • Recognition of key problem areas - General to industry/government - Specific to industry/agency	• Company/agency profile - Products and markets - Financial Data - Technical or R&D orientation - Specific problems and opportunities • Match of specific application of use area to known needs and problem areas • Cost/benefit of specific application of STS to specific company/market

In the papers, electrophoresis is described and related to biological materials in three specific areas: identification of various molecular species, quantitative analysis of each species, and preparation of isolated fractions. The shortcomings of a gravity environment are discussed, e.g., lack of resolution due to convection, sedimentation, etc., and the advantages of space processing described. Limitations are also noted, e.g., that space electrophoresis may not alter the heat dissipation problem. Key references are cited for further background. Though the particular points could be expanded for further information, the papers serve the dual purpose of (1) providing initial background material to the market researcher, useful in evaluating specific opportunities and constraints of the use area; and (2) providing inputs to the development process in the area of initial presentation material.

Finally, the status of technological development must be described. The research done by NASA and by others must be put into context and described. The Bier papers[1,2] briefly note the Apollo 14, Apollo 16 and Skylab experiments in electrophoresis, but the level of detail is insufficient for purposes of the use area technical summary. Beyond this, it is important to outline the planned development effort, if any, i.e., what will be done in this area, by whom, and at what time. Anticipated development progress and costs should be evaluated, and major obstacles cited.

User Community Marketing Research

With a basic understanding of the use area technology and the opportunities as well as limitations imposed, together with a summary of the technology development effort to date and a planned technological approach, a marketing analysis of the user community is initiated. In this task, the companies/agencies related directly and indirectly to the use area are determined, and the interrelationships of the user community outlined. The community is characterized as to its application of high technology, involvement in space and prior participation in NASA programs. Major trade organization or technical/scientific organizations are determined and their roles identified. Key problem areas specific to various industry/agency groups are then determined for input to the development process.

User Community Profile. Initially, the companies and agencies related directly and indirectly to the use area are determined, and a general profile of the user community is outlined. This profile would include:

(1) Structure - major industry groups, government agencies, organizations, and interrelationships among them in relationship to the use area
(2) Markets served and key products or services
(3) Financial analysis, e.g., sales, profits, R&D expenditures, significant trends
(4) Levels of technology currently employed in research and manufacturing, determination of overall skills
(5) Prior involvement in space programs/NASA.

As a case to illustrate the type of information gathered in profiling an industry, the pharmaceutical community is outlined below. Complete analysis is not intended; however, the items do illustrate the range of data requirements.

(1) Structure of the Industry

(a) Related Communities

- Medical and scientific community (private and governmental)
- Academic community
- Medical equipment designers and suppliers
- Government regulatory agencies
- Chemical process industry
- Pharmaceutical companies
- Pharmaceutical Manufacturers Association (PMA)
- Consumer

(b) Key Factors

- Companies are intensely competitive and secretive
- Five to ten companies control the industry
- Some major developments come from small companies
- Highly visable industry; public image is important
- Major influencing forces include doctors, FDA and universities
- Products are developed from common elements that are likely to be available industry-wide
- Industry well represented (90%) in PMA.

(2) Markets Served and Key Products or Services

- Health care markets; chemicals for analysis and diagnostic use; drugs, both ethical and over the counter. Concentration on ethical drugs alone would lead to many subcategories by activity (antibiotics, vaccines, contraceptives, antimicrobics, antisteroids, hormones, etc.) or by use (tranquilizers, cardiovascular, etc., by therapeutic application).

Other details include such items as:

- Highly proprietary products
- Highly regulated products.

(3) Financial Analysis, R&D Evaluation

- Strong demand for products, with 9 percent growth per year. Value of shipments, 16 billion dollars per year by 1980 compared to 10.4 billion dollars in 1975.
- Expanding overseas markets
- Slowdown in introduction of new chemical entities induced by federal regulations
- Increasing diversification of drug companies into non-drug areas (hospital supplies, cosmetics, related areas)
- R&D plays important role, e.g.,

  1973 - 719 million dollars
  1974 - 749 million dollars
  1975 - 850 million dollars

  Increases average 4 to 5 percent/year - over $1 billion dollars by 1980
- R&D focus is currently on the discovery of agents, e.g., anticancer, cardiovascular, central nervous system, antiviral
- R&D by private companies typically is applied, that is, toward development of products with known end-product characteristics, rather than basic
- R&D by government (NIH) is more basic.

(4) Level of Technology

Level of technology employed ranges from sophisticated biological and chemical research and complex, exacting, manufacturing procedures to relatively simple chemical processing.

(5) Prior NASA or Space Involvement

In general, there has been no prior involvement of the pharmaceutical manufacturing community with NASA space programs, with the exception of a few isolated cases such as Abbott Lab's urokinase efforts, or efforts involving the scientific community through GE Space Science Division and a few universities.

Key Problem Areas. With the community profile performed, initial barriers to developing the specific community come into focus. The barriers and constraints, particular to government agencies and private industry, are addressed in the strategy development section, below, in addition to barriers resulting from a potential user's sophistication in relating to space. As examples of specific community barriers, key problem areas in the pharmaceutical and space communications industries are outlined below, in addition to some barriers from other potential communities (government, electronics, space broker).

Key Problem Areas in the Pharmaceutical Industry. Continuing the example of the pharmaceutical community, certain types of barriers are noted below:

- Highly competitive industry - difficulty in industry-wide participation.
- Meeting between NASA and PMA, coordinated by the NSI, alienated some drug companies.
- Not really interested in STS, some interest in Spacelab, real interest will be in potentials of space processing of biological materials:
  - Isolation of pure substances
  - Analysis, diagnosis, immunization.
- Some feel that NASA does not comprehend the pharmaceutical needs, research approaches and methods of operations.
- NASA has not been successful in involving the industry in space processing research.

- Companies primarily do applied, not basic, research - means that they will be interested when technical feasibility and projected economic viability are shown (by NASA).
- Companies not enthusiastic about being partners with another government agency (i.e., including NASA) due to present stringent regulatory controls of FDA and FTC.

Key Problem Areas in the Space Communications Industry. The space communications industry is made up of both systems operations organizations (INTELSAT, COMSAT, American Satellite Corp., Global Satellite, Inc., Western Union, etc.) and spacecraft manufacturers (RCA Astro/Electronics, Hughes, TRW, GE, Aeronutronic-Ford, etc.). The profiles of the community as a whole would clearly point out that they, collectively, are very much concerned over the substitution of a new space launch system over which they have little control, little inputs to and limited options. The overall relative competitiveness (cost, availability, ease of access, etc.) of the STS to the current expendable launch vehicles (ELV) and assurance of smooth transitioning (both design and operations) from the ELV's to STS are issues. The past, current status, and future influence and regulatory controls of government agencies (such as the FCC) should be identified. Primarily, then, the community is concerned about the business risk of committing to the STS and the projected effect upon their present services and costs. Referring to each of the industry segments, key barriers are noted as follows:

(1) Spacecraft Manufacturers

- Manufacturers are concerned about the costs of redesigning to take advantage of the STS capabilities and how (and how much) they can pass these on to the space communications community.
- Cost/effectiveness of redesigning to on-orbit checkout, satellite retrieval, maintenance, relaxed mass and volume constraints must be considered case by case.
- Need and impact of design compatibility to both an ELV interface and STS interface must be determined.
- How much of payload to STS interface compatibility will be assumed by STS, by spacecraft redesign, by kits -- how much is negotiable?
- Should spacecraft designs be responsive to space communications community requirements or should they take the lead in new designs for STS?

- Timing is a big issue; e.g., can they believe NASA/STS schedule/availability dates.
- Should projected competitive launch vehicles be taken seriously? Taken into compatibility design considerations?
- What are NASA's answers to questions/recommendations posed by studies (such as the Hughes[4] study) identifying actions which the STS must do to be effective to the space communications community?

(2) Space Communications Operations Community

- Concern and resentment over the substitution of a new launch system without consulting industry and by policies over which they have little control, little input to and limited options.
- Relative competitiveness (cost, performance, ease of access) of STS to ELV's are issues.
- Availability, ease of access, priority of use, need to be established.
- Reliability and safety of STS must yet be demonstrated.
- Business risk of committing to STS must be evaluated.
- STS effect on company's present service and cost must be determined.
- Smooth transitioning from ELV's to STS (both operations and vehicle interface compatibility) must be worked out.

Barriers in Other Communities. Examples of specific barriers in other user communities are noted below:

(1) Other Government Agencies

- Dealing with today's problems, hard time reacting to STS until it becomes operational.
- Concerned with technology, data and spacecraft developments/ use independent of the launch system.
- Have concern about working with NASA at their problem level and retaining program control.
- Do not see or appreciate significant direct value of STS.

(2) Semiconductor Industry

- Highly competitive industry.
- Casual interest in STS, more interest in Spacelab, real interest will be with space processing.
- Demonstrated technical feasibility must be shown.
- NASA is not adequately involving the industry in their research -- feeling is that aerospace companies are doing the exploratory research and studies and not representing the industry.

(3) Earth/Space (Space Broker)

- Irritated, frustrated with NASA on their lack of acceptance of a space broker concept.
- Believe NASA is against free enterprise and will never relinquish its role in dealing with users.
- Establishment of credibility is a real problem.
- Market for a space broker has not materialized.
- STS is downstream - will fall in place if relationship with NASA can be determined.

In an actual market analysis, the information presented above would be significantly more complete. The examples, however, do illustrate the types of data required.

At this point in the market analysis, the picture of the user community would be reasonably complete. The structure of the community would have been examined; organizations and interrelationships, market and products, financial, technology, and specific problem areas would have been discussed. The next level of analysis involves a detailed examination of each specific company, agency, technical or trade organization in the community to profile the specific company, match STS applications to known needs, and assess the cost/benefit of the STS use to the specific market.

Specific Company/Agency Marketing Research

Once the user community has been profiled, barriers analyzed, and likely specific companies/agencies determined for actual development, a detailed analysis of each specific company/agency is required to provide the data base for the strategist to use in determining: (1) what firms and agency to see and (2) what to discuss so as to maximize the probability of further development after the initial contact. Specifically, the following information is developed:

- Company/agency profile - including organizations, products, markets, financial data, technical or R&D orientation, specific problems and opportunities
- Match of specific application of use area to known needs and problem areas
- Cost/benefit of specific application to specific market.

Company/Agency Profile.

Marketing and Financial. In the profiling effort, the list of companies, agencies, and related organizations from the screening and ranking and user community analyses is subjected to a detailed financial and market analysis. Key inputs are obtained from documents such as Dun and Bradstreet's Million Dollar Directory, Moody's Industrials Manual, Standard and Poors Directory, etc., as well as annual reports and SEC-10K forms (Securities Exchange Commission annual filing of financial data). The following information is gathered on each firm:

Size:	Sales Volume
	Net Worth
	Fixed Assets
	Employees
Business Performance:	Sales Margin
	Return on Net Worth (net income after taxes/ net worth)
	Current Ratio (current assets/current liability)
	Debt to Assets Ratio (total debt/total assets)

Technical:	R&D Budget
	R&D as a Percentage of Sales
	R&D Orientation
Products:	All Major Product Groups
	Group of Interest as a Percentage of Total
Market:	Markets Served.

A listing of the most significant firms and agencies on the basis of financial strength and R&D orientation is, of course, of limited value unless concurrently a potential use area of significance to the firm, its philosophy, products, and markets, can be visualized.

Specific Characterizations, Problems and Opportunities. Equally important to categorize is the firm's role in the industry (e.g., particular strong and weak points) with respect to a potential use area, general business philosophy, and past experiences with the particular technology and with NASA, if any. From the space communications industry, for example, a characterization of a specific communications entity such as Western Union would describe their role in the communications industry, the service provided under FCC regulations, their business philosophy of purchasing everything they need and manufacturing nothing, and their involvement with NASA in the WESTAR project.

Similarly, a characterization of a spacecraft manufacturer such as Hughes would describe their relationship to the communications industry as a supplier of satellites and systems, designs, expertise, philosophy of standardized satellites to match broad needs, and relationship with NASA and STS on the timing and types of redesigns to make as ELV's are phased out.

A characterization of a pharmaceutical company would show a specific interest in electrophoresis as a means of obtaining pure substances for analysis, diagnosis or immunization, a philosophy of applied as opposed to basic research, and little expectation of financial involvement until technical feasibility is demonstrated in a specific area of interest. At this time it would also show little or no involvement with space or NASA; in fact, skepticism in dealing with another government agency.

Information on a government agency can be outlined as well. For example, the budget, and philosophy toward high technology R&D could be discussed with reference to Department of Interior, or specific users such as the United

States Geological Survey. The type of research, likely use area, current problems, and responsibility of regional center vs. headquarters are all key parts of the agency profile.

Characterizations can also be made on prospective user organizations on which a financial or business profile cannot be drawn. An example of this is illustrated in a overview of the Public Service Satellite Consortium (PSSC) detailed in Appendix B, Volume II of this report.

Determining Specific Applications. In the above section it was noted that, during the detailed analysis, it was necessary to attempt to visualize applications of STS in the framework of user needs, products and markets. To clarify this, an example can be drawn from the pharmaceutical community.

The screening and ranking procedure outlined in Volume II reduced the list of over 100 companies and agencies to 10 firms and one government agency, The National Institutes of Health. Turning specifically to the manufacturing sector, the following companies were listed as "highly viable" on a preliminary basis:

- Eli-Lilly
- Merck Sharp & Dohme
- Miles Laboratories
- Upjohn
- Squibb
- Warner-Lambert (Parke-Davis & Co.)
- G. D. Searle
- Pfizer
- American Home Products
- Schering Plough.

SEC-10K reports and annual reports on the above companies were analyzed to determine product and market orientation, in addition to general levels of sales, R&D, and so on. One split in the list that soon became obvious was the division between OTC (over-the-counter drug-oriented companies) and ethical (prescription drugs) pharmaceuticals. At this point, initial inputs from the technical background of

electrophoresis in space showed the need and application of the technology much more closely tied to the ethical firms. The applications of obtainable pure substances ranged from their use in analysis of biochemical systems to the formulation of immunization agents, to separation and synthesis of hormones and enzymes, to use in development of diagnostic methods.

Though the end application of electrophoresis might vary with each firm in the industry (one company would use the pure substances to analyze key reactions, another would manufacture an enzyme or a hormone, the NIH might initiate cancer research in zero-G, etc.), electrophoretic separation in a zero gravity environment to produce pure substances was seen to have potential application in the ethical pharmaceutical community. The ethical drug firms were then chosen for further contact:

- Eli-Lilly
- Merck Sharp & Dohme
- Upjohn
- Squibb
- Parke-Davis, division of Warner-Lambert.

The five firms were contacted (see section on test cases, Volume II). Four of the five firms agreed to discuss STS and electrophoretic separation, and two eventually were visited. In both cases, electrophoretic separation in zero-G was viewed as highly interesting, having definite possible applications. The thoughtful matching of a possible STS end use to a specific user was seen to be a significant part of the pre-development activity.

Cost/Benefit Analysis of Specific Applications. Once a specific application of STS has been determined at an end user level (e.g., the manufacture of vaccine to prevent disease "X" by electrophoretic separation in zero gravity), a business analysis must be performed which indicates quantitatively what the market for the product is, what the economic factors are in bringing the product to market, considerations such as regulatory problems, technical development, and other major unknowns. This analysis is a necessity to developing eventual use of Shuttle/Spacelab by any potential user. To a businessman, the market projections and economic analysis must indicate that the idea can compete seriously with all other possible uses of available funds. To a congressman, the cost/benefit to the eventual user community must be justifiable.

The concept of market demand alone is extremely complex. Kotler[5] states "market demand for a product class is the total volume which would be bought by a defined customer group in a defined location in a defined time period under defined environmental conditions and marketing effort". While it is not intended to digress as to whether bought means purchased, consumed, ordered; or what exactly constitutes environmental conditions, e.g., technical, economic, political and related factors; the definition serves to indicate some of the key parameters which must be addressed.

To illustrate, take the example of a vaccine for a certain disease. The prevalence of the disease in a given population may be contingent on sanitary conditions, diet, hereditary parameters, and countless other variables. The changing variables could obviate the need for the vaccine. On the other hand, they could increase its importance. This must be assessed. The population and growth rate has to be analyzed, that is, those populations particularly vulnerable to the disease by virtue of the conditions noted above.

With the "raw" market determined, one must consider the units of vaccine consumed per capita, and the timing of innoculation. Will everyone be vaccinated, every 5th, or every 20th person? Is the vaccination permanent or is re-innoculation required? How will the program likely be implemented, i.e., in stages, or all at once? Who will administer it? Who will pay for it?

Price sensitivity must be considered. Market share must be determined if there are likely to be competing products. Contingency plans must address major unknowns (extreme case analysis). Finally, the timing of the technological development must be considered in addition to the constraints induced by regulatory agencies.

The result of the market analysis is a market and product demand curve (Figure 4) indicating number of units for a given time period under stated conditions.

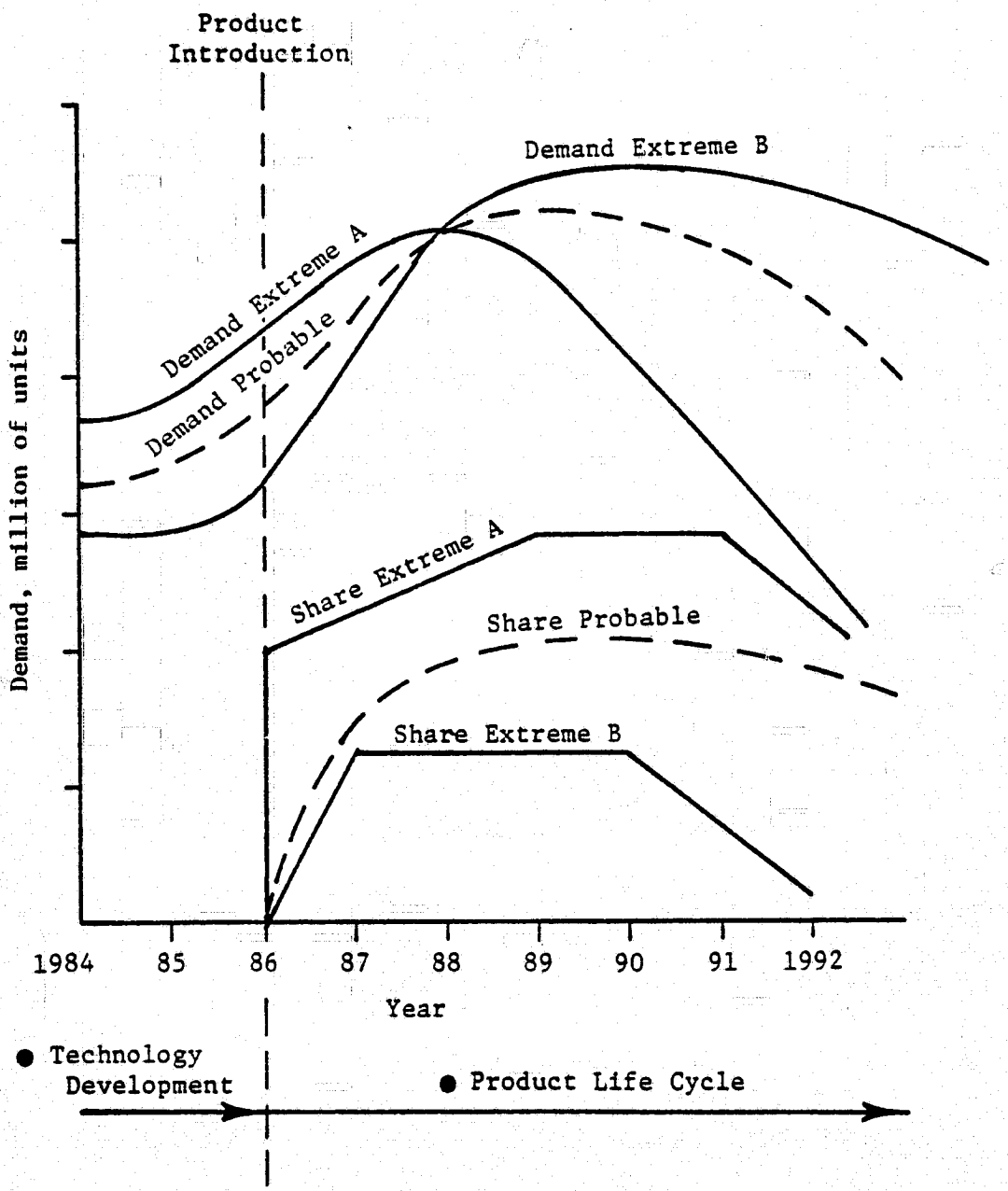


FIGURE 4. MARKET DEMAND AND PRODUCT LIFE CYCLE

The completed market analysis gives part of the business picture, that is, demand under certain conditions and at varying price levels. A cash flow analysis is required to determine economic viability of the project.

The technical development plan must be fully detailed to determine the level and timing of the effort, expected cost of various phases of the program, and major unknowns. The R&D costs and timing of R&D expenses can then be determined.

The unit cost of the product must be estimated based on likely quantity of units sold at any point in time, from the market analysis. Major capital expenditures can be estimated and projected in time.

The result of the analysis is a cash-flow model (Figure 5) of the business which projects major sources and uses of funds over the life of the business venture.

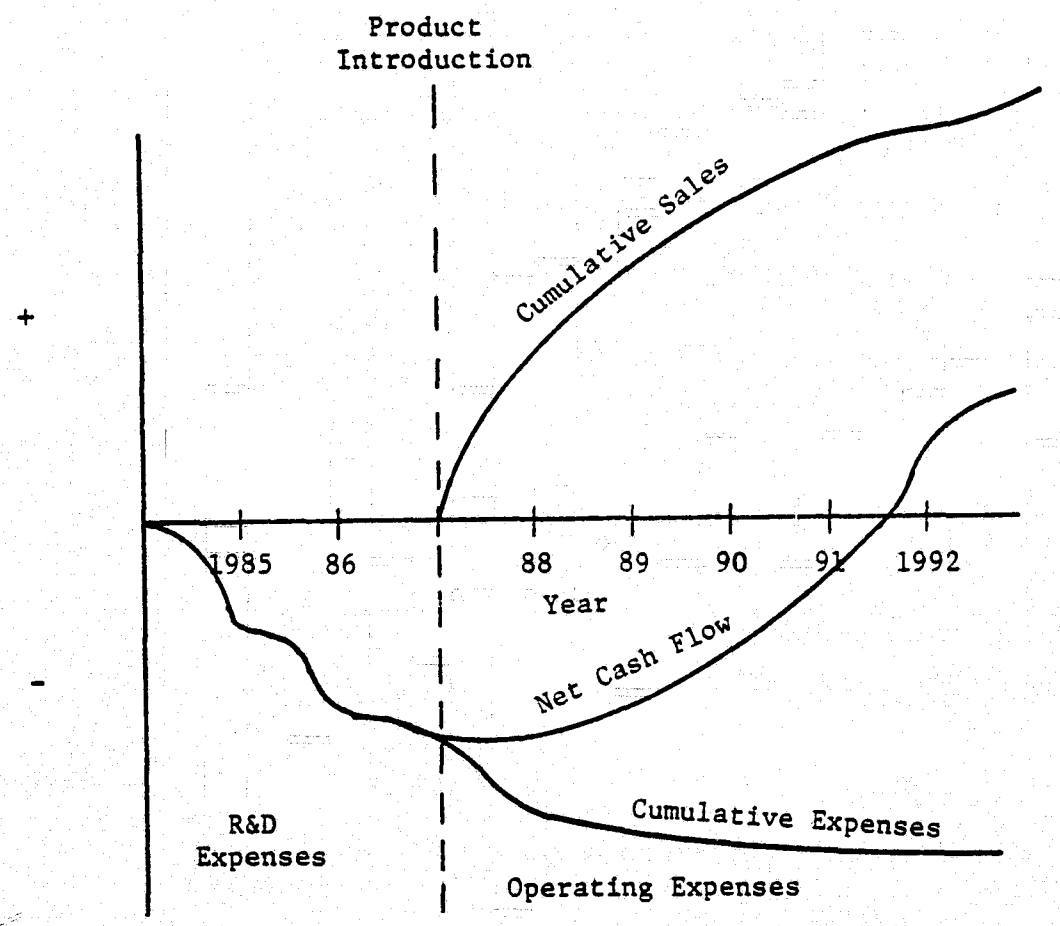


FIGURE 5. TYPICAL CASH FLOW CURVE

The cash flow stream can be fully discounted to current dollars so that the businessman can look at the expected return on investment (ROI), and with an assessment of risk involved, determine whether the venture is a viable undertaking.

The need for a specific business analysis of the projected use area is a critical input to the development process, especially in the private sector. That this type of input is essential was cited repeatedly in every test case conducted in the private sector. It also was noted that in order to have believability, the end user would have to be part of the analysis so that his specific marketing experiences and economic determinations would be reflected in the conclusions. If the end user were not involved in the key marketing and economic assumptions, the analysis would still be useful as a tool to stimulate interest in the community, but care would have to be taken so that the examples and decisions made have scientific and business credibility. An interested potential user will almost certainly scrutinize the analysis or repeat it with his own staff as a matter of business procedure. If the user development team is to retain and nurture its credibility, it must perform such analysis thoroughly and objectively.

Strategy Development and Implementation

Strategy Developmment and Implementation is the responsibility of the User Development Function shown in Figure 2 on Page 7. This function primarily determines a proper development plan for a particular potential user and the key interface within the prospective organization (i.e., the proper level of entry). In addition to the barriers, opportunities and information requirements of a specific potential user, the strategy also involves a coordinated approach to contact and information exchange with various elements of the user community. Basically, an approach is determined that will involve all key elements of the user community at the proper time, treating the interests of each element as a separate case. For example, the plan for the space communications use area would include specific plans for INTELSAT, COMSAT, Hughes, RCA, Western Union, and so on, throughout the entire community. After initial contact has been made (strategy implemented), the development plan is continually updated to respond to feedback from the user community and ensure maximum support, from within NASA, to the development efforts. The user development function, therefore, addresses two major activities:

(1) Development of a strategic plan specific to a potential user, and designed to minimize known barriers and maximize opportunity for involvement in STS

(2) Initial contact with a potential user and coordination of follow-on activities to minimize barriers and maximize opportunities as the development process is carried out.

Strategic Plan

Inputs to the strategy are prepared within the STS/NUD Administration, Technology Management, and Market Research functions as detailed in the foregoing discussions, These inputs are used by the strategist in assembling a unique development plan designed to maximize interest in a particular use area and minimize barriers to further development.

Key Elements of the Plan. The plan for each prospective user reflects at least the following elements:

- The projected STS use area in which the prospective user will be interested (Earth resources, space communications, space processing, etc.)
- The specific match of STS benefit to the user needs or product area (use of Spacelab for space satellite development as a commercial venture, use of electrophoretic separator for space separation of isoenzymes, etc.)
- The specific STS payload carrier of interest as an interface to the user (orbiter pressurized compartment, orbiter bay with attachment points or spin table, IUS, Spacelab space processing furnace, LDEF experiment tray, etc.)
- User involvement in space (from none to presently operating a space communication system)
- Status of technology involved in projected user's interest area (from satellites for space communications to silicon ribbon growth or electrophoretic separation in space processing)
- Role of user organization in user community (spacecraft operator, spacecraft manufacturer, a data user, a product marketer, a representative of a collection of users)
- Type of user organization (government agency, regional center, research laboratory, industry organization, a consortium, a broker, trade association, educational institute).

Barriers Unique to User's Level of Sophistication in Space Technology. Barriers which must be addressed include not only those unique to the specific company or agency, but also (1) those inherent in the level of sophistication of the user regarding space, and (2) those related particularly to industry and government. Referring first to a characterization by sophistication regarding space, three distinct user categories appear:

Category 1 - The group of user organizations who will be actively involved in space research/operations currently using expendable launch vehicles. This group will include organizations such as INTELSAT/COMSAT, NOAA, Global Satellite, Inc., Western Union, and spacecraft manufacturers such as Hughes, TRW, Aeronutronic-Ford, GE, RCA.

Category 2 - The group of users who are knowledgeable of space benefits and the current space programs and who will be on the verge of committing resources to a space program. COMSAT, user organizations (such as Satellite Business Services and American Satellite Corporation), future Earth resources consortiums, and future maritime or weather consortiums, are included in this user category.

Category 3 - The potential group of users who have yet to participate significantly in space programs and who are relatively unknowledgeable of the benefits of space. Potential users in the space processing program characterize this user group.

The above user categories, simply stated, cover the spectrum of users from those in the space business, those on the verge of entering the space business, and 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. In addition to the above user categories, it is recognized that certain factors of resistance can be uniquely associated with industry and with domestic government agencies/organizations.

Category 1 (The Space User). The users in this category represent various degrees of sophisticated space users who will view the STS as a potential means toward product/system improvement, system expansion or variations, and product/system derivatives. The resistance these users will present to the NUD representative 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 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. Advertised performance and system flexibility benefits to be provided by the STS will be evaluated or resisted in terms of the benefits/costs. These 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 alternate (and competitive) launch systems. The users who are fully committed to space programs understand the space technology applications and appreciate the cost/benefits of the space operations as compared with terrestrial systems. Their resistance or acceptance to STS will be in terms of the impact (near-term or long-term) on profits. The NUD representative will meet a very sophisticated and opinionated group of users in this category who will have significant experience in operating a space business as a direct comparison to what STS may offer. Some will have specific issues or concerns which are based upon less than satisfactory previous experience with NASA. They will be looking for a realistic prepayment plan and cost monitoring techniques for the STS to eliminate problems they experienced with the expendable launch vehicle programs. In many cases, their expendable vehicle experience will be a major factor in their acceptance attitude.

Category 2 (The About To Be Space User). These users can be considered as very knowledgeable of the applicable space technologies and space programs, but they will still be evaluating the cost/benefit of committing to a space system in comparison to a terrestrial system. Inherently, they will present much of the same resistance to STS as users in Category 1, but will view STS and its cost as part of a total front-end investment in a large complex space venture. They will be in a position to accept STS as a major fixed price (hopefully) element for their consideration in the economic assessment of their contemplated venture. In view of this, the resistance or acceptance to the NUD representative will be dependent on his ability to effectively describe how the user can use the STS (user charge, terms and conditions of use, schedules, user interface with NASA/STS, etc.) as a basis for a venture assessment.

Category 3 (The Unknowledgeable, Yet To Be A Space User). This group of users will include those organizations which have had little prior interest or involvement with the space program and, therefore, conceivably must be educated as to the benefits of space and the application of the STS. Initial resistance to the NUD representative may be in terms of misunderstanding or lack of understanding of space/STS. Subsequent resistance can be measured by their ability to comprehend and to relate the benefits to their needs, problems, operation, and organization. The resistance of the potential users in space processing may also be dependent upon an evolving, perhaps yet to be fully flight demonstrated, technology. Acceptance may be high if a process under zero-G conditions will produce results not possible on Earth or will represent a significant improvement on a product's characteristics (purity, homogeneity, immiscibility, electrical and magnetic properties). In this case, further acceptance will depend upon the economic assessment of the projected market, cost of R&D, cost per flight, cost of the total (Earth and space) processing, and facility and resource investments. The expected resistance to the long-term availability of Spacelab (earliest will be 1981) can be minimized by identifying early means of research or other program involvement, such as the space processing sounding rocket program. Some indication of NASA initial funding, as a cost of marketing, may be needed to encourage interest of some users who typically do applied research as compared to fundamental research.

Barriers Unique to Industry/Goverment. As a second mode of characterization, unique factors of resistance can be associated with the industry sector and with non-NASA/non-DOD domestic government agencies.

Industry. One of the major areas of resistance to a NUD representative interacting with industry can be associated with the basic difference in objectives between industry and government (NASA in this case). While NASA strives to serve the best interests of the public, industry must serve the best interests of the stockholder. This represents an emphasis on technical, as opposed to economic, considerations. Industry will, therefore, be very sensitive to the economics of space involvement and the STS application and terms and conditions of use. STS policy on proprietary rights, confidentiality of research/information, allocation of risks/liability, and assurance of access to STS services will have a significant influence on resistance/acceptance.

The sensitivity of the industry user to STS terms and conditions and his projected response (resistance or acceptance) have been previously discussed in detail in a Battelle memorandum[6] prepared for the STS User Charge Policy Working Group (NASA/JSC).

Also, industry over the years has developed an inherent mistrust and resistance to business involvement with the government. Some of the mistrust is unfair and not based on real situations; on the other hand, the image of government red tape, control policies, budget constraints, etc., contributes to industry resistance. Just the complexity of dealing with a complex operation, such as STS, will be resisted by industry. Regulations and fair trade policies in the pharmaceutical industry have alienated that industry relative to working with another government agency (NASA).

Domestic Government Agencies. Most of the resistance anticipated with industry, which is based upon dealing with any government agency, will not be experienced in NUD contacts with non-NASA/non-DOD government agencies. Other government agencies are appreciative of governmental control and business policies, objectives, etc. The Phase I NUD study conducted by SRI[7] 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. 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 user's concerns considering profit incentives.

Information Package. Once the profile of the user community and the specific company/agency has been assembled, and key barriers addressed, an information package can be assembled. The relationship of the various factors to the resulting information package is shown in Figure 6.

In general, the types of information to be covered should include:

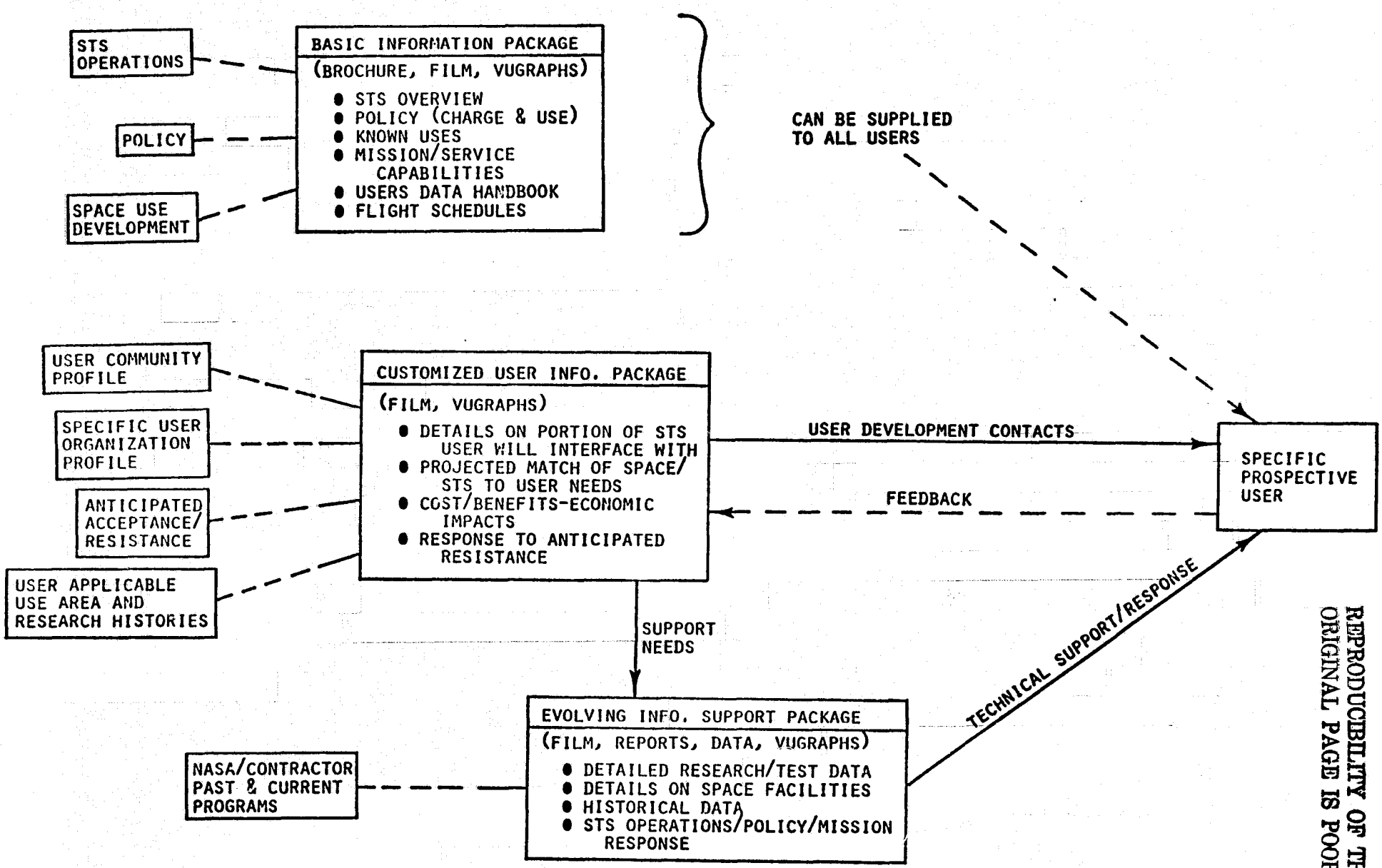


FIGURE 6. STS NUD INFORMATIONAL MATERIALS PROGRAM

- Overview of STS concept/program
- Cost per flight
- User charge/sharing policy
- Methods of determining charge/design tradeoffs related to charge
- Terms and conditions of use
- STS planned availability/accessibility
- Overview of STS operations
- User community profile and relationship of specific firms and agencies
- Technical summary of use area
- Projected match of STS to user needs
- Cost/benefit or business analysis
- Method of interfacing with STS (applicable technology and operations)
- Means of potential early involvement for use
- Specific follow-on steps
- Long range, future space planning (e.g., space station)

Obviously, the content and emphasis in any particular case will depend heavily on the technical sophistication of the user, prior experience with NASA, and particular use area.

It is realized that the basic package may be overdesigned for certain users who are currently involved in space operations. The user development strategy will consider the role of a user and the need for what information and how much should be presented.

Strategy Implementation

The Development Process. Key to the new user development program is actually interfacing with the prospective user once preparation preceding the first call has been completed, and the informational material developed. The dynamic, iterative exchange of information between the developing user and the NUD program is a vital part of the development activity. In developing the non-NASA/non-DoD market for STS, this proactive user development strategy is required.

Initially, interest is gained and enthusiasm generated in management level personnel in an organization, eventually resulting in direct "idea generation" and specific use/mission discussions with research and development personnel. The stimulation of innovative, new ideas from those user individuals who can relate their needs to STS capabilities and services will determine the success of user development. The entry point and path, within a prospective user organization/agency, to get to that creative group must involve a carefully planned contact and cultivation through the appropriate management levels to achieve acceptance, interest, and enthusiasm at those levels. The thrust of the actual user development will be initiated with an initial management level contact accompanied by adequate informational material and background assessment to achieve the interest and a follow-on commitment to a technical working session with the user's technical personnel. The NUD operation will be responsive to the necessary support of the user's new idea generation working sessions or plans to use a STS service and the feedback resulting from these sessions. Final user commitment to using the STS is to be the ultimate object of the NUD activity. Figure 2, Page 6, outlines the functional activities of the NUD program and shows the interaction required between NASA and the developing user as the potential customer moves from initial interest to idea generation, evaluation, and finally commitment to use STS/Spacelab.

An example of the development process can be made from the pharmaceutical community to more clearly illustrate the steps. Since there is virtual unawareness within this community of STS and the Spacelab or the potential impact of space processing of biomaterials on the markets serviced by this industry, the first task is to provide general information on capabilities, timetable, etc., and to discuss the level of development in the use area as related to the particular user. For example, the initial interface with a pharmaceutical company might involve a brief overview of Shuttle and Spacelab, a discussion of electrophoretic separation on Apollo 14, Apollo 16, Skylab and ASTP, and an overview of the current direction of biomaterials processing activities at NASA and elsewhere.

The second level of user development shown in Figure 2 is technical response or user-community involvement in the use area technology (perhaps by review of initial research and theory, and participation in planning of future R&D efforts). This involvement may be directly with a private organization,

or through scientific or trade groups representing many members in an industry having a common interest. For example, since the pharmaceutical industry is highly proprietary, it would be difficult to involve all the major industrial bioscientists in one common forum because of corporate disclosure policy. The PMA (Pharmaceutical Manufacturing Association), therefore, could be a communication link with all companies interested in electrophoretic separation, or any other biological application. A working subgroup would be formed within the PMA which, in addition to the government, academic and medical communities, would provide the proper interface for theories and research objectives. If one company dominates a particular field (e.g., a certain type of vaccine), then it makes sense to perhaps limit industrial contact to that organization, perhaps funding preliminary research to stimulate exchange ideas and review concepts. The purpose of the technical response stage, then, is involvement at an early point (initial research concepts and programs) in the activities surrounding the use-concept so that the potential user can (1) begin to visualize the possibilities of STS in his environment, and (2) participate in developing the use area, thereby maximizing future acceptance and minimizing future barriers. In an area such as space manufacturing where much of the pioneering research is yet to be planned, this early involvement in the private sector can have significant impact.

Having gained the participation of the end-user community in initial concept generation and interchange of ideas leading to viable research theories, the user community will begin to match STS concepts to internal needs. The STS/use concept phase shown in Figure 2 is the point at which the end user can identify actual R&D efforts that, if successful, could be of commercial interest. Such concepts might, for example, be the isolation of a particular immuno-substance from blood that will allow synthesis of a new type of vaccine, or a new type of modular satellite design. Our study indicates private firms will not, in general, fund the research effort until demonstrated results can be shown; but they will very likely work with NASA in outlining research programs, possibly funded by NASA, which will have significant commercial potential if feasibility and practicality can be demonstrated. Eventually, NASA will have to address industrial companies, who can provide significant inputs to the content and direction of further research as it relates to their needs and possible application. By involvement at an early stage in the

technology, the problem of immediacy can be overcome. Though the Shuttle is not available for several years, the individual company can become involved now in basic research inputs -- an activity profitable both to NASA and to the industry.

In addition to working directly with private companies or specific government agencies, STS use concepts could be stimulated by working with the academic community, scientific and technical societies, and trade associations. Throughout the development effort strategies for specific use areas and user communities may involve the following activities as well as direct contact with specific companies and agencies:

(1) Involvement of most of the scientific community through the societies, publishing in scientific literature, and direct interface, to discuss the value of proposed experiments and review results of previous experiments so that ideas could flow in from this sector

(2) Involvement of specific companies, perhaps by NASA-funded basic research in areas of demonstrated market dominance or scientific expertise

(3) Involvement of the academic research community, which is sensitive to areas that may have significant breakthrough potential.

Initial Contact.

Entry Level. The study has determined that, generally, the correct entry level for beginning the STS development activity is a meeting with the Vice President of Research and Development and the Vice President of Corporate Planning. The test cases (Table 2, Page 47) conducted in evaluating this plan confirmed the entry point. Usually, a middle management contact is valuable only for gaining information. Initiation of plans to study the potential application of STS will take an officer-level commitment (Persons familiar with sales of contract research to industrial organizations will recognize the importance of executive involvement.) In government agencies, conversely, the chief administrator is not likely to be the correct individual to contact. In this case, the ideal contact is the senior scientist or a similar individual in a particular technology area whose recommendations heavily influence the direction of R&D. This has been

demonstrated in the course of Battelle's own relationships with non-NASA/non-DoD government agencies. Unfortunately, while the vice presidents of large corporations are visible and accessible, the location of key individuals within non-NASA/non-DoD government agencies is a difficult and frustrating task to those unskilled with a particular agency. Persons directly involved in sales of contract research with these agencies, having a working knowledge of the agencies, will be essential to the STS New User Development in the public sector.

The correct persons to contact having been determined, commitments for an initial meeting are easily secured by calling (no letters) the individual, explaining the purpose of a meeting (e.g., information), and briefly explaining how this company/agency, user community is key to the use area. The object of this first meeting will be to exchange information and secure a commitment for the user to pursue the potential for STS application further within the organization.

Prior Preparation. Prior preparation for the meeting on the part of the development representative is essential. The efforts of all the functional elements in the NUD program detailed in previous sections of the report are applied to the user community through the representative, and can be lost through poor preparation. This preparation must include familiarity with the use area technology, user community interrelationships, and the specific company.

- Be aware why the use area being developed has been selected as a high potential for STS utilization.
- Understand the specific match of STS capability or service to the user's need (what part of the STS is being promoted?).
- Know why the user should be interested (technical and economic benefit).
- Be familiar with the cost/benefit, economic assessment and market projections made for the user's case.
- Know the applicable technology history and status.
- Know the user, be familiar with the user organization's financial and business profile or agency profile.
- Understand the entry point being made at the user's organization (why it was selected and role in authority chain).

- Be familiar with the general acceptance/resistance to be anticipated from the user community (user community profile).

Further, the development specialist must assure that the informational material is properly tailored to the user. Ideally, he would actually participate in development of the strategy and preparation of the user presentation and additional informational material. His observations on the end user might include the following types of input:

> "Beyond a general overview of Shuttle and Spacelab operations which can be provided in a short film to orient a potential user, what is really needed to interest this specific user in the STS is actual experimental results that the firm sees as having commercial potential. A good result would be a separate component of a complex biological material."

Or he may have the following types of information on a specific user:

> "Terms and conditions of use and user charge policy do not require detailed discussion during the initial meetings, although, for this customer, a brief statement of the disclosure policy (showing how this company's rights are protected) should be made. If possible, some cases should be outlined which would show anticipated costs of launch, operations, etc., and which would give a feeling for the range of costs expected. The ballpark cost information is important for the company to begin to consider the possibility of use (e.g., does it cost $100,000 or $10,000,000?)."

Follow-On Activity. In making the initial presentation, the representative must be prepared to listen, since his observations are the key to further strategy and user development. The presentations made in the test cases confirmed that the briefer and less detailed presentations (lasting no more than an hour) produced the most effective discussions. The user contact must be an exchange of information and ideas.

The representative must be prepared to establish channels of communication between the potential user and NASA. It was noted during the test cases, for example, that there is a need to have information available on all aspects of Shuttle, Spacelab, and STS operations available from one contact point. It is not reasonable to expect a potential user to interface with a variety of different offices, having to extract information, with attendant poor response time. The representative must be prepared to help the development process in moving toward a commitment by the potential user to actually use STS. He must:

- Be responsive to user ideas, questions, need for more data
- Be capable of providing or coordinating technical backup (research history/results/status)
- Be able to identify and implement the next step.

During the subsequent user development, the STS NUD function supplies technical support and information as required by the user, and provides NASA with information on key barriers and opportunities for further user involvement. It is this ongoing, iterative process that forms the framework of the user development activity.

Determine Best Application of Varied Resources

It is recognized that the resources of both government and industry can be applied in appropriate degrees of magnitude, timeliness, and effectiveness to achieve the objectives of the STS NUD program. The objective of a study subtask was, therefore, to assess the resources of NASA, other appropriate private government agencies, and the commercial sector, to determine whether, and in what manner, they could be applied to support the development of new users for the STS.

The definition and understanding of the overall requirements of a New User Development function are basic to the conduct of an analysis of what, and how, resources (financial, technical and facilities) of different agencies, communities, and organizations can best be applied. Figure 2, Page 7 was prepared as a means of defining the functional requirements associated with a NUD function as a primary element in the preliminary implementation plan

to be presented and evaluated through test cases. The plan was found to be valid through all the test cases shown in Table 2, and Figure 2 is proved to be accurate representation of the functional requirements of the NUD program. The relationships and interactions between the NUD operation and other supporting activities outside the NUD function are shown. Therefore, the analysis conducted and the resulting recommendations are based on the NUD function shown in Figure 2.

The obvious approaches to implementing the NUD function would, at one end of the spectrum, have NASA undertake the entire functional/organization responsibility and, at the other end of the spectrum, have NASA utilize an outside organization to undertake the entire functional/organization responsibility. There could be many variations of this latter approach, ranging from a subcontractor arrangement to the creation, probably by legislation, of an independent, regulated monopoly (similar to COMSAT) to conduct the user development task as a commercial venture. Another variation could comprise an initial subcontractor arrangement evolving over time to the COMSAT-like organization. There is no clear-cut, outstanding advantage to any of these approaches and it is obvious that many major, complex issues would have to be addressed prior to a final decision as to which way to go.

It is felt that none of the above approaches should be recommended, at least in the immediate future. First of all, this study has confirmed that the development of non-NASA/non-DoD users of the STS will be a very large, complex understanding for any agency or organization. Such a development program must be initiated <u>soon</u> if other government agency and industrial interest and use is to be achieved in the 1980's, concurrently with the maturing STS. This dictates an approach which blends the capabilities and experience of both NASA and industry. The implementation plan developed in this study stresses the use of industrial marketing techniques and know-how. It is very apparent, however, that marketing of the STS must be directly supported by STS knowledgeable personnel and space use development activities, clearly a function and responsibility NASA must retain in the NUD function. It is also believed that it would be more cost-effective for NASA to obtain the experienced, qualified personnel, who will be required to do the market research and user development functions from outside NASA. Referring to Figure 2, it is recommended that NASA establish the overall NUD function as shown, and employ industry resources

TABLE 2. STS NUD TEST CASE SUMMARY

TEST CAST ORGANIZATION	LOCATION	DATE	BCL-NUD REPORT	USER TYPE	USER COMMUNITY	STS APPLICATION OF INTEREST
Department of Transportation - Systems Development and Technology	Washington, D. C.	1/23/76	MM-76-2	Government Agency - Headquarters	Earth observations, weather, communications navigation	Multi discipline - satellite/Spacelab
Public Service Satellite Consortium	Washington, D. C.	1/30/76	MM-76-3	Consortium	Telecommunications	Educational use of satellites/Spacelab
Department of Interior - United States Geological Surveys	Menlo Park, California	2/4/76	MM-76-5	Government Agency Regional Center	Remote Sensing, communications	Research support - satellites/Spacelab
* Earth/Space	Palo Alto, Calif.	2/5/76	MM-76-4	Space broker	Potentially all	All
Fairchild Camera and Instrument Corporation	Mountain View, California	2/5/76	MM-76-6	Private company	Semiconductor Industry	Space processing - electronic materials
Texas Instruments	Dallas, Texas	2/10/76	MM-76-7	Private company	Semiconductor Industry	Space processing - electronic materials
Merck, Sharp and Dohme	Rahway, New Jersey	2/25/76	MM-76-8	Private company - research labs	Pharmaceutical Industry	Space processing - biological applications
Warner Lambert (Parke-Davis)	Detroit, Michigan	2/27/76	MM-76-9	Private company - research labs	Pharmaceutical Industry	Space processing - biological applications
* NUS Corporation	Washington, D. C.	2/19/76	MM-76-11	Private engineering and consultant firm	Utilities	Remote Sensing - environmental impact assessment
* RCA Astro/Electronics	Princeton, New Jersey	3/10/76	MM-76-12	Private company	Space communications	Spacecraft manufacturer
* Western Union	Upper Saddle River, New Jersey	3/11/76	MM-76-13	Private company	Space communications	System operator
* Ohio State University Research Foundation	Columbus, Ohio	3/15/76	MM-76-14	University	Education	Space research, space education, Spacelab

* No formal presentation was made. Informal meeting was substituted.

to accomplish the "Market Research" and "User Development" functions. It is, however, recognized that, where lines of communications already exist between NASA and an agency (e.g., NOAA) or an organization (e.g., COMSAT), it may prove to be more practical for NASA to be responsible for those specific user developments. The key determining factor would be demonstrated experience in a particular user community and knowledge of a specific agency or organization.

The recommendations to utilize industrial marketing experience, the key factors for such recommendations, and the characteristics of the industrial firms required were discussed in great detail in two of the Phase I studies[8, 9] and, therefore, are not repeated in this volume. The issues identified and the points made in those reports are still considered to be valid.

REFERENCES

(1) Bier, M., and Snyder, R. S., "Electrophoresis in Space at Zero Gravity", AIAA Paper No. 74-210, AIAA 12th Aerospace Sciences Meeting, Washington, D. C., January 30-February 1, 1974.

(2) Bier, M., Binder, M. J., Snyder, R. S. et al., "Role of Gravity in Preparative Electrophoresis".

(3) van Oss, C. J., Bigazzi, P. E., Gillman, C. F., and Allen, R. E., "Preparative Electrophoresis of Living Lymphocytes".

(4) "Utility of Space Transportation System to Space Communication Community", Hughes Aircraft Company, NASA Contract No. NAS8-31435, October, 1975.

(5) Kotler, Philip, Marketing Management, 1967, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, "Concepts in Market Measurement", p. 99.

(6) McDowell, J. R., "Terms and Conditions Policy for STS Use", BMI-NLVP-IM-75-10, August 19, 1975, Battelle's Columbus Laboratories.

(7) Archer, J. L., Beachamp, N. A., and MacMichael, D. C., "Final Report on Development of Methodologies and Procedures for Identifying STS Users and Uses", NASA Contract No. NAS8-30533, June 20, 1974, Stanford Research Institute, Huntsville, Alabama.

(8) Gripshover, Paul J., "Final Report on Space Shuttle Transportation System Technique for User/Use Development", NASA Contract No. NAS8-30592, June 30, 1974, Battelle's Columbus Laboratories.

(9) Krebs, William A. W., "Final Report - An Approach to Developing the Market for Space Shuttle Payloads (Business/Public Policy Issues and International Marketing Considerations)", NASA Contract No. NAS8-30739, August 31, 1974, Arthur D. Little, Inc., Cambridge, Massachusetts.