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A STUDY OF
THE POTENTIAL IMPACTS
OF SPACE UTILIZATION

Final Report

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INTRODUCTION

In April 1978, NASAs Office of Space Transportation Systems commissioned the Georgetown University Graduate School "Space Utilization Team," under the direction of Dr. T. Stephen Cheston, to undertake a preliminary study of the emerging interest of the social science/humanities community in space utilization concepts. The historical context of this study is described in the Community Assessment section (Overview of Technology and Society).

The contract required the Team to (a) assess the academic social sciences/humanities community, specifically: developing a list of its members, conducting a current literature review, handling relevant correspondence, developing a list of current and planned academic courses, and generating a preliminary matrix of relevant social sciences; and (b) determine the academic scope/focus of a proposed social science space-related journal, specifically: identifying technical topics to be reviewed (through such approaches as reviewing relevant literature and consulting with industry/government experts), defining academic scope (through such approaches as developing a matrix of core disciplines and consulting experts), identifying disciplines which should be represented in the editorial board/reviewer system (and suggesting potential editors and reviewers), and assessing the time and funding necessary to develop a self-sustaining journal (including analysis of costs, income, general organizational structure, marketing/distribution, and funding sources).

On several occasions the Team determined that further data collection was either essential or advisable. These efforts to supplement and enhance the utility of the study are detailed within the body of this final report.

CONCLUSIONS / RECOMMENDATIONS

Major conclusions and recommendations of the study are presented below:

I. COMMUNITY ASSESSMENT

A. Conclusions

1) A substantial and growing number of scholars are studying the space program from a social science/humanities perspective. Interest on the part of these scholars can be expected to increase as Shuttle-based space utilization projects are approved/undertaken.

2) The existence and future growth of an emerging community of social scientists interested in space has important implications for NASA.

   A. NASA will increasingly require objective social science input as the goals of the space program focus on meeting Earthly needs through the application of space technology. By establishing a two-way communication mechanism with the academic community already studying social science aspects of space utilization, NASA can obtain access to high-quality research and review of mission-related social sciences. Much of the quality research identified in the present study was not funded by NASA, or otherwise integrated into the planning process.

   B. The absence of such a communication channel may cause the space agency to become isolated from the mainstream of social science research, thus necessarily rendering proposed future space projects less relevant to social needs and realities.

B. Recommendations

1) Beginning at the concept development stage, NASA should seek to foster interaction between space planners and social scientists. More specifically:

   A. In the near-term, NASA should seek to promote the growth of the interested academic community by providing assistance in the development of resource materials and by encouraging the growth of peer review and interaction among members of the community.

B. As Shuttle-based utilization projects are planned and implemented, it may be useful to support more comprehensive social science input. At that time, NASA may wish to consider supporting a social science research clearinghouse, analogous to the Lunar Planetary Institute in the physical sciences. Such an organization might conduct research, offer social science fellowships for advanced studies, and provide a forum for the dissemination of research.

C. Impact of Implementing Recommendations

1) NASA would receive assistance in:

A. Planning socially-relevant space technologies.

B. Evaluating mission planning.

C. Identifying and utilizing existing social science data applicable to agency activities.

2) NASA would assist the academic community in accord with agency policy.

A. By providing a focal point for research input.

B. By providing the directions for future social science space research.

C. By helping to insure a professional approach to space social science research by providing for peer review and interaction. This would result in the long-term development of an academic community with a multi-technology viewpoint.

II. JOURNAL FEASIBILITY

A. Conclusions

1) Some professional communication mechanism for interested scholars is necessary, but it is doubtful that a quarterly publication is feasible at this time. Financial considerations are the primary reasons for this conclusion.

2) Even if financially feasible, such a journal should be independent of NASA, aerospace corporations, or other identifiable "interest groups" to insure the full credibility of the publication.

B. Recommendations

1) NASA should examine alternative forms of written communication mechanisms, such as a "handbook" of basic materials relevant to the social sciences.

C. Impact of Implementing Recommendations

1) NASA would not be committed to the rigorous schedule of maintaining a quarterly publication schedule, but would be able to provide basic materials to interested scholars.

COMMUNITY ASSESSMENT

The contract required a multifaceted assessment of the social science community interested in space utilization. Major components included: (1) a listing of the community members, including institutional affiliation, time involved in the field, specific interests, and scholarly production; (2) a review of current literature; (3) the construction of a preliminary matrix of related social science disciplines, based on consultations and available resource material; (4) the management of correspondence with interested individuals and groups; and (5) an examination of current and planned academic courses. The Space Utilization Team chose a survey of the social sciences community as the optimal means of obtaining information on community members and current/planned courses. The survey was expanded to gather relevant information on the social science community beyond that required by the contract. Survey respondents and other experts were consulted (both personally and through the literature review) to enhance the quality and pertinence of the preliminary matrix of related social science disciplines. The matrix was reviewed and revised repeatedly to insure maximum utility.

The Team's assessment of the social science community should serve several functions, including: (1) providing a preliminary overview of the level of activity and interest in the social science community concerned with space utilization, emphasizing strengths and weaknesses of the community and identifying knowledgeable institutions and individuals; (2) serving as a basis for subsequent NASA interaction with the social sciences; and (3) possibly suggesting new insights or procedures to NASA planners.

A preliminary assessment of the interested community of social science scholars is also timely in light of the need for social science analysis of spac utilization and the potential utility of such research, as the overview notes.

OVERVIEW OF TECHNOLOGY AND SOCIETY

Technology inherently creates new opportunities but simultaneously generates new problems of unknown dimensions for individuals and society. Sociologist Daniel Bell contends that: "Technology does not determine social structure; it simply widens all kinds of possibilities . . . a single technology is compatible with a wide variety of social patterns and the decision about the use of the technology is, primarily, a function of the social pattern a society chooses." [1]

Technology and the Social Sciences

In recent years the continued growth in scientific and technological advances has produced applications which frequently result in major societal impacts--some foreseen, others unexpected. Emmanuel G. Mesthene, then director of the Harvard University Program on Technology and Society, noted in 1970 that: "What distinguishes our time (from earlier technology-induced eras such as the 18th century industrial revolution) is less the fact that technology has important social consequences than our widespread awareness of that fact and our readiness to deal with it." [2]

The social analysis of technology now constitutes a significant research activity--supported by studies undertaken in the academic, governmental, and private sectors. University programs--especially at graduate levels--concentrate on preparing students to systematically analyze the interdisciplinary forces of technology and society. [3] Specific social science disciplines, as well as interdisciplinary analysis, have been applied to individual technologies and major projects in response to governmental policies and legislation which promote such

research for the purpose of obtaining diverse insights into optimal approaches to policy planning and implementation. (This phenomenon is discussed in greater detail in the matrix--impact assessment section.)

Scholarly analysis of the social consequences of technology and technological change definitionally encompasses significant roles for many, if not most, of the social sciences (Appendix A defines the social sciences for purposes of this study).

Because natural and applied scientific research can be verified, while the social sciences, for the most part, cannot, some observers have argued that the social sciences are substantively distinct from the natural and applied sciences. [4]

However, recently social scientists increasingly have been attempting to construct social science research projects to facilitate quantification and consensus analysis. This trend suggests that the distinction between the so-called "exact" and "inexact" sciences is less valid than previously supposed. [5]

Regardless of the ultimate evolution of the social sciences, their utility in addressing the effects of technological initiatives will be exploited increasingly. [6] And, as more and more scholars assess the social impacts of technology, both the studies' quality and the analysts' expertise might be expected to improve. This progression may well provide an institutional base for comprehensive, long-term social analyses.

Space Technology, Society, and the Social Sciences

The present study should be considered within the broad context outlined above and within the narrower context defined by space technologies. The National Aeronautics and Space Administration and space technology have been molded by and within the social/economic/political

environment. Concomitantly, space technology has influenced that environment. A 1970 study sponsored by the Aspen Institute for Humanistic Research declared that: "Few events are likely to change human perspectives more than man's hard-won ability to launch himself from planet Earth to explore the reaches of space." [7]

The study of the inter-relationships between space technology and society has developed, over time, in a cyclical fashion--generally in response to NASA program objectives. Major space projects, especially manned missions, have generated interest in and the need for mission-related "human factors" social science studies and studies of the societal impact of the space program. During periods of relative inactivity in the manned space program, such studies not unexpectedly have been fewer in number. Given the near-term realization of the next major U.S. manned space enterprise--the Space Shuttle--NASA planning and programming should benefit from a preliminary evaluation of the relevant social sciences and the community of scholars interested in applying their expertise to the analysis of Shuttle-based space utilization.

the development of a space-related social science community: 1958-1968

In 1974, Dr. Mary Holman (currently chairman of the department of economics, The George Washington University) completed a review of NASA's contracts and grants in the social sciences from 1958 to 1968 as part of her book, The Political Economy of the Space Program. One important conclusion of this ten year review: "Since its inception, NASA has done much in its attempt to understand the socio-economic effects of its actions and programs. Although small compared with total expenditures, about one-tenth of one percent of a ten-year budget, about $35 million,

was spent for research in the social sciences between 1958 and 1968." [8] While this figure does not reflect all NASA-sponsored social science research conducted during the period, e.g., social science research on "human factors" is excluded, it does document NASA's intrinsic interest in such research. Dr. Holman further noted that "the mandates of the Space Act are not the sole explanation for NASA's support of research in the social sciences. Interest in the social and economic effects of the space program . . . necessarily became the concern of NASA officials." [9]

The Apollo program, in part because of the national commitment of resources and prestige, inevitably raised social, economic, legal and policy concerns in many sectors of American society. The interest prompted by these concerns encouraged some social scientists to analyze the broad social impacts of space programs on society and, conversely, the effects of society on the space effort. [10] Some of these studies were reviewed or analyzed in books, professional journals, and (to some extent) the popular press. [11] Respected scholars in some disciplines addressed the need for this type of analysis, arguing that, in fact, social analysis was not a luxury but a necessity. [12]

Concurrent with this spontaneous growth of social science interest in the Apollo program, NASA began to appreciate the necessity of familiarizing itself with the real and potential contributions of the social sciences to space program planning and implementation. Through grants and contracts, NASA sought to focus some of this research in areas of greatest relevance to the agency.

NASA-sponsored Apollo era social science research tended to concentrate on mission-related human factors or highly specific studies of the impact of NASA spending on local and regional economies, or on

occasion the legal aspects of NASA's policies and programs.

As the Apollo program concluded, the interest level of the social science community in space research apparently began to decline. For NASA, the early 1970's were a time of initially developing the Shuttle and of planning how best to utilize the opportunities offered by the Space Transportation System. Because new programs and technologies as yet were not clearly defined, the social science community interested in space had no focus for their interest--thus the interest began to dissipate.

the continuing evolution of a space related social science community: mid 1970's-present

Beginning approximately in the mid-1970's, however, several proposals for Shuttle utilization were commissioned by NASA, the aerospace industry, and in some cases, private organizations and individuals.[13] These proposals have been categorized generically by the Georgetown Team as addressing "space utilization" and generally have envisioned employing the Shuttle and/or Shuttle-based technologies in space to pursue objectives such as providing energy, developing new products, and creating new information and resource development services--objectives with potentially significant benefits for Earth.

These proposals, especially those receiving attention outside NASA, prompted a re-emergence of interest in social analysis of the space program by academic institutions, members of non-profit organizations, the aerospace industry, and some members of Congress. Additionally, heretofore uninterested sectors of the public--for example, the public interest group community--analyzed, and in many cases opposed, future Shuttle-related space projects on the basis of perceived social effects.[14]

This escalating interest of social scientists in space was generated not only because of the potential impacts on society of space ventures, but also because of the potential for new advances in the social science analysis of human interactions within the isolated environments of the Shuttle and the NASA/European Space Agency Spacelab. [15]

NASA's mail on the subject also began to show an increase--seemingly directly attributable to the emergence of proposed Shuttle-based technologies, and related proposals for their utilization. [16]

the future of the space-related social science communi: : the Shuttle age

As the Shuttle nears completion and initial orbital testing, the stage is set for a new era in space. Dr. Frank Press, director of the Executive Office of Science and Technology Policy, recently testified that: "The Shuttle era will continue these (space-induced) changes (in our daily lives) as it introduces new vistas in science, exploration, and applications." [17]

In the Shuttle age, the role of the social science community will, in some respects, be similar to the Apollo program role, in spite of the fact that the era of "space spectaculars" has been supplanted by a program operating within realistic budgetary constraints and emphasizing beneficial terrestrial impacts of the space program. The social sciences constitute a necessary component of program planning, both legally and practically. Carrying out the mandates of the still-operative National Space Act of 1958 will, of necessity, include elements of social science analysis. The Act requires "the establishment of long-range studies of the potential benefits to be gained from, the opportunities for, and the problems involved in the utilization of aeronautical and space activities for peaceful and scientific purposes." [18]

Since the space program is a product of American society, attempts to understand fully potential benefits and problems necessarily assumes an analysis of the social context within which the program must operate. The social sciences have thus traditionally been relevant to NASA.

In another sense, over the next decade, the social science community might well assume an even more prominent role in NASA planning. The Space Utilization Team has identified three trends which may require greater social science analysis input in NASA planning during the 1980's:

(1) The Changing Nature of the Space Program Since Apollo. In terms of manned space flight (the Shuttle), the primary goals of future projects will not be limited solely to scientific exploration. Rather, as enunciated in the Administration's "Fact Sheet on Civil Space Policy" : "In the future, activities will be pursued in space when it appears that national objectives can most efficiently be met through space activities." This increasing emphasis on using space technology to pursue national goals will require a clear view of how those technologies affect society--which in turn requires an understanding of mechanisms and methodologies employed in the scholarly analysis of society, i.e., the social sciences.

(2) Increasing Desire for Public Participation in Agency Decisions. National policy has been moving toward increasing the public role in agency decision-making processes, beginning in 1969 with the National Environmental Policy Act (NEPA) and continuing today with several agencies' public participation programs. [19] Legislation and court decisions have mandated that environmental and social impact statements accompany any agency proposals likely to affect such concerns. [20] Already social scientists are beginning to analyze these programs and their impacts--potentially providing an important input into public participation programs, social impact assessments, and other mechanisms for public

participation in decision-making. Numerous government agencies (including the Department of Energy, the Corps of Engineers, the Environmental Protection Agency, and the Tennessee Valley Authority) have recognized that the societal effects of their programs compel them to seek increased public involvement and/or social analysis. If NASA takes a similar approach, the social sciences will be able to provide an external, professional assessment of the advantages and shortcomings of various procedures and policies.

(3) Increasing Demand for Mission-Related Social Sciences. Larger and more differentiated crews will distinguish Shuttle and Shuttle-based activities from earlier manned efforts. Dr. B.J. Bluth, a sociologist at the University of California, Northridge, noted significant implications for NASA in a recent communication with the Georgetown Team: "With the change in the character of Shuttle/Spacelab missions, the factor of more frequent and routine missions involving many more people than in the past with direct relationships with the space environment will require a change in management and organization practices if the missions are to be effective, efficient, and if morale is to remain good. This trend would imply that NASA will need a larger social science input as the mission profile develops." [21] An earlier NASA task group concurred: "Translating our knowledge of social and political science to the environment of space, and understanding the special problems and opportunities provided by this environment requires emphasis by NASA." [22] The ability and opportunity to conduct ground-breaking sociological experiments may generate experimental data applicable to the study of societies on Earth, thus stimulating "a real leap ahead in the quality of human social life in space and on Earth." [23] The need to anticipate and deal with social interaction in the space

environment will challenge NASA and several professionals included in this study.[24]

Dr. Bluth has identified three characteristics of sociological studies generated in the Shuttle environment which distinguish them from currently available studies: (1) the physical isolation of the space facilities; (2) the unique aspects of new jobs which address living and working in the space facilities; and (3) the level of sophistication achieved by organizational planners in the last few years. Dr. Bluth contends that the simultaneous existence of these conditions is unique and that careful analysis of data generated in such an environment may yield new and useful insights into terrestrial social organization.

Each of the above trends, therefore, could intensify the need for research pertinent to NASA mission/policy planning--and in the case of research results, may be applicable to a broad range of terrestrial needs. The cross-application of space research results to Earth-based research is quite clear in the case of assessing the impact of NASA technologies on Earth societies; in the cases of requiring public participation and conducting mission-related research, new techniques of social science analysis might be developed for space research purposes which could be applied to terrestrial situations.

SURVEY

The survey is the primary means of developing the required list of scholars currently involved in the social science aspects of space utilization, the duration of their interest, their specific areas of interest, and their scholarly production to date. In support of the broader contractual goal of assessing the social science community, the survey was expanded to track the contemporary development and growth of the social science community interested in space utilization (a copy of the survey is included as Appendix B). Additional survey questions addressed topics such as: age; profile of current job; educational background; membership in professional associations; professional knowledge and evaluation of space utilization; and experience in relevant funded research.

Such a survey is appropriate for defining the scope and characteristics of a spontaneous and diverse community, such as the social science community interested in space utilization. By cataloguing legitimate social science concerns and assessing professionals available for advice, NASA can take the first step toward integrating the social science perspective into its planning process. Disciplines relevant to NASA planning include: anthropology, architecture/design, business/management, communications, economics, education, geography, history, philosophy, political science, psychology, public administration, religion/theology, and sociology. Further analysis of relevant fields appears in the matrix section, and a list of pertinent sub-fields is attached as Appendix A.

The Space Utilization Team, NASA, and a variety of experts reviewed the final survey for substance, style, and such characteristics as due concern for respondents' privacy, clarity of language, and unambiguous question formats.

DISTRIBUTION

The Space Utilization Team distributed approximately 600 surveys, initially mailing to a carefully-screened core list of 175 professionals with a probable interest in space utilization. The Team subsequently contacted other social science/humanities professionals and/or departments likely to be interested in space utilization. Potential respondents receiving the survey included: (1) social scientists or humanities professionals with a known interest in space utilization, based on the Team's knowledge of the field; (2) social science professionals who independently contacted the Georgetown Team or NASA; (3) individuals referred to the Team by NASA or interested experts; (4) social scientists or humanities professionals recommended by survey respondents as candidates for the survey--currently 283 recommendations have been received, with approximately 145 representing new candidates for the survey (125 arrived in time to be placed on the mailing list); (5) professionals discovered through the limited literature review undertaken for matrix/journal development; (6) relevant university programs or departments, including a small subsample of departments listed in the EVIST (Ethics and Values in Science and Technology) Resource Directory published by the American Association for the Advancement of Science; and (7) professionals who responded to survey notices placed in professional journals.

The survey sample excluded members of the press, but included both a small representative sample of scientists (physical/mathematical) with social science concerns and interests and a small subsample of students.

RETURN

Realizing that the longer survey (totaling eight pages) would tend to lower the return rate, the Space Utilization Team employed a telephone

outreach program, encouraging potential respondents to participate. This outreach effort, combined with the explicit interest of most of the sample, produced relatively high return levels. Approximately 35% of all distributed surveys were returned (213 of 615). However, a more relevant calculation might be the number of surveys returned as a percentage of the number of surveys distributed directly to individuals (as opposed to departments or meeting participants). This calculation yields a return rate of about 46%, which is relatively high for direct mail surveys.

RESULTS

The final tabulation was based on a sample of 212 surveys. Subjective questions were tabulated manually, and objective questions have been computerized for easy access and cross-tabulation capabilities. Questions which defined sample characteristics or which generated generalizable and functional findings are analyzed below.

Data limitations include: (a) the sample selection techniques, which focused on social scientists with a demonstrated interest in space utilization. Hence, the sample is not random, nor was it intended to be; and (b) the sample size (212 respondents), which represents a preliminary base from which to draw conclusions. Results must therefore be evaluated as tentative conclusions--useful insights to guide future research and planning.

Characteristics of the Sample

(1) Education (Survey Question III-A). Most survey respondents are well-educated (see Table 1, p. 18). Approximately 141 of 212 respondents hold Ph.D.s and 37 have MAs --over 66% of the sample. Only

TABLE 1

Educational Qualifications*

141	PhDs
37	MAs
27	BAs
7	none listed

* based on highest degree listed

TABLE 2

Organizational Affiliations*

University	104
College, Jr. Coll.	10
Other Educ.	4
Education	118
Non-Profit	19
Research	16
Academic Research	35
Corp/Business	15
Aerospace Corp/Bus.	13
Business	27
Federal Govt	12
State/Local Govt	2
Military	5
Government	19
Media/PR	2
Other	3
All others	5

* 204 out of a sample of 212 responded

7 respondents list no degrees. Fields displaying the heaviest concentrations of reported degrees include: sociology (26), psychology (21), law (16), anthropology (14), and political science (12). The sample thus appears to be well-educated in a variety of fields. Many respondents reported interests crossing over several fields, a phenomenon discussed later.

(2) Organizations (Survey Question II-B). The sample predominantly represents professionals affiliated with educational institutions (see Table 2, p. 18), with 118 of 212 respondents (over 55%) employed by universities, colleges, junior colleges, or other educational institutions. Roughly 35 respondents (over 16%) are affiliated with non-profit or research organizations, and 27 respondents (almost 13%) work for corporations or businesses (12 for aerospace-related firms). Only 19 survey respondents (about 9%) are employed by federal, state, or local governments. Hence, the survey sample is comprised of largely academic professionals from educational institutions and from institutions conducting social science analyses (the latter identified by the Team based on prior knowledge or matrix research).

(3) Age (Survey Question I-B). The age distribution of the sample reveals a number of survey respondents (136) between the ages of 29-48 (see Table 3, p. 20). This preponderance of younger respondents suggests several possible implications--e.g., the sample probably includes many individuals who were not involved in the earlier burst of social science interest in space policy (see Community Assessment introduction). In addition, the age distribution indicates that NASA could identify a pool of advisers with rising professional expectations and the capacity to study space utilization over time. Finally, the age distribution seems to demonstrate that the sample does not contain a large proportion

TABLE 3

Age*

69-79	3
59-68	10
49-58	37
39-48	60
29-38	76
19-28	16

* 202 out of a sample of 212 responded

TABLE 4

Geographic Distributions

Northeast	54
West Coast	45
DC-area	36
Midwest	23
Southwest	23
Southeast	15
California	40
New York	26
Texas	20
Virginia	13
Missouri	12
Pennsylvania	11
DC	11
Massachusetts	9

of professionals who have been at the top of their fields for many years.

(4) Experience in Funded Research (Survey Question V-H). Approximately 67% of the sample (139 respondents) have never applied for funded research in space-related fields. A slightly higher percentage of respondents (69%, or 144 respondents) have never undertaken funded research in space-related fields. Of the 64 respondents who claimed to have undertaken funded research, only 35 (or 17% of the total number of respondents) reported undertaking social science or humanities research.

(5) Geography (Survey Question I-E). The sample is well dispersed geographically (see Table 4 , p.20), with heaviest concentrations of respondents in the Northeast, the West Coast, and the Washington, D.C. area. Explanations for this distribution are not definitive. The distribution may be explained partially by exposure to space-related issues; for example, the heavy response from California and to a lesser extent Texas may be related to aerospace activities and corporations in these areas. The relatively large proportion of respondents in the Washington, D.C. area might be explained by citing exposure to federal space policy debates. Of course, such hypotheses would not explain the relatively high concentration of respondents in the Northeast (which might be attributable to response from the many educational institutions in the area) or the relatively low concentration in the Southeast. Simply, the sample is geographically diverse, probably because of a variety of factors.

The three states with the most respondents--California (40), New York (26), and Texas (20)--are all relatively large states with sig-

nificant urban populations. The importance of this distribution is not readily apparent--and given the size of the sample, conclusions should be drawn cautiously.

ted Responses

(1) Information Levels (Survey Question IV-E). The majority of survey respondents attempt to follow the development of space utilization either very closely (105, or over 49%) or somewhat closely (84, or almost 40%)--(see Table 5, p. 23). While respondents may or may not be successful, their subjective evaluation of intentions suggests that the sample seeks to be well-informed--and, concomitantly, would welcome additional materials relevant to their interests. Furthermore, it is likely that survey respondents have a professional perspective including not only their own field but also the field of space sciences. While the sample's understanding of the technical/scientific aspects of space utilization concepts may not approach that of NASA and other technical experts, the respondents are, minimally, capable of making preliminary judgments on the relevance of space technologies to social science/humanities research. Given the sample's acquisitive bent, a continuing/expanded dialogue between the social science/humanities community and the space technology/scientific community should encourage greater understanding of major social and technological issues/options in both communities.

(2) Time of Involvement (Survey Question IV-A). Over half of the sample cited non-professional interest in space-related fields in the early years of the space program (before 1962), with only 16% reporting professional or primary professional interest in space-related fields during that period (see Table 6, p. 23). By the early 1970's, over

TABLE 5

Information Levels*

Follow the development of space utilization:

Very closely, actively seeking all available information	105
Somewhat closely, seeking information on occasion	84
Not too closely, rather randomly	22

* 211 out of a sample of 212 responded to this question

TABLE 6

Time of Involvement*

	No Interest	Non-Prof'l Interest	Prof'l Interest	Primary Prof'l Interest
Before 1962	68	108	24	11
1962-69	35	106	45	25
1970	16	73	88	34
After 1975	4	32	112	63

* 211 out of a sample of 212 responded to this question

57% claimed a professional/primary professional interest in space-related fields, and by 1975 the figure had grown to over 80% (an estimated 90% of the sample old enough to claim professional/primary professional interest actually claimed such a level of interest).

These findings broadly indicate the importance of individuals with non-professional interest in space-related fields. Cultivating individuals with such an interest--making efforts to assure the availability of accurate and wide-ranging information--could produce beneficial long-term effects, such as an improvement in the social scientists' familiarity with space-related issues, the development of a pool of diversely qualified advisers, and an increase in the total number of professionals interested in space-related issues.

(3) Space Utilization Concepts (Survey Question IV-F). Across the board, survey respondents evidenced strong interest in space utilization concepts ranging from shorter-term, earth-oriented systems to more extensive utilization of space as a general social/scientific resource (see Table 7 , p. 25).

A total of 708 expressions of strong interest in the ten concepts were registered by the 212 survey respondents.

Space industrialization prompted roughly 31% of the total expressions of strong interest, specifically: energy systems (13%); resource development/exploration (10%); and manufacturing/processing sytems (9%). This finding might stem from interest in mid-range projects which address significant earth problems (resource shortages/misallocations/maldistributions). Alternatively, this interest might indicate that the social science community is concerned with the economic aspects of space utilization, such as the potential for industrial activity and the prospect for corporate specialization in space production.

TABLE 7

Interest in Space Utilization Concepts

CONCEPTS	EXPRESSIONS OF STRONG INTEREST
Space Industrialization:	
Energy Systems	89
Resource Development/Exploitation	70
Manufacturing/Processing Systems	64
	223
Scientific Research:	
Exploration of Space	100
Space Research (On Astronomical Topics)	53
	153
Human Settlements:	
All Types	134
Satellite Systems:	
Communications Systems	72
Remote Sensing (Of Earth Phenomena)	53
	125
Other:	
Medical/Therapeutic Advances	31
Tourism	21
Write-Ins:	
Political Systems	5
Application of Space to Earth's Problems	4
Military Systems	4
Miscellaneous	8

Another noteworthy result is the sample's interest in space utilization projects whose primary focus is the acquisition of scientific knowledge. Approximately 22% of the total expressions of strong interest supported scientific research--specifically, the exploration of space (14%) and astronomical space research (7%). Multidisciplinary support for scientific research seems apparent--either in principle or because the data have multidisciplinary applications.

The human settlement category generated roughly 19% of the total expressions of strong interest. This figure is probably a complex reflection of several factors, such as:

(a) an interest in short-term and long-term orbital human factors (because of a previously-undetected design idiosyncracy, the human settlement category is the only choice specifically encompassing human activities in space, whether modest or extensive in scope--whether focused on space station assignments or on space colonization);

(b) the broadly interdisciplinary character of such an ambitious undertaking as small or large human settlements in space (as matrix development emphasized, the human settlements concept cuts across all academic disciplines, so that the successful design and operation of human settlements in space would require the application of a wide range of disciplines, and hence attracts widespread interest/concern); and

(c) a general interest in space projects known to the sample, which does not preclude general interest in more immediate programs, of course (two factors should be considered: 1) the idea of human settlements in space triggered extensive mass media attention--in fact, recently the human settlements concept has been analyzed with much greater frequency and by a wider range of publications/programs than other space projects. It is therefore likely that more social scientists have been exposed to

this concept than to other space projects which are largely the province of NASA and more specialized publications/programs. Near-term technologies, in particular, are not as well publicized as the broader human settlement schemes. For example, note the relative public awareness/publicity of O'Neill's concepts versus the Rockwell space industrialization study or the Aerospace Corporation study of, primarily, mass communication prospects), and 2) almost all respondents citing strong interest in human settlements also expressed strong interest in other space utilization concepts, many with shorter time frames, which might demonstrate an across-the-board interest in space projects which can be focused on particular programs, e.g., more near-term or high priority projects).

(4) Significant Potential Problem Areas (Survey Question IV-H). Respondents cited two types of potential problems, implementational feasibility and operational feasibility (see Table , below). Proportionally, respondents were most concerned with: (a) political feasibility, with 91 expressions of concern (24% of the total) over such issues as public support for the space program, long-term governmental support of space projects, adverse reactions to high technology, and government's inability to implement programs successfully; (b) the feasibility of humans living in space, with 61 observations (16%) on the importance of designing space environments for people, selecting/training personnel, studying physical/psychological reactions of personnel, evaluating the impact of assignments of varying lengths, planning for social and cultural shock, predicting/avoiding human error, and preparing personnel to return to Earth; (c) the funding and cost-benefit status of space programs, with 48 expressions of concern (13%) over absolute costs of projects, cost-benefit evaluations of specific space

utilization projects, and comparisons of Earth-based versus space-based projects pursuing similar goals; (d) international feasibility, with 47 expressions of concern (12%) over issues of international control/funding of space utilization projects, equitable distribution of benefits, and international competition over space resources; and (e) military operations in space, with 39 observations (10% of the total) on the danger of moving Earth-based conflicts into the new space arena and the possibility of over-emphasis on military development of space. Several respondents discussed in specific detail the imperative need for NASA to integrate social factors/impacts into the program planning process.

MATRIX

The contract calls for "the development of a tentative matrix of specific fields and sub-fields within the social sciences/humanities that relate to space utilization" (see Appendix A for a discussion of the Space Utilization Team's working definition of space utilization). The Team based the tentative matrix on extant knowledge, the review of current literature required by the contract, and consultations with relevant experts. The matrix was reviewed and revised several times in search of a useful format.

FUNCTIONS/GOALS

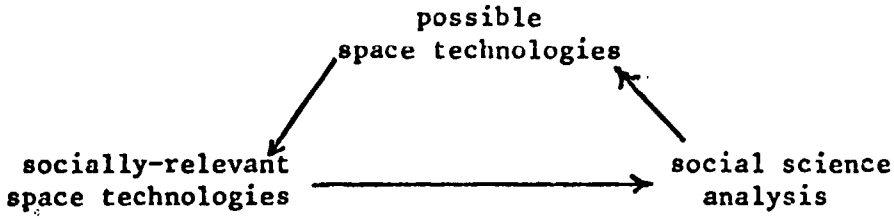
The functions of the preliminary matrix are numerous. As discussed in the community assessment overview, prospects for Shuttle-based utilization have prompted a re-emergence of interest in the space program among social science/humanities scholars. This emerging community of scholars currently is not interconnected--in general, there exist few, if any, efforts designed to encourage peer review and interaction among scholars. Thus, interested professionals often are unaware of previous or current research which might provide insights into their own studies. One purpose of the matrix, then, is to provide a tentative framework for organizing and reviewing available literature and research relevant to the social science study of space utilization. Such a framework should alert interested professionals to existing scholarship in their own fields and, ultimately, should help identify "research gaps." This latter function can serve as an initial guide, in conjunction with an analysis of future NASA programs, to space utilization research requirements in the social sciences.

A second matrix function, if properly developed and utilized, might be to foster productive interactions among the diverse but related communities of: (1) scientists and professionals charged with planning and implementing NASA missions, and (2) scholars and researchers actively investigating various social science aspects of the space program. The need for such increased interaction (specifically with respect to ocean development policy/oceanographic science) was isolated by Dr. Robert Frosch, then Associate Director for Applied Oceanography at the Woods Hole Oceanographic Institution, in 1977:

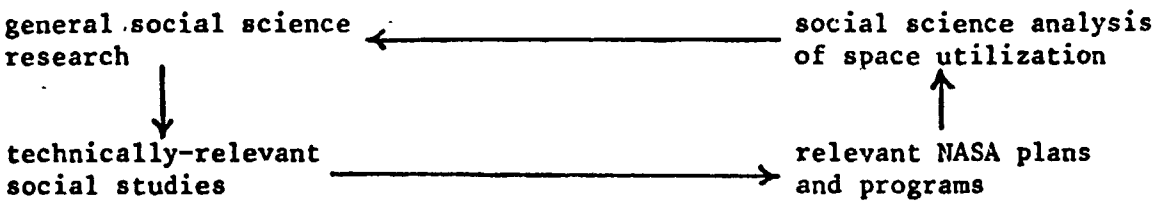
> In short, it is not sufficient to address the scientific, technological, and policy aspects of a "problem" in isolation from each other, since the social and economic questions will have implications for the scientific questions, and vice versa. Instead a more integrated approach is required, with mutual formulation of the problem the first step (emphasis added). Otherwise the result will be analyses of different or conflicting "issues," none of which addresses the underlying (but undefined) problem . . .
>
> The uniqueness of this approach lies in the notion that the dialogue on public policy between scientists and policy analysts will result in efforts on the part of the scientists to advance the state of the art in new directions. In the past, this dialogue has taken place only episodically, in terms of the existing state of the art. Combining policy analysis with a working laboratory and field operation, so they can influence each other on a continuing basis, should lead to new oceanographic science.
>
> --Newsletter on Science, Technology, and Human Values, Harvard University, January 1977, p. 13-14

Applying similar analysis to space utilization, one can determine two probable results of matrix-keyed interactions between social scientists and natural/engineering scientists. First, as argued by Dr. Frosch, the mutual formulation of research issues/priorities might foster the

development of space technologies which better address valid social concerns.



Second, interactions between social scientists interested in space utilization and NASA scientists/planners might encourage social analyses relevant to the actual universe of NASA plans and programs.



Partially because of the "undirected" and sporadic dialogue between NASA and the interested social science/humanities community, many well-intentioned social analyses of proposed space technologies are not as relevant to agency and societal concerns as they might be. Such analyses too often focus either on outdated technologies (from a technical/scientific viewpoint) or on space projects with lengthy lead times--while at the same time ignoring important implications of near-term space technologies. By producing matrix-based "technical guidance" for the interested community, NASA can sharpen the foci of social science studies of space utilization.

MATRIX DEVELOPMENT/REVISION

The development of a functional matrix has proved challenging--the current matrix is the third version.

The first matrix format delineated six areas for categorizing the

numerous social science/humanities studies of space projects, specifically:

1) Economics
2) International Relations
3) Public Perspective
4) Philosophical Aspects
5) Law
6) Orbital Human Factors (defined below)

Each of the six categories was sub-divided into three time spans (near-term, present to ten years; mid-term, ten to twenty years; and long-term, twenty to thirty years and beyond), in order to specify when the issue/technology under study would be operationally relevant. This format while somewhat useful (particularly in terms of defining proper time frames for technology-specific analyses) ultimately was rejected because of a failure to properly classify multidisciplinary studies. A single study can (and frequently did) include several, or all, of the six categories, thus rendering the categorical distinctions largely useless.

Cognizant of this difficulty, the Space Utilization Team devised a second matrix format which sought to accomodate the multidisciplinary nature of most space-related social science studies within a broader, generic structure which would also permit the inclusion of relevant "unidisciplinary" studies. Four basic categories of space-related social science analysis were delineated in this version:

1) Impact Analysis
2) Orbital Human Factors
3) "General" Space Social Science
4) Space Law

Research falling within these categories (with the exception of General Space Social Science) was then sub-divided by specific space technologies.

Subsequent testing of the matrix and further consultation resulted in a third version of the matrix which condenses the four categories of the second version to three ("Space Law" research is subsumed into rele-

vant sections of the remaining three categories).

Thus, the final research categories of the tentative matrix:

1) Impact Analysis -- Comprehensive, multidisciplinary studies of the effects of major space/technological projects on national and international society, and on specific sub-sections of those societies.

2) Orbital Human Factors -- Studies of human needs and behaviors outside of Earth's biosphere.

3) General Space Social Science -- Studies which interpret space and related human experiences in terms of social realities and values.

Tier A -- The questions, processes, institutions, and their interactions that affect the overall direction of near term space activity.

Tier B -- The cultural images, values, and their interactions that affect attitudes toward space.

LIMITATIONS

The current matrix is limited, much as any preliminary analysis. For example, some sub-sections within the matrix are more clearly defined and structured than others. Operating within the constraints of this initial Office of Space Transportation Systems effort to identify relevant social science research interests, the Georgetown Team chose to concentrate on the impact analysis and orbital human factors categories of the matrix, because these sections appeared most closely related to near term Shuttle and Shuttle-based utilization missions. Thus, the preliminary matrix should be viewed as an initial step in a continuing process of interaction among relevant social science/humanities disciplines. The present format should stimulate review and analysis among interested scholars, to the end of producing more refined, detailed, and useful versions of the matrix.

IMPACT ANALYSIS

For purposes of this study, impact analysis can be defined as comprehensive, multidisciplinary studies of the effects of major space/technological undertakings on national and international societies and on specific societal sub-sectors.

Although numerous impact analysis methodologies exist, and the scope of projects which can be studied through impact analysis is very broad, impact studies usually possess a similar goal. Impact analysis was conceived as an aid to the decision maker, with the intention that better information would lead to better decisions on technology. Impact studies can constitute an important component in the formulation of public policy by (a) facilitating the comparative assessment of different technologies/implementing organizations and (b) providing a methodological framework for understanding "feedback" relationships between technology and society.

In recent years, impact assessments have been integrated formally into governmental decision-making at the state, Federal, and (in some instances) international level.

Federal agencies, including the Environmental Protection Agency and the Department of Energy among others, regularly conduct environmental, social, and economic impact assessments of proposed facilities and projects. The National Environmental Policy Act (PL 91-190), effective January 1, 1970 required that every action by a Federal agency which significantly affects the environment be preceded by an environmental impact statement. The act specifically requires "a systematic interdisciplinary approach which will assure the integrated use of the natural and social sciences . . ." (Section 102). More recently, President Carter signed

an executive order requiring similar statements from Federal agencies when their projects might significantly affect the global commons.

Environmental impact assessment requirements clearly apply to NASA, as evidenced by the Space Shuttle environmental statement issued by the agency in 1972.

Congress created an in-house imapct assessment group in 1972, when the "Technology Assessment Act of 1972" (PL 92-484) established the Office of Technology Assessment. OTAs basic function is "to help legislative policymakers anticipate and plan for the consequences of technological changes and to examine the many ways, expected and unexpected, in which technology affects people's lives."

Increasing governmental reliance on impact analysis has expanded the academic community's interest in research and teaching programs and has provided a focus for such interest. Many university programs and courses now provide students and potential analysts with the opportunity to (a) study specific methods of technological impact assessment, (b) gain competence in applying these tools to specific technologies, and (c) interact with leading researchers in the field. Scholarly research is advanced through contracts with relevant agencies and organizations, opportunities for publishing in relevant journals, and peer review and interaction. In this manner, the academic community serves organizations and agencies by defining impact analysis requirements, conducting high-quality research, providing an objective source for external review and verification of studies, training new analysts, and offering access to "cutting edge" research in the field.

RELEVANCE TO NASA

NASA has a longstanding interest in some forms of impact assessment, and has applied the methodologies of impact assessment to some projects.

Apollo Era

> "The exploration of space is one of the most massive technological efforts ever deliberately undertaken. It is natural that both NASA and society at large should be actively concerned with the wide range of impacts, both favorable and unfavorable, that may result from this program."
>
> --Dr. Raymond A. Bauer
> Social Indicators, 1966

Apollo-era impact assessments included: (1) general studies of the effects of space activities on national and international societies; (2) early development of "social indicators" research; and (3) analyses of the economic and/or regional impacts of space spending and contracting decisions.

(1) General Studies. These studies generally preceded the development of the comprehensive assessment methodologies (such as technology assessment) which now exist. Many of the studies were wide-ranging, preliminary overviews of potential effects of space technologies and sought to provide a basis for further specific research (see, for example, Donald N. Michael, Proposed Studies on the Implications of Peaceful Space Activities for Human Affairs, Brookings Institution, Washington, D.C., 1961).

NASA-funded research in this area included (a) support for the establishment of the "Committee on Space Efforts and Society" of the American Academy of Arts and Sciences (see, Space Efforts and Society: A Statement of Mission and Work, AAAS, Boston, January, 1963), and (b) a grant to explore the historical technological development and social effects of railroads as a potential model of the space program.

(2) Social Indicators. NASA support for Dr. Raymond Bauer's Social Indicators in 1966 did much to spur the development of an initial paradigm

of quantitative measures of the state of society and various conditions of society. Professor Bauer, reviewed the existing data in the field of the measurement of social phenomena and rapidly concluded that a comprehensive, quantitative assessment of NASA's social impacts depended upon the development of a valid set of social indicators. Dr. Bauer cautioned that "the problem of measuring the impact of a single program (the space effort) could not be dealt with except in the context of the entire set of social indicators used in our society."

(3) Economic and/or Regional Analyses. The magnitude of Federal expenditures on Apollo inevitably generated effects on regional economic growth, the structure and growth of industries, the government's possible contribution to monopoly structures in the economy, and the efficiency of the allocation of resources within the public sector.

In response, NASA collected data, sponsored research, and to some extent, employed the findings of: economic analyses, technology transfer and utilization research; regional studies; and management studies. During the Apollo era, these analyses were perhaps the most sophisticated, well-developed, and best-utilized impact studies. Scholarly techniques and methodologies (primarily quantitative/economic) were well-established and credible, so that application to the space program was (comparatively) an orderly, systematic effort, culminating in the generation of useful data and findings.

Shuttle Era

As noted in the community assessment overview, prospects for Shuttle-based utilization likely will increase the demand for comprehensive impact analyses of space technologies. A recent NASA-sponsored Aerospace Corpora-

tion evaluation of advanced space concepts reached a similar conclusion. The report examined three advanced space technologies (electronic mail, educational television, and personal communications) and declared that "social and institutional questions abound in considering these three initiatives."

Federal Role. Federal agencies with relevant jurisdiction recognize the necessity of analyzing potential social/economic impacts of proposed space technologies prior to implementation decisions. NASA, the Department of Energy, and the Congressional Office of Technology Assessment have conducted or currently are conducting space-related impact assessments.

NASA, complying with the requirements of the National Environmental Policy Act, sponsored an environmental impact assessment of the Shuttle in the early 1970's. The assessment remains an on-going process, with updates reflecting new research results. Advanced space projects, including the proposed solar power satellite (sps), also are being analyzed for environmental effects. The Department of Energy's Solar Power Satellite Societal Assessment (described below) includes a comprehensive, computer-based analysis of potential rectenna sites, and an environmental impact statement for a proposed site. Other advanced space concepts, for example the proposed heavy-lift launch vehicle, will necessarily require comprehensive environmental impact statements.

As part of an overall assessment of the proposed solar power satellite, the Department of Energy is examining some social impacts of the system, including institutional, international, resource, and public acceptance aspects of power satellites. The study actively involves participants from academic, private, and "public interest" sectors.

Congress' Office of Technology Assessment also is studying solar power satellites -- as well as conducting a comprehensive analysis of space utilization. OTAs study of space utilization technologies, the most ambitious Shuttle utilization impact assessment to date, seeks to "identifying representative applications of space technology, evaluate the technological and institutional requirements for their applications, and develop a compreshensive assessment of their impacts." The assessment focuses on Earth-oriented applications (available within the next two decades) that can produce economic or social benefits.

While the above-mentioned government assessments of the potential impact of specific space technologies involve academic social scientists to some extent, the structure of the studies will not encourage the development, over time, of an interacting academic community interested in the social science analysis of a large variety of proposed space technologies. The OTA study seems to be concentrating on receiving the input of scholars not previoulsy particularly interested in the impact of space technologies and the DOE study is solely focused on the sps. Neither study has as its goal the development of an interacting social science community interested in space utilization, broadly defined.

Academic Role. Academic interest in space utilization impact studies is manifested in courses and research which apply impact assessment methodologies (such as technology assessment, social indicators analysis, social forecasts, systems analysis, economic impact analysis, etc.) to space technologies and in research funded by government agencies, and in some instances, corporations. Several survey respondents reported

their participation in such activities. Comprehensive impact assessments of space technologies are generally beyond the resources of individuals or groups of scholars. Often the role of the academic social scientist is to aid a larger research effort by: (a) applying knowledge of specific social science disciplines to potential technologies as part of a larger, integrative technology assessment, (b) participating on a multidisciplinary team in an interactive analytic process, or (c) serving as an external evaluator of part or all of the research project.

The humanities/social science professional interested in examining the impacts of space technologies can serve a potentially important role suggested in the discipline and technology-keyed sub-matricies in Appendix D. More specifically, scholars can examine and assess diverse research in their fields of expertise, focusing on reserach which has not previously been applied to proposed space technologies. Thus, in the Appendix examples, sociological studies of human responses to disaster predictions can be applied to the proposed satellite-based earthquake prediction system, and knowledge gained in quantitative political science analyses of political participation and television viewing can be applied to the proposed two-way interactive satellite systems.

ORBITAL HUMAN FACTORS

Studies of Orbital Human Factors address human needs and behaviors outside the Earth's biosphere. This area of study is applicable to the Office of Space Transportation Systems since the various programs evolving from OSTS activities and space industrialization concepts very likely will require that a greater number of people be physically present in space than in the past. In turn, this will permit wider variety in the types of individuals qualified for space assignments. The pilot/astronaut of the 1960s was joined in the 1970s by the scientist/astronaut, and in the early 1980s the scientist/payload specialist will begin serving in space. At the same time, individuals from other nations will begin participating in United States space operations, amplifying the complexity of the social makeup of space-based personnel. This phenomenon probably would intensify with the eventual participation of blue collar/industrial workers.

The expansion and diversification of the space work force poses new challenges to NASA that can be met only in part by engineering solutions. Many questions generated by work force expansion/diversification require analysis by highly-qualified social science professionals with expertise in fields such as: industrial, social, and environmental psychology; architecture; design; physical anthropology; labor economics; organizational sociology; law; communications; and certain aspects of philosophy.

The fundamental objectives of researching and studying Orbital Human Factors would be: (1) to ensure safe space facilities; (2) to maximize individual and group productivity; and (3) to optimize the length of personnel assignments in orbit. The consequences of inadequate social science research on such topics can include safety hazards equally as dangerous

as engineering mistakes (e.g., psychological disorders which can precipitate major human errors in on-board procedures) and cost overruns resulting from poor productivity or shorter personnel assignments. The media probably will scrutinize closely the questions related to people working in space and notify the public of any deficiencies with important implications for the viability of future manned space programs.

The organization of Orbital Human Factors can best proceed from specific technologies or programs envisioned by NASA, e.g., a 14-person zero-gravity space facility with a male/female staff assigned to test production of pharmaceuticals. Within this programmatic framework social science expertise can be clustered to focus on: (1) selection of personnel; (2) training of personnel; (3) orbital stay times; (4) design of space facilities; and (5) procedures for personnel in orbit. Within each of these categories a variety of relevant factors would be examined, as exemplified by the following outline.

A. Selection of Personnel

(In addition to technical competence criteria, the following characteristics constitute examples of social science considerations relevant to selection.)

(1) Psycho/Physiological Factors

A) Otolith organ symmetry
B) Completeness of hemispheric brain lateralization
C) Levels of prior psychosocial maturation

(2) Personality Characteristics

A) Intrinsic motivation for going into space
B) Dependability
C) Social tolerance
D) People oriented

B. Training of Personnel

(1) Social sensitivity - to understand others

(2) Communication skills - to articulate anxieties and frustrations to avoid build up and deviant behavior manifestation.

(3) Group performance - including skills to lead, follow, and facilitate compromise.

(4) Intermixing of educational levels, social classes, cultures, and world views.

C. Orbital Stay Times
(Factors with possible influence on individual stay time in space)

(1) Specific job function

(2) Personality type

(3) Level of education

(4) Sex of individual and male/female distribution of facility

(5) Age

(6) Prior psychological history

(7) Family relationships

(8) Motivation for being in space

D. Design of Facilities in Space

(1) Basic Parameters

A) Purpose
B) Function
C) Location
D) Capacity
E) 1 G, partial G, or zero G

(2) Baseline Physical Requirements

A) Radiation shielding
B) Atmospheric composition and pressure

(3) Baseline Psychological Requirements

A) Private space for individuals
B) Flexible interior environment - easily altered to meet changing needs of the personnel - applies to both individually and collectively used spaces.
C) Attention to detail - minor design flaws become major problems in isolated facilities that allow for little or no external activity.

D) Spaces that foster interaction and group relationships as well as privacy.
E) Spaces for leisure activities.
F) View of external environment - windows.

E. Procedures, Regulations, and Services for Personnel in Orbit

(1) Purpose of Procedures, Regulations, and Services

A) Promote productivity and behavior maintenance in an isolated/exotic environment.

(2) General Problem

Space facilities will be institutions where work, play, and all extra work activity will occur at one location. The procedures, regulations, and services at such facilities should meet the conscious and subconscious needs of the resident personnel to help insure:

A) The safety of the facility
B) Maximum productivity
C) Maximum advisable stay time of personnel
D) Management and authority organization

The procedures will address aspects of working and living in orbit such as governance, legal systems/remedies, mental health of worker-residents, social/cultural environment, financial provisions, and communications.

(3) Sample Issues

A) Governance
--appointed versus "real leadership," methods to converge the two.
--information flow to leadership - e.g., "town meetings" to air frustrations and other forms of counterproductive emotions, and to inform the leadership continually about emerging problems and potential ways to deal with them.

B) Legal Systems/Remedies
--clarification of the civil and criminal code as applicable to personnel in orbit; should have provisions for handling multi-national work force.
--clarification of law as applicable to patents developed in orbit.
--punitive procedures for in-orbit handling of minor infractions of law.
--right of individual privacy versus right of administration to monitor the physical and mental health of personnel.
--right of individual to privacy versus right of physical and social science researchers to collect data on personnel.

C) Social/Cultural Environment
--degree of flexibility for personnel to develop unique social activities and norms.
--extent of facilities for social/cultural activities.
--ceremonies and rituals for major annual events, e.g., Christmas.
--methods for dealing with "existential" stress of residency in orbit.
--alcohol usage.

D) Financial Provisions
--amount and form of compensation for personnel, e.g., salary, profit sharing, stock options.

E) Communications
--privacy of personal communication with family and friends on Earth.

(4) Data Base for Research

Experience of Arctic and Antarctic installations, submarines, oil tankers, undersea labs, overseas military bases, mining and drilling operations in isolated areas, earlier NASA manned programs, the NASA SMD III study, and the Soviet manned space program.

F. Spinoff of Research to Non-Space Application

Application of the social sciences to manned space missions will stimulate the design of research methods which produce new levels of certainty and predictability. The close interaction between social scientists and NASA engineers (who seek workable solutions to concrete problems) will encourage the movement within the social sciences toward replacing paper proofs with practical proofs. As new research methods are applied - successfully or unsuccessfully - to the varied social questions implicit in Orbital Human Factors, information will be produced which can be applied in non-space fields.

In addition, social scientists will have access to unusually comprehensive data on well-defined groups of people. The long training period for a mission and the isolated environment of a space facility will provide opportunites to acquire in-depth data on human behavior in cases where extraneous variables can be managed effectively. The results of Earth-based studies are often diluted by the impact of variables that are not germane to the study. Space-based studies eventually may be able to identify fundamental patterns of human behavior, and such knowledge could be applicable to more complex situations on Earth. This is a particularly valid expectation in the case of psycho/physiological research on large groups of space workers. The ability of the social sciences to predict stress tolerance potentials or deviant behaviors will be cross-applicable to other industrial environments and to more general activities, much as NASA's current technological research is cross-applied to other fields of study/production by the Technology Utilization program.

Sample bibliographical entries for Orbital Human Factors are noted in Appendix D.

GENERAL SPACE SOCIAL SCIENCE

The General Space Social Science category encompasses studies which interpret space and related human experiences in terms of social realities and values. These studies differ from those categorized under Impact Analysis and Orbital Human Factors by virtue of more general coverage and of loose or nonexistent ties to specific near-term space technologies or programs. Space-related general social science studies can be broken down into two "tiers":

A) The Questions, Processes, Institutions, and their Interactions that Affect the Overall Direction of Near-Term Space Acivity (sample topics include:)

   1) Public Perspectives and Policies

   2) Military Aspects of Space

   3) Economic Institutionalization of Space Activity

B) The Cultural Images, Values, and their Interactions that Affect Attitudes Toward Space and Space Ventures (sample topics include:)

   1) Economics of Space Activities

   2) International Aspects of Space Exploration and Development

   3) Philosophical Aspects of Space

   4) Space Settlements

   5) Extraterrestrial Life

   6) History

One can argue that Tier B studies analyze factors that stimulate space activity in general while Tier A studies examine those factors that guide more specific space projects. General Space Social Science studies examine the above topics (and others within the category), identifying and clarifying the relationships between space activity and the inner impulses and processes of society. Space activity is thus best understood not only in terms of

mission objectives but also as a full or partial expression of a broad spectrum of elements ranging from recessive national values (e.g., fear of overly-concentrated economic power) to immediate overt political concerns (e.g., the Soviet military space program). These studies describe various features of the psychic environment that surrounds NASA endeavors and relates them to issues and to social dynamics that gain force from non-space concepts.

General Space Social Science studies promote an understanding of the level/pace of the national commitment to space and of the particular mission paths that the space program follows. As a result, careful and selective reading of such studies can be useful to NASA, especially the Office of Space Transportation Systems, as plans are developed for utilizing the Shuttle. General Social Science studies can, among other accomplishments, alert NASA to Shuttle application problems or potentials that might elude normal program review.

For the most part, General Space Social Science studies are generated without NASA support. They provide a kind of space self-education service for academics and professionals with expertise and/or interest in the non-science aspects of space development. At this point in time there is a diffuse quality to the research, denoting a sprawling subject that lacks internal coherence and methodologies. Such a situation is not uncommon in the formative stages of a social science. Additionally, studies are of uneven quality — ranging from highly professional, objective work to amateur expressions of unexamined biases - and tend to address future projects rather than past or current space activities.

CORRESPONDENCE AND COURSES

During the study period, approximately 150 letters of inquiry were received by the Space Utilization Team. Nearly three quarters of all correspondence originated within the professional academic community. The letters were generally in response to notices or articles about the study which appeared in several journals, newsletters, and newspapers.

Letters were received from professionals in a number of social science disciplines, especially: anthropology; architecture; communications; economics; education; geography; history; law; political science; psychology; and sociology.

Correspondents generally requested information and/or results from this study. Many asked for bibliographic references and basic materials relevant to the social science study of space utilization. Several unsolicited papers and research results accompanied the correspondence.

Approximately fifteen percent of the letters came from students--graduate and undergraduate. Several students asked for guidance as to where to pursue studies in social science and space utilization.

During the study period twenty-six courses primarily focused on social science aspects of space utilization and thirty-six courses with segments relevant to the social science study of space utilization were identified. A listing of these courses is included as Appendix F.

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12. Murray L. Weidenbaum, "Measures of the Impact of Defense and Space Programs," paper presented at annual meeting of the American Statistical Association, Philadelphia, Sept. 9, 1965.

13. see bibliography -- defining the technological parameters of the study.

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15. B.J. Bluth, Ph.D., "Alternative Social Structures in a Vacuum," American Astronautical Society, The Industrialization of Space, Volume 36, Advances in the Astronautical Sciences, 1978.

16. see correspondence section

17. Statement of Dr. Frank Press before the U.S. Senate Committee on Commerce, Science, and Transportation, subcommittee on science, technology, and space, January 1979.

18. cited in statement of Dr. Robert Frosch, before the U.S. Senate Committee on Commerce, Science, and Transportation, subcommittee on science, technology, and space, January 1979.

19. see "Paying to Hear Divergent Views," Business Week, January 15, 1979, p. 110.

20. see Impact Analysis section which follows

21. B.J. Bluth, personal communcation to Space Utilization Team, May 1979.

22. NASA, A Forecast of Space Technology, January 1976, p. 2-14.

23. B.J. Bluth, "Alternate Social Structures . . .", op cit.

24. Orbital Human Factors analysis emerged as an important field of study --- see survey section.

JOURNAL FEASIBILITY STUDY

The journal feasibility study required by the contract is comprised of several tasks, including: (1) determining academic/technical scope of a journal focused on the social science aspects of space utilization; (2) evaluating editorial/business approaches to journal format, editorial/review board composition, marketing, production, and management/staffing of the journal; and (3) estimating the cost of producing and distributing the journal, then investigating potential funding mechanisms (including self-support and various sources of outside funding).

The journal feasibility study conclusions are based largely upon consultations with thirty-two professionals (see Appendix F) with expertise in various aspects of scholarly publishing, such as editorial functions, circulation, printing, journal format/design, and financial management. Consultants were systematically selected to represent a wide variety of publications, from small-circulation newsletters to scholarly journals with large circulations (5,000 or more copies per issue). The consultants provided insights on a wide range of topics, including: (1) the state of scholarly publishing, particularly for innovative multidisciplinary publications; (2) publication options, including potential timing/size of publications; (3) criteria for cost-effective/appropriate journal formats; (4) editorial structures, including staff size/functions; (5) manuscript solicitation and review; (6) marketing, advertising, and circulation; (7) procedures for estimating overhead/publication costs and journal purchase price; (8) funding strategies; (9) appropriate content and scope of the journal, including central disciplines and features such as book reviews; and (10) reprint policies.

The Space Utilization Team tested the consultants' findings by producing a prototype journal, Volume 1 of the Space Humanization Series, which was monitored throughout development, production, and marketing. Volume 1 of the Space Humanization Series was produced with funds provided by sources outside of NASA.

Final journal feasibility study conclusions are based upon consultants' advice, prototype journal experience, and relevant data from the community assessment survey and preliminary matrix.

The assessment of journal feasibility is particularly timely in light of: (1) increasing social science interest in space utilization, as evidenced by papers presented at conferences, articles published in journals and newsletters, and advanced courses offered through universities and colleges; and (2) intensified Congressional interest in the broad policy implications of space utilization, as demonstrated by the number of committee meetings and reports on this subject. Given such levels of interest, it seems appropriate to assess means of fostering a community of interested groups/individuals by establishing a forum for the regular exchange of multidisciplinary analyses of the social science implications of space utilization.

OVERVIEW OF SCHOLARLY PUBLISHING

Scholarly publishing includes periodicals such as professional/scholarly journals and magazines, trade journals, and professional society publications. Although information on subscription revenue trends is scarce, the Team's professional consultants indicated that scholarly publishing has been expanding rapidly. According to the National Commission on Libraries and Information Science, expenditures for the publication, distribution, and use of journal articles increased from $1.3 billion in

1960 to more than $9 billion in 1977.[1] For example, the number of journals in literature and languages alone rose from 54 to 215 from 1965-1975.[2] The expansion of scholarly publishing is attributable to several factors: (1) the growth of higher education in the past decade, which generated increasing numbers of articles; (2) the often relatively insignificant time and research required for journal articles (compared to books, for example); and (3) the explosive growth of knowledge which has created numerous sub-fields that are not always recognized or accepted by the editors of established journals. Professionals active in new sub-fields frequently organize a relevant system of information exchange, utilizing vehicles such as newsletters and journals. Several editors acknowledged that their publication started in a comparable manner.[3] Such an approach has appeal for social scientists who claim there are insufficient publishing outlets for serious research on space utilization.

However, journal managers concurred that the previously rapid growth in journals is ending for a variety of reasons. All the journal managers agreed that the following factors contributed to the reversal in journal growth: (1) foremost, precipitous increases in the costs of journal production and operations. In the past two years, printing costs have increased more than 25% and mailing costs have jumped more than 50%. In addition, the price of paper has more than doubled in the past year alone. As James McCartney observed in an article for The American Sociologist: "Journals have shown losses by inflation greater than the overall inflation rate of the economy, and the worst is not yet over,"[4] and (2) concomitantly, journal managers warn that increasingly scholarly publishing is becoming a "buyer's market." A recent report on the circulation of periodical literature documents that because of "the continued

increase in the number of periodical journals published and the even more rapidly increasing subscription prices, the American libraries are acquiring a decreasing proportion of the world's periodical literature output."[5] Journal experts note that academic salaries have not kept pace with the economy and consequently, as one editor observed, "Many people are apparently cutting back on their professional subscriptions in order to balance their family budgets."[6]

Although funding strategies are reviewed separately, it should be noted that smaller journals (especially those with circulations under 2,000) have fewer alternative sources of income during tight market periods than publications with larger circulations. A recent study reported that small journals average only about $500 of advertising income whereas large journals receive an average of over $20,000 for advertising.[7]

Despite these constraints, scholarly publishers are adjusting to a tight market--and employing innovative strategies. Although this study is restricted to assessing the feasibility of conventional "print on paper" journal format, technological trends are exerting fundamental pressures on the future of all publishing. Electronic alternatives to printed texts include the "synoptic journal" (full article text delivered via computer terminal on demand only); the "electronic mailbox" (personalized selective dissemination of information); teleconferencing; and the "shoe box" file (researcher records findings directly into a computer network to be assimilated for "publication on demand").[8] In addition, developments in microminiaturization, computer networks, cable television, and cheap laser communications (using fiber optics and satellite relays) should produce significant impacts in the long-term.

These non-traditional publishing alternatives are utilized almost exclusively by scientific and technical disciplines. A recent meeting of

social science journal editors concluded that a decade or more would elapse before the electronic journal is used extensively throughout the social science/humanities community.[9] This prediction assumes that search and retrieval systems used by electronic journals are more applicable to the physical sciences (where the content of an article usually is indicated by its title) versus the social sciences (where titles tend to be more ambiguous).[10] Journal managers also cautioned that electronic retrieval systems assume a tight-knit community of interest. Given the preliminary state of social science interest in space development issues and the multidisciplinary nature of the subject matter, the conventional publication format was deemed the most appropriate mechanism for near-term information exchange.

In addition to the above cost reduction procedures, journal editors are undertaking more direct approaches to meeting revenue needs. For example, journal subscription prices are rising to the level of increased production costs: In 1977, the average price per title was $35 a year, but in 1978 it had risen to $39.95, and it is estimated that by 1982 the mean annual journal subscription price will be $64.40.[11] Editors also are considering the possibility of banding together to pool their resources. For example, the National Science Foundation recently sponsored a meeting of social science editors to consider establishing a council to share information on improving economies of operation. In addition, a new organization, the Society for Scholarly Publishing (SSP), has been formed to assess the concerns of all individuals interested in scholarly publishing, regardless of professional identity.[12]

The bottom line should be emphasized: there are an extremely large number of variables to be confronted when initiating a publication. Full evaluation of any one publishing option requires time and resources beyond

the scope of the immediate study. The professional consultations undertaken for this study will provide a "feel" for factors which determine the feasibility of any scholarly publishing enterprise.[13] As one journal expert has written: "In nine cases out of ten the success or failure of a new journal will depend on how soundly it was conceived and whether or not the sponsors knew at the outset the problems involved."[14]

ACADEMIC/TECHNICAL SCOPE

The scope of a social science/space humanization journal would be defined by academic concerns and technical developments which would interconnect, cross-influence, and evolve over time. However, matrix development analysis documented the relative dearth of recent (i.e., post-Apollo) interactions between the social science and technical communities. As a consequence, the Team's research plan approached academic scope and technical scope as independent considerations, although some preliminary interfaces were identified by matrix and survey data and by the development of the Space Humanization Series.

TECHNICAL SCOPE

The Space Utilization Team sought to define appropriate technical topics for the journal by employing data from the community assessment and by consulting experts in seemingly relevant technical fields.

The matrix development process suggested that social science analysis of near-term and mid-term technologies would be of most immediate relevance to NASA planning and operations--although high-quality analyses of long-term technologies are vital to long-term planning and can offer valuable insights into technologies with more near-term potential. The preliminary literature review suggested that social science research overlooks specific technologies with the potential for near-term implementation--and on occasion suffers from insufficient attention to the complexity of analyzing long-term technologies.

Survey results indicated that many social scientists are interested in a variety of space utilization projects, ranging from short-term to long-term options. Some of this across-the-board interest undoubtedly could be channeled into productive analysis of the social science effects

of short-term and mid-term technologies. The analysis of long-term technologies should not be discouraged--but such complex analyses should be focused to provide useful data and to clarify the social/technical context of the analysis.

Based on the community assessment, the journal should assign high priority to: (1) including a balanced selection of analyses of short-term, mid-term, and long-term technologies, (2) encouraging authors to reference specific technologies where relevant, and (3) promoting interactions among authors and readers in the social science and technical communities, to refine topics of interest and research gaps.

Consultations with experts in and outside NASA, supplemented by matrix and survey data, enabled the Team to identify numerous technologies which would fall within the journal's technical scope, including: (1) remote sensing (53 expressions of strong interest, see Table 7), (2) space solar power generation (89 expressions of strong interest, see Table 7), (3) communications (72 expressions of strong interest, see Table 7), and (4) space processing (64 expressions of strong interest, see Table 7). These four representative technologies range over all time frames and have received increasing attention from the media, government agencies, and the private sector. The Team interviewed four professionals with acknowledged expertise in the above technologies: Delbert Smith, editor, Satellite Communications; Charles Boyle, NASA (space processing); F. Koomanoff, Department of Energy (space solar power generation); and D. Landgrebe, Purdue University (remote sensing). With one exception, the experts represent institutions with no direct interest in the aerospace industry or in NASA--which should facilitate relatively objective responses. The Georgetown Team sought evaluations of: general/specific

issues generated by the technologies, the existence of research or communication gaps between the social science and technical communities, and the need for a journal to examine the social science aspects of relevant issues.

Three of the four professionals cited a definite need for an interdisciplinary social science journal to analyze relevant social and economic issues. Dr. Landgrebe noted that growing numbers of socio-political questions could restrain advances in space technology applications; and, consequently, he felt that social science questions must be addressed, although he himself did not feel competent to judge the potential utility/role of a social science journal in this communications process.

Both Boyle and Koomanoff contended that social scientists should be interacting more directly with their technical counterparts to frame space development issues. Koomanoff warned, however, that the journal must be oriented toward the general reader, in order to circumvent the aerospace community's tendency to talk to itself.

Smith, publisher of the recently-established monthly, Satellite Communications, added a further observation: Complete integrity for the publication is crucial to forging a new community of interest--regardless of the field of concern--so the journal must not be perceived as representing any particular vested interests within the space field. Thus, any dependency on the major aerospace actors--NASA, industry, labor, public interest groups--should be avoided in favor of diversified support.

Obviously these insights do not constitute a comprehensive overview of the technical community's reaction to a space social science publication. Rather, they represent a preliminary evaluation of the advisability

and pitfalls of such a publication. This sample of experts suggests potentially broad support in the technical community for a continuing interface with social scientists interested in the ramifications of technical developments.

In summary, the technical scope of the journal can be initially defined and subsequently refined by consulting and interacting with the relevant social science and technical communities--a process initiated in determining the contents of Volume 1 of the Space Humanization Series (discussed below). There seem to be strong indications of interest in an interdisciplinary journal in both the social science and the technical communities.

ACADEMIC SCOPE

The Georgetown Team evaluated the academic scope of the journal by analyzing community assessment data and by producing Volume 1 of the Space Humanization Series.

The diversity of potential Shuttle applications (in the short-term and mid-term) and the possibility of more intensive human space activities (in the mid-term and long-term) would suggest that all social science disciplines would be relevant to at least some space utilization projects. Additionally, the preliminary matrix and survey data categorized a number of disciplines with primary relevance to planned and potential NASA programs, including: sociology, psychology, law, anthropology, political science, economics, education, business, communications, international relations, and history.

The article composition of the first volume of the Series is detailed in Appendix G. Although the articles are relevant to several disciplines

(including psychology, law, and agricultural sciences), the issue is centered around two introductory articles and numerous articles of primary interest to political scientists and policy-makers. This reflects the Team's decision, based on consultations with experts, that each issue should appeal to diverse interests but offer a cluster of interrelated articles with fundamental relevance to one or a very few disciplines. Using this approach, the journal would seek to provide balanced coverage over time (and issues) of the multidisciplinary/interdisciplinary concerns relevant to short-term, mid-term, and long-term space utilization projects. This policy will be open to modification based upon further experience and reader feedback, in response to the experts' nearly-unanimous belief that the need for balanced content will constitute the single most important and difficult editorial problem confronting an interdisciplinary journal.

EDITORIAL/BUSINESS PRACTICES

The Space Utilization Team sought guidance on editorial/business practices by interviewing over thirty professionals in scholarly publishing and integrating relevant information from the community assessment. Critical editorial/business policies are reviewed in depth or capsulized below.

FORMAT

The Team realized early in the journal feasibility study that the journal option actually represented a desire for an effective vehicle for interdisciplinary communication, which could take forms such as newsletters, monographs, abstracts, se ies, or quarterly journals. Journal managers suggested that format choice be based upon criteria such as: (1) the number of quality manuscripts that reasonably can be expected to be reviewed on an annual basis (all editors cautioned that even established journals with known markets have extremely large rejection rates--e.g., a recent survey of sociology journals documented rejection rates of 82%); (2) the number of potential subscribers (individual/institutional); (3) the resources available to sustain the journal (i.e., staff and finances); (4) the number of illustrations and other costly reproductions; (5) the extent of advertising in the publication; (6) the number of individuals and disciplines with interest in the journal; (7) the likelihood that college/university libraries will subscribe to the journal, and (8) the likelihood of institutional funding (from one or several sources) versus shoestring financing on an issue-by-issue basis (with minimal staff and collateral support).

Consultants advised that sustaining a quarterly journal would require a supply of articles for four issues, or one year; a 100-page journal should publish approximately 48 articles per year. Given a limited resource base, a limited pool of quality interdisciplinary manuscripts, and the current "periodical crisis," the journal managers suggested a format other than a quarterly journal, which would be resource intensive.

Journal managers commonly expressed a preference for a "safer," staged approach to developing a community of interest in a new field. A staged approach basically employs newsletters, monographs, abstracts, or workshop proceedings to foster interest and attract publishable articles.[15] The advantages of a staged approach are readily apparent: compared to a journal, newsletters and other small-scale publications are relatively cheap (from the standroint of staff size and finances) and could disseminate information on the latest developments in the field to potential journal subscribers. Eventually, given sufficient interest, the small-scale publication could evolve into a larger publication with an existing pool of manuscripts. If, on the other hand, interest flags, a small-scale publication is in a better position to withdraw and recoup losses.

The series option received the most support from the Team's consultants. Unlike a quarterly, a series possesses greater flexibility in its publishing schedule and consequently may be issued once, twice, or as many times as the publisher desires as long as each issue is predictable and/or well-publicized. Series are often published on a seasonal basis and the editor is assumed to fulfill his obligation to the subscriber as long as the publication appears within the appropriate time frame.

The consultants' opinions, in combination with the Team's evaluation of the proposed journal's resources and goals, prompted the Team to issue Volume 1 of the Space Humanization Series, which will be published and publicized on an intermittent basis (resources, articles, and readers permitting). The Series employed a conservative design (i.e., non-glossy text paper and minimal illustrations), consonant with the advice of the journal managers. Although the Series is still being distributed, the general reaction has been positive. The Series apparently is perceived as a professional collection of scholarly papers, as indicated by several orders for Volume 1 from colleges/universities where the Series has been required as a course text and from university/business/government libraries. The Team currently is exploring the possibility of distributing the Series through bookstores with relevant special collections, through museum bookstores, and through college/university libraries.[16]

CONTENT

The section on academic and technical scope of the journal (above) defines the general content of the journal. An additional consideration--emphasized by the Team and by consultants--is the absolute necessity of publishing high-quality articles. By employing an interactive manuscript review process, the staff, authors, and reviewers can pool their multi-disciplinary expertise to produce detailed and high-quality articles.

The readership profile of a journal is important not only to fiscal stability but also to journal content. Consultants were unable to agree on the audience to which the journal should be directed. While one expert suggested that the journal "aim at the general reader," Dr. Bluth declared that "rather than be one more journal among many, distinguished [only] by a different topic, this journal could represent a qualitative change

in journals in social science that could have an impact on the discipline itself." Dr. Bluth contends that a new interdisciplinary journal should establish common definitions of core concepts and publish studies treating social science concepts as hypotheses subject to experimental verification (comparable to physical science hypotheses). Dr. Bluth feels that development along such lines will encourage physical scientists to consider social sciences more seriously and will enhance a trend already at work in the social sciences.

Survey data documents broad interest across technical and professional disciplines, which would seem to provide support for a relatively specialized journal. The first volume of the Series was somewhat broad in conception and appeal, with an emphasis on political science and policy-making interests. To date, distribution indicates interest by professionals within those disciplines (reflected in the journal's assignment as a course text) and by professionals in other fields (reflected in sales of the first volume, despite explicit advertising of the journal's content).

EDITORIAL BOARD AND REVIEWER SYSTEM

The editorial board and reviewer system is designed to assure high-quality articles by promoting expert review and interactions among staff, authors, the editorial board, and the reviewers. The journal editorial board and reviewer system can be formulated using the preliminary matrix. The board can be comprised of as few as three editors representing Impact Analysis, Orbital Human Factors, and General Space Social Science. However, the wide-ranging nature of Impact Analysis and General Space Social Science may require the attention of more than one editor.

The individual(s) charged with editing Impact Analysis articles should have competence in the various sub-fields (e.g., technology assessment and

social impact assessment) and a broad understanding of Impact Analysis literature which evaluates space and non-space technologies. The Impact Analysis editor should be capable of comprehending the nature of space technologies, particularly those with high probabilities of near-term implementation. In this case comprehension could be based on strict technical competence or on high-level lay competence. The Impact Analysis reviewers should possess in-depth knowledge of particular space technologies (e.g., communications satellites and Earth-sensing satellites) and of relevant impact analyses.

The editor responsible for Orbital Human Factors (OHF) articles probably should demonstrate broad familiarity with psychology and a facility for moving comfortably among the numerous OHF dimensions. The OHF editor should be well acquainted with research on groups working in isolated environments. The editor should be assisted by: (1) reviewers expert in personnel selection/training; (2) reviewers with experience in research/data on people working in stressful, exotic environments (e.g., Antarctica, submarines, and Sealabs); (3) reviewers with expertise in designing work, living, and leisure facilities for use in hostile environments (including, if possible, a representative of Skylab or space laboratory design groups); (4) reviewers familiar with the research or personnel procedures developed by the military, Kibutz management, and other institutions requiring highly mobilized work forces; (5) reviewers with expertise in cross-cultural communications; and (6) reviewers with knowledge of civil and criminal law and their relevance to the space environment.

The General Space Social Sciences editor(s) should have exceptionally broad capabilities, singly or in combination. Reviewers would be very numerous in this area, ultimately including most of the major social science disciplines. Suggested General Space Social Science reviewer

groupings include: (1) economists expert in capital formation, equity structures, income distribution, and international/developmental economics; (2) political scientists familiar with the American policy process, public opinion measurements, and the introduction of technical and social innovation into society; (3) international relations specialists proficient in the role of technology (including military technology) in international affairs, technology transfer, and the role of technology in shaping political power; (4) historians with knowledge of the role of science and technology in the development of society and the impact on society of opening new territory; (5) philosophers with specialties in epistemology, cosmology, and metaphysics; (6) sociologists expert in social organization; (7) anthropologists knowledgeable in both physical and cultural anthropology; (8) literature scholars familiar with science fiction; and (9) educators expert in space education.

Other Editorial/Business Practices

The Space Utilization Team conducted interviews of numerous experts, seeking timely information on editorial/business practices central to new journals. The Team then synthesized their advice on several important matters, including:

(1) Determining Number of Issues. A journal issued less than four times per year must be mailed at a higher postage rate. Four is the minimum number of issues which must be mailed each year to qualify for second class postage rates.

(2) Dating the Issues. Journals often run behind schedule, particularly small journals dependent on volunteers and on authors who receive no monetary reward. One common approach describes issues by season rather than by month. To avoid confusion, four issues could be published in one calendar year.

(3) Pricing the Journals. A standard subscription price formula is the number of issues per year times the price per issue (the cost per issue is discussed in the potential funding mechanisms section). Since the demand for academic journals tends to be inelastic, journals can be sold at somewhat higher subscription rates than would be justified by the above formula, although recent declines in subscribers should be considered before pricing the journal. A single issue price for the Series of $5.00 (plus postage and handling) does not appear to be prohibitive, based on preliminary ditribution figures.

(4) Pricing for Back Issues. Before a publisher begins to charge more than the subscription price for back issues, the potential subscribers must be permitted to discover the new journal. Most publishers wait for 2 or 3 years before at least doubling the subscription price for back issues.

(5) Estimating the Number of Subscribers. Journal experts warn that frequently new journals succeed in inverse proportion to the number of disciplines included in the journal's scope (although this may seem at first counterintuitive). Selling general journals is more difficult because the expert cannot easily evaluate the journal's overall relevance to him. The most successful journals explicitly define ongoing editorial purpose(s).

(6) Providing Free Subscriptions. The trend is to limit free or exchange subscriptions severely--or to eliminate them altogether. Library "exchange" subscriptions are another matter, since in most cases libraries will act as a single agent, purchasing several copies at reduced rates.

(7) Advertising. Journal managers agree that little if any advertising can be sold at the outset. A decent circulation rate is required before

advertising space can be sold in sufficient volume, and at a sufficient price per page, to make advertising worthwhile.

(8) Staffing the Journal. Given the fledgling market and limited resources available for a space social science journal, journal management and overhead should be kept to a minimum: (a) a part-time editor to assign articles and maintain purpose/direction of the publication (proposed salary: $9,000); (b) an editorial board composed of reputable scholars is recommended; such a board would serve on a volunteer basis and would be concerned with periodic reviews of journal content (liaison with editor via telephone); (c) managing editor (faculty volunteer paid a minor stipend to act as "traffic cop," sending articles to appropriate reviewers, handling liaison with printer, and answering correspondence; (d) reputable reviewers in the various disciplines represented by the journal; reviewers would be responsible for critically evaluating manuscripts (usually unpaid, but credited in staff box); and (e) student volunteers for miscellaneous tasks.

(9) Paying for Articles. Few academic journals pay for articles. In the era of "publish or perish," most authors are eager to publish their material and will forego payment. No compensation was provided for any of the articles in Volume 1 of the Series.

(10) Providing Reprints. If possible, the publisher should include exact dates for reprint availability in the production schedule. The printer often handles reprint sales.

(11) Reviewing Books. Book reviews constitute an important section of scholarly journals. Because of the shortage of competent reviewers, any individual reviewer is often in great demand. From the receipt of the book to actual publication of the review can take up to eighteen months. Developing a pool of competent volunteer reviewers might shorten this delay.

POTENTIAL FUNDING MECHANISMS

The Georgetown Team analyzed journal production costs, sales receipts, and outside funding sources, basing its estimates on consultations with experts and the financial experience gained by producing the first volume of the Space Humanization Series.

Production Costs and Sales Receipts

The following analysis is summarized in Table 8 (p.71), which details production costs, receipts, and deficit levels for a quarterly journal. The statistics in Table correspond roughly to the costs of producing Volume 1 of the Series, which was held to a bare minimum budget by a variety of means.

Printing costs (including typesetting) approximated $3.00 per copy for a printing run of 2,000 copies, with an additional 1,000 copies averaging $1.75 per copy and each 1,000 copies above 3,000 averaging $1.50 per copy. While these costs may be somewhat lower than average, they are competitive with general market prices for printing a conservative-style journal such as the Series (2-color cover with no illustrations/designs, standard 6"x 9" format, 120 trimmed pages on 60 pound paper, and perfect binding).

Overhead costs (including salaries, rent, telephone, and office supplies/operations) totaled $6,000, a very conservative figure which incorporates the experts' low estimate for minimal part-time editing. The overhead figure thus assumes cheap or volunteer labor of very high quality.

The marketing/distribution cost of $3,000 likewise represents a low figure, with primary emphasis on simple direct mail advertising to an

TABLE 8

MINIMUM/MAXIMUM COST/RETURN ESTIMATE PER ISSUE (QUARTERLY)

2,000 copies @ $3.00 each, printing cost	$6,000
Overhead (salaries, rent, telephone, etc.)	$6,000
Marketing and Distribution	$3,000
	$15,000
2,000 copies @ $6.00 each, sales price	$12,000
Deficit (assuming all copies sold)	$3,000

established mailing list and on favorable review publicity (in essence, free publicity). Marketing costs, in particular, can vary widely, reflecting the cost differential between such options as advertising through simple flyers versus purchasing advertising space in other journals or purchasing relevant mailing lists. The $3,000 estimate for marketing could easily rise to $15,000-20,000 for the early issues of a new journal, according to journal managers.

Setting a selling price for the journal is a complex yet central task. One successful direct mail publisher states flatly that the publication must be sold at a price which triples basic costs or risk bankruptcy.[17] While a non-profit organization could operate at a lower margin--say 2½ times basic costs--publishers must allocate sufficient funds for marketing and improving journal quality in the face of steadily rising costs. and growing competition among specialized journals.

New journals therefore must budget funds to penetrate the market and to maintain a viable position in the market. However, journal managers generally agreed that a selling price of $6.00 per journal copy (exclusive of postage and handling) constituted an upper price limit beyond which sales resistance would be encountered. If all copies of a single issue were sold (an unlikely prospect) at $6.00 per copy, the total sales revenue would be $12,000, a figure $3,000 short of the bare minimum expenditures of $15,000. A selling price of $7.50, generally considered prohibitively high, would be necessary just to cover the bare minimum budget--yet costs could easily rise well beyond that level. The annual figures for a quarterly journal would approximate the following: $60,000 total production costs; $48,000 total income (assuming sale of all copies); and a deficit of $12,000 annually.

The bottom line seems apparent: a space social science journal breaking into a new market would need outside funding support.

External Funding Sources

To obtain information on available sources of support for a social science, space-related journal, the Georgetown Team interviewed three financial development consultants and investigated resources at the Foundation Center Library. These consultations and the Team's experience [18] form the basis for the following conclusions.

(1) Foundations. A space-related social science journal would be considered esoteric by most foundations. As a consequence, a great deal of time and effort could be applied to searching for a grant--with doubtful results. On balance, foundation funding is not likely in the absence of foundation trustee(s) with both strong interest in the space field and an understanding of the importance of integrating the social sciences into the field. But there are very few foundation officials with known interests in the space sciences. While this situation may be altered in the future by the advent of greater space activity and the generational change in foundation staffing, the Foundation Center couldn't identify any past/current grants to a journal with a space-related focus--and other sources could verify only two small grants by foundations for space-related research.

(2) Corporations. Corporate donations could be sought from the aerospace companies with a greater chance of success. However, such support undoubtedly would bring the journal's objectivity into serious question. Corporate grants could only be accepted in very limited circumstances, if at all. Funds from non-aerospace corporations are possible but unlikely.

(3) Public Agencies. The National Science Foundation, the National Academy of Sciences, and the National Endowment for the Humanities indicated that they are unlikely to support an unproven journal in the space social science field. Although NASA might have a legitimate interest in supporting a space social science journal, the journal's reputation for independence and objectivity would be tarnished, possibly irretrievably. NASA might consider the option of publishing special or state-of-the-art papers or monographs as an alternative form of communication which would better serve in-house priorities.

(4) Individuals. Personal donations constitute the most promising source of support for new ventures. The first volume of the Series was funded largely through individual contributions. However, close personal ties with donors are essential as a basis for mutual trust.

Funding a specialized journal inevitably is associated with institutional relationships. Funding is unavailable from most sources unless the journal is associated with a specific institution--such as a university, a separate research institute, or other non-profit organization--with separate and relatively secure operational funding procedures. It would be more difficult to secure funds for an organization established for the purpose of publishing a journal.

In summary, the specialized journal market has expanded rapidly during the past two decades but is showing some signs of slowing down because of increasing inflationary and competitive pressures. Smaller journals (with circulation below 2,000) have difficulty attracting advertising and thus must rely on sales and any available outside support. Publishing experts believe that a space-related social science journal is feasible but warn that little or no advertising can be expected

in the initial development/production stages. Obtaining an absolute minimum of $12,000 (and more likely $15,000-30,000) per year for journal support would be necessary for a period of about three years, to establish the journal's viability. This task would be difficult, albeit not impossible.

FOOTNOTES

1. National Commission on Libraries and Information Science, Effective Access to the Periodical Literature, April 1977.

2. August Fruge, "Beyond Publishing: A System of Scholarly Writing and Reading," Scholarly Publishing, July 1978, p. 301.

3. Joseph Raben, a professor of English, recalled that his interest in the impact of computers on the discipline (an interest shared by a growing number of colleagues) led to the journal, Computers and Humanities (circulation 1,400).

4. James L. McCartney, "Confronting the Journal Publication Crisis," The American Sociologist, 1976, Vol. II, p. 145.

5. Jack Magarrell, "Coping with the Crisis in Periodical Literature," The Chronicle of Higher Education #3.

6. Interview with James McCartney, editor, The American Sociologist.

7. Study by King Research for the National Science Foundation, 1978.

8. National Commission on Libraries and Information Science, op.cit., p. 16.

9. McCartney, op.cit., p. 149.

10. Interview with Herb Costner, Social Science Division, National Science Foundation.

11. National Commission on Libraries and Information Sciences, op.cit., p. 17.

12. SSP was established too late to be of utility to the journal feasibility study.

13. The Space Utilization Team expresses its appreciation to John Strawhorne of Capital Systems Group (a publishing consultant firm) for identifying several of the experts subsequently consulted and delineating salient issues of journal publishing.

14. John H. Langley, "Starting a New Journal," Scholarly Publishing, October 1970, p. 75.

15. Professor Mullins, Indiana University, is conducting pioneering research into optimal means of developing an "invisible network (or college)" of scholars potentially interested in exchanging ideas.

16. College/university libraries include numerous special collections, including those in the following fields: humanities (394), social sciences (880), business and finance (1,760), law (806), medicine (1,955), religion (996).

17. Joseph Karbo, The Power of Money Management, Sunset Beach, CA: Financial Publishers, 1977.

18. A Team member was director of research for a major foundation for eight years.

I. Definition of Space Utilization

The opportunities created by space have prompted serious consideration of a proper definition of space industrialization/utilization. James A. Downey, General Chairman of NASAs Marshall Space Sflight Center, provided a sound outline of the salient characteristics at the AIAA/MSFC Symposium on Space Industrialization on May 26-27, 1976:

> Space industrialization basically involves effective utilization of the extraterrestrial environments to produce products or to provide services of value to Earth. Inherent in such a program are the following objectives:
>
> 1. The development of the capability for the commercial processing in space of unique and valuable materials and pharmaceuticals.
>
> 2. The support of future public service projects in space that will provide significant social and economic returns. For example, large public platforms in space offer opportunities for a variety of low cost communications, including TV, and electronic mail services.
>
> 3. The introduction and development of new techniques and concepts to satisfy national needs, such as conversion of solar energy to electrical energy in space and its transmission to Earth for public use.
>
> 4. The development of significant advancements in the extended space capabilities required to accommodate future new space initiatives, including the development of space operations and construction bases needed to fabricate and erect the large structures needed for accomplishing future public service missions.
>
> 5. The development of permanent occupancy of space by man, an essential ingredient in truly exploiting the potential uses of space for industrial purposes.

II. Relevant Social Sciences

A) Business and Management

1) Business and commerce, general
2) Accounting
3) Business statistics
4) Investment and securities
5) Business management and administration
6) Industrial management
7) Marketing and purchasing
8) Transportation and public utilities
9) Insurance
10) International business
11) Personnel Management
12) Labor and industrial relations
13) Business Economics
14) Operations research

B) Communications

1) Communications, general
2) Communications, media
3) Communications, theory

C) Psychology

1) General psychology
2) Psychometrics
3) Industrial psychology
4) Physiological psychology
5) Social psychology
6) Environmental psychology

D) Public Administration

1) Public policy
2) Urban and regional planning

E) Anthropology

1) Physical anthropology
2) Cultural anthropology

F) Economics

1) History of economics
2) Economic systems
3) Econometrics and mathematical economics
4) International economics
5) Industrial organization and public policy
6) Labor economics
7) Economic development

G) History

1) Modern history
2) History of science

H) Geography

I) Political Science

1) Government
2) International relations
3) International law and organization

J) Sociology

1) Sociological methods
2) Social organization
3) Sociological theory

K) Education

1) Science education
2) Social science education

L) Architecture and Planning

1) General architecture
2) Environmental Design

M) Philosophy

1) General philosophy
2) Philosophy of science

N) Religion and Theology

GEORGETOWN UNIVERSITY
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GRADUATE SCHOOL

OFFICE OF THE DEAN

Space Utilization Team

June 1, 1978

Dear Colleague:

The social sciences and humanities are confronting numerous questions and issues raised by recently developed prospects for the large scale utilization of outer space. Serious proposals to industrialize or otherwise develop or utilize space have stimulated a number of individual and group research efforts, which are now considering the potential implications of space utilization from various professional perspectives.

The broad participation of the social sciences/humanities community is important to planning and perhaps one day implementing a program of systematic space utilization. Consequently, under NASA sponsorship, the Space Utilization Team has begun to make a preliminary assessment of the size, needs, activities, growth potential, and appropriate role of the professional community currently concerned with the potential implications and impacts of a large scale space utilization program (a brief description of this research is enclosed).

We would request that you:

(1) Please take the time to complete the enclosed survey and return to:

The Space Utilization Team
The Graduate School Office
Georgetown University
Washington, D.C. 20057

(2) Attach or send under separate cover any materials that you would like indicating your background, interest, or involvement in the social sciences and humanities aspects of space utilization, for example: resume, curriculum vitae, books, articles, speeches, papers, course outlines or descriptions, and other pertinent work(s).

The results of this survey will be tabulated in late 1978 and will be provided to NASA for research and program planning. We appreciate your kind cooperation, which is essential to the success of this project.

Sincerely yours,

T. Stephen Cheston
Principal Investigator

THE SPACE UTILIZATION TEAM, GEORGETOWN UNIVERSITY, WASHINGTON, D.C., 1978

Since the launch of Telstar in 1962, corporations, governments, and non-profit educational institutions have relied more and more on products and services provided from space. In the 1970s, producers and consumers have placed an increasing emphasis on space applications employing satellites, such as LANDSAT. The 1980s promise even greater demand to utilize the unique attributes of the space environment, bolstered by a new age of space transportation built around NASA's Space Shuttle.

The opportunities created by space have prompted serious consideration of a proper definition of space industrialization/utilization. James A. Downey, General Chairman of NASA's Marshall Space Flight Center, provides a sound outline of the salient characteristics:

> Space industrialization basically involves effective utilization of the extraterrestrial environments to produce products or to provide services of value to Earth. Inherent in such a program are the following objectives:
>
> 1. The development of the capability for the commercial processing in space of unique and valuable materials and pharmaceuticals.
> 2. The support of future public service projects in space that will provide significant social and economic returns. For example, large public platforms in space offer opportunities for a variety of low cost communications, including TV, and electronic mail services.
> 3. The introduction and development of new techniques and concepts to satisfy national needs, such as conversion of solar energy to electrical energy in space and its transmission to Earth for public use.
> 4. The development of significant advancements in the extended space capabilities required to accommodate future new space initiatives, including the development of space operations and construction bases needed to fabricate and erect the large structures needed for accomplishing future public service missions.
> 5. The development of permanent occupancy of space by man, an essential ingredient in truly exploiting the potential uses of space for industrial purposes.*

A growing number of scholars and policy-makers have suggested that the rise of space industrialization/utilization should be accompanied by on-going assessments of impacts on the social fabric. These professionals contend that man's future in space involves more than a mere evaluation of the technical and scientific feasibility of various projects. Economic, social, legal, political, and value issues must be addressed as new capabilities permit previously improbable adventures in space. This "pioneer" stage of space industrialization offers a unique opportunity to address these critical social issues before key technological decisions are made.

* AIAA/MSFC Symposium on Space Industrialization, May 26-27, 1976, p. ii.

Working under a NASA grant supplemented by modest private donations, the Space Utilization Team at Georgetown University, under the direction of Dr. T. Stephen Cheston, is beginning to prepare for the potential impacts of large scale utilization of outer space by conducting a preliminary study which addresses two related objectives:

(1) To evaluate the pertinent social science community

The Space Utilization Team is initiating a preliminary assessment of the professional community concerned with human aspects of space utilization, focusing on such characteristics as size, activities, needs, and growth potential. The tools employed in the evaluation include: (a) a survey of social scientists, (b) a current literature search on space industrialization/utilization and related public policies, (c) a review of university-level courses on space utilization, and (d) the development of a preliminary matrix which identifies social science and humanities disciplines and sub-disciplines that are potentially relevant to space utilization.

(2) To assess the feasibility of a relevant journal

The Space Utilization Team is conducting a feasibility study to assess the academic and financial requirements of a scholarly, interdisciplinary journal which concentrates on the human factors of space utilization. Such a journal would seek to improve the quality of discussion by facilitating the exchange of space utilization information and reflection. The tentative journal format includes original articles, updates on relevant technological developments, and progress reports on research in related fields.

Other on-going functions of the Space Utilization Team include: liaison with participants in the public policy-making process; active membership on the Board of Trustees and on the Tower from Space Committee of the Universities Space Research Association (a group of 51 major American universities); coordination of the Georgetown University Faculty Working Group on space developments; and the development of graduate-level courses in the area. The Space Utilization Team also coordinated the social science aspects of the 1977 Princeton University Conference on Space Manufacturing Facilities. The Space Utilization Team is currently organizing a half-day seminar, "Human Factors of Outer Space Production," for the annual meeting of the American Association for the Advancement of Science.

Dr. T. Stephen Cheston, principal investigator on the NASA study, is associate dean of the Graduate School at Georgetown University. Dr. Cheston is assisted by a staff of four research assistants with expertise in such fields as human values, technology transfer, journalism, and international relations.

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SINGLE DISCIPLINE, TECHNOLOGY-KEYED MATRIX

PROBLEM AREA: Potential for widespread death and property damage from earthquakes

Background: A recent study reports that "Senator Alan Cranston (D. - California) told the Senate: 'The United States today faces the greatest potential danger from earthquakes that we have ever faced before. It is only in the last decade or so that our population has become concentrated in major cities and along our coastal regions, and major construction has occurred on landfill and other unstable soils.' If California were to experience today an earthquake comparable to the 1906 San Francisco quake, Cranston said, deaths could number in the tens of thousands and the property damage could exceed $20 billion. Some 70 million Americans live with a significant risk to their lives and property, according to the National Academy of Sciences . . . Only 8 percent of Americans can safely ignore the earthquake hazard." (1)

RELEVANT SPACE TECHNOLOGY: Satellite-based earthquake prediction system

Background: A satellite-based earthquake prediction system has been described in several studies as one option for increasing the timeliness and accuracy of earthquake predictions. (2) In March 1979, the European Space Agency and the Council of Europe announced a joint program, expected to be in full swing by 1990, which utilizes data from ground stations, satellites, and aircraft in an attempt to supply data which will aid earthquake prediction in ten European countries. (3)

RELEVANT SOCIAL SCIENCE DISCIPLINE: Sociology, especially human and social organization response to disaster predictions

Discussion: Sociologists studying human reaction to disaster predictions are beginning to document an interesting, and in some quarters, unexpected phenomenon. Public predictions of major disasters may, on balance, be more costly in lives and dollars than withholding of such information. Scholars warn that earthquake predictions might lead to mass migration of people and industries, a drastic drop in real estate values, reduced tax revenues, and widespread unemployment for remaining residents. The social chaos which might accompany such predictions is a potential impact of reliable predictions, not to mention predictions with a lengthy time span, or even incorrect predictions. Some experts have concluded that earthquake prediction research should be immediately discontinued because of the potential social effects. (4) Others present empirical research which suggests that earthquake predictions have little, if any, socio-economic consequences. (5) The British journal, Nature, concluded in 1973 that "the prospects for society are neither uniformly good nor uniformly bad, and there is still time, but relatively little, to explore the ways in which good prospects can be encouraged and bad ones minimized."

Thus, the most recent study by the Commission on Sociotechnical Systems of the National Academy of Sciences concluded: "Constructive

use of this new prediction technology will depend to a considerable extent on the accuracy and reliability of our knowledge about how people and organizations will respond to these predictions and warnings." (6)

Social scientists have an important opportunity, and responsibility, to coordinate and disseminate relevant findings in this field before final decisions as to the usefulness of earthquake prediction technologies are reached, and well before any implementation of such technologies. Studies of the technical feasibility of such technologies should be augmented by socio/political/economic impact analyses of earthquake prediction devices.

SOME FUTURE RESEARCH PRIORITIES: Empirical studies of forecast effects; comparison of different countries' public policies toward prediction; impact of administrative structures on prediction outcome.

NOTES:

(1) Editorial Research Reports, Advances in Science, Washington, D.C., 1979

(2) National Aeronautics and Space Administration, Outlook for Space, Washington, D.C., 1976.

Wall Street Journal, "Tracking Tremors," April 18, 1979.

INSIGHT, the National Space Institute, January 1979.

(3) Science News, March 31, 1979, p. 31.

(4) Garret Hardin, Stalking the Wild Taboo, 1973, pp. 123-134.

(5) Dr. Eugene Haas, Institute for Behavioral Sciences, the University of Colorado, New York Times, May 15, 1976.

(6) cited in "Earthquake Forecasts: The Perils of Prediction," The Futurist, June 1979, p. 233.

PROBLEM AREA: Declining access to decision makers of the general public, accompanied by the rise in special interest representation and lobbying create a society improperly represented.

PROPOSED SPACE TECHNOLOGY: Two-way interactive satellite communication systems, as suggested in the Rockwell and Aerospace Corportation studies. Such a system has been tested by Congress.(1)

RELEVANT SOCIAL SCIENCE DISCIPLINE: Political science, especially citizen participation and interaction of technology and politics.

Discussion: Many observers have proposed utilizing two-way, interactive satellites as a means of promoting low cost "remote testimony." It is argued that such facilities would encourage the citizen who is normally not able to be represented in Washington to provide his/her views to lawmakers. While initial experiments have demonstrated the theoretical usefulness of such a system, (2), certain quantitative data developed by Professor Norman Nie of the University of Chicago (3) suggest that as viewers are exposed to advanced television concepts, political participation declines. Moreover, if the new systems are not limited to political participation, that is if expanded entertainment choices accompany the new system, one can expect actual political participation to decline. The impact of this study, while not definitive, provides insight into possibilities not suggested by proponents of the two-way systems. Perhaps the insights generated in the study of political participation can be applied to the new interactive technologies so as to encourage greater levels of participation.

FUTURE RESEARCH NEEDS: To establish a definitive relationship between political participation and exposure to new communications technologies; to study the level of participation, as well as the makeup of those participating in current two-way interactive situations.

NOTES:

(1) See Fred B. Wood, et al, "Videoconferencing via Satellite: Opening Congress to the People," the George Washington University, February 1978.

(2) See Ben A. Franklin, "2 Mayor and Aides Confer for 2 Hours on Satellite TV," New York Times, Nov. 21, 1978.

(3) Norman H. Nie, "Future Developments in Mass Communications and Citizen Participation," in Political Science and the Study of the Future, Albert Somit, editor, Hinsdale, Ill, The Dryden Press, 1974, p.132-154.

MATRIX TABLE 1

Preliminary Discipline-Keyed Matrix

DISCIPLINE	OHF	IMPACT	GENERAL SOCIAL SCIENCE	
			Tier A	Tier B
Anthropology	X			X
Architecture	X			X
Business	X	O	X	X
Communication	X	X		X
Design	X			X
Economics	X	X	X	X
Education	X	O	X	X
Geography				X
History		O	X	X
Int'l Relations	O	X	X	X
Law	X	X	X	X
Philosophy	O			X
Political Sci.	O	X	X	X
Psychology	X		O	X
Public Adm.	X		X	X
Sociology	X	X	X	X

Key:
X - discipline with primary applications
O - discipline with secondary applications

MATRIX TABLE 2

General Social Science - Tier A

Discipline	Institutionalization of Space Indust.	Public Perspective and Policy	Military Aspects
Anthropology			
Architecture			
Business	X	X	
Communication			
Design			
Economics	X	X	X
Education	O	X	O
Geography			
History	X	X	X
Int'l Relations	X	X	X
Law	X		X
Philosophy			
Political Sci.	X	X	X
Psychology		O	O
Public Adm.	X		
Sociology		X	O

Key:
X - discipline with primary applications
O - discipline with secondary applications

MATRIX TABLE 3

General Social Science - Tier B

Discipline	Economics	Int'l Relations	Pol. Power	Science	Phil. Aspects	Space Settle-ments	Extra-terr. Intell.	Hist. Analogy	Space Ed.	Space Fiction
Anthropology			X			X	X			
Architecture						X				
Business	X	X				X				
Communications						X	X			
Design						X				
Economics	X	X	O			X		X		
Education				O		X			X	
Geography						X		X		
History				X	X	X		X		X
Int'l Relations	X	X	X	O		X		X		
Law	X					X				
Philosophy					X	O	X			X
Pol. Science	O		X			X				
Psychology						X				
Public Admin.	O					X				
Sociology						X				

Key:
X - discipline with primary applications
O - discipline with secondary applications

MATRIX TABLE 4

Orbital Human Factors

Discipline	Selection	Training	Orbital Stay Times	Design of Facilities in Space	Procedures for Personnel in Orbit
Anthropology		0		X	0
Architecture				X	
Business					X
Communication		X			X
Design				X	
Economics	X		X		X
Education		X	0		0
Geography					
History					
Int'l Relations	0				0
Law	X	X	X		X
Philosophy					0
Political Sci.					0
Psychology	X	X	X	X	X
Public Adm.		X			X
Sociology	X	X	X	X	X

Key:
X - discipline with primary application
0 - discipline with secondary application

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UNIVERSITY OF MINNESOTA, Minneapolis, Minnesota. "Responses to Stress and Extreme Environments," 1976-1979. Michael K. Popkin, M.D, school of medicine.

UNIVERSITY OF NORTH CAROLINA, Chapel Hill, North Carolina. "Science and Policy, " 1975-present. Dietrich Schroer, Ph.D., department of physics and astronomy.

UNIVERSITY OF NORTH CAROLINA, Chapel Hill, North Carolina. "Physics and Society," 1969-present. Dietrich Schroer, Ph.D., department of physics and astronomy.

UNIVERSITY OF TEXAS, Austin, Texas. "Social Psychology," 1977. Robert Helmreich, Ph.D., department of psychology.

UNIVERSITY OF TEXAS, Austin, Texas. "Research Methods in Social Psychology," 1977. Robert Helmreich, Ph.D., department of psychology.

UNIVERSITY OF TULSA, Tulsa, Oklahoma. "Science, Technology, and Society," 1971-1974. Nancy Feldman, Ph.D., department of sociology.

UNITED STATES MILITARY ACADEMY, West Point, New York. "Political Philosophy," 1978. Major Francis Butler, Ph.D., department of philosophy.

UTAH STATE UNIVERSITY, Logan, Utah. "Current Problems and Trends in Education," 1977 and 1978. Richard S. Knight, Ph.D., department of secondary education.

UTAH STATE UNIVERSITY, Logan, Utah. "Values and the Future," 1977. Richard S. Knight, Ph.D., department of secondary education.

VIRGINIA POLYTECHNIC UNIVERSITY, Blacksburg, Virginia. "The Politics of Energy," 1976-1978. Jack Salmon, Ph.D., department of political science.

ADDENDA

UNIVERSITY OF CENTRAL FLORIDA, Dr. James Ragusa, department of economics. 1978. An analysis of the economic and organizational aspects of future manned space stations.

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