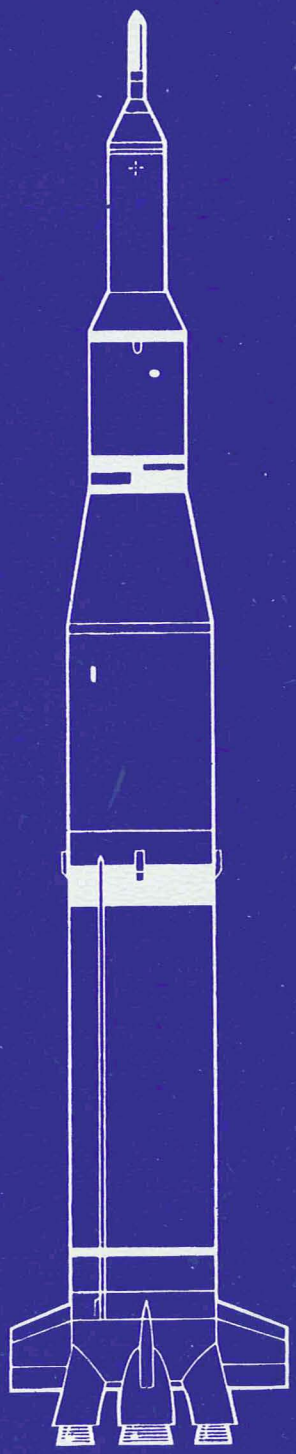
SYRACUSE/NASA PROGRAM



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National Aeronautics and Space Administration

Syracuse University

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SYRACUSE/NASA PROGRAM

for the period

July 1, 1969 - December 31, 1969

MULTIDISCIPLINARY STUDIES IN MANAGEMENT AND DEVELOPMENT PROGRAMS IN THE PUBLIC SECTOR

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I. INTRODUCTION

The four major interdisciplinary research projects, Role of the Project Manager, NASA/Business Relations, Case Studies, and Regulations in Space continued to provide the major focus for the activity during the report period, July 1 to December 31, 1969. At the same time, several smaller projects were being carried out, namely, those concerned with Partitioning NASA Incentive Contracts, under Professor P. Bruce Berra; Exposition and Real Time Decision-Making, under Professor G. Harry McLaughlin; and Public Administration, the Universities, and NASA, under Professors Frank Marini and W. Henry Lambright. Also, a small undertaking on The Accuracy of Cost Estimation for Apollo Decision-Making in NASA was begun under the direction of Professor Mohamed Onsi.

William Davis continued his thesis work on NASA's Experience with the Sustaining University Program under the direction of Dr. John C. Honey. The educational and training program for graduate students, although not reported on herein, continued to have close association with the research effort. This combined research and educational activity under the Syracuse/NASA Program during this reporting period involved 19 faculty members and 22 graduate students from the Maxwell School and the Colleges of Engineering, Law, Business Administration and Journalism.

There were several highlights during the reporting period which are worth mentioning in this introduction. The first of these was the conference held September 2-5 at the off-campus Minnowbrook Conference Center of Syracuse University with participation by NASA personnel and Syracuse University faculty and students from the Project Manager's group. Details of this meeting will be found in the section of the report on the Role of the Project Manager.

The second highlight was the Program Review presentation at Syracuse University October 23-24 to key personnel from NASA and other invited guests which reviewed the Syracuse/NASA Program in its entirety for the previous year. This two-day program featured a meeting with the new Chancellor, Dr. John E. Corbally, Jr., at which the relation-

ship between Syracuse University and NASA was discussed. Following the presentation, there was an opportunity to review proposals for the following calendar year 1970, thus providing a succinct statement of where we had been and where we were going.

The third highlight was our participation in the NASA-sponsored Program Review of the Administration and Management Research Program held at NASA Headquarters December 11-12 which was attended by representatives from eleven universities and organizations. This meeting allowed for the presentation of a brief review of the work we had accomplished during the year and presentation from others of their ongoing work. A feature of this Program Review was a dinner meeting on December 11 at which Professor Frank Marini presented a paper entitled, "The New Public Administration," which engendered warm, frank and meaningful discussion which carried on until a late hour.

II. ADMINISTRATION

Professor Martin E. Barzelay of the Department of Mechanical and Aerospace Engineering, and Professor Edwin A. Bock of the Department of Political Science continued as Co-Directors of the Syracuse/NASA Program. Professor Barzelay's prime responsibility was as Principal Investigator of the Grant, and Professor Bock's responsibility was in connection with the Traineeship activities. During this period, Professor Barzelay phased out his direct activity in connection with research on the Role of the Project Manager.

This Program continues to report to the University Vice President for Research and Governmental Affairs, Dr. John C. Honey. The Deans of the five participating schools and colleges have continued to be kept informed of progress of the Program by the Program Director and individual Project Directors.

Project Directors for the four major research efforts were:

Role of the Project Manager - Professor Eugene E. Drucker (College of Engineering).

NASA/Business Relations - Professors Peter G. Franck and E. Bruce Fredrikson (College of Business).

Regulations in Space - Professor George J. Alexander (College of Law).

Case Studies - Professor Edwin A. Bock (Maxwell School).

During this reporting period members of the four major project teams and others continued to make field trips to NASA Headquarters, NASA field centers, universities and private corporations but at a reduced rate compared with previous reporting periods. A substantial number of working papers and preliminary reports and theses were written by faculty and graduate students and papers were delivered at several conferences. These papers have been detailed in a list compiled and submitted to NASA in December. Several University-wide seminars also were conducted during the reporting period.

III. MAJOR PROJECT RESEARCH

A. ROLE OF THE PROJECT MANAGER

The research dealing with the Role of the Project Manager has involved one and one-half years of activity by an interdisciplinary team of social scientists, engineers, and members from the School of Business Administration. The scope of the effort has been allowed to range beyond the behavior of the project manager in NASA to include, for example, the total NASA organization and its relationship to the Congress and other agencies in so far as these have affected the administration of NASA projects. However, the continuing focus has been on the project manager.

At present, the project group is involved in an attempt to correlate all of the pieces of information and insights gained from the interviewing and writing of the past two years. This is the most difficult period in the project. The final product will be a comprehensive report. It will analyze the form and evolution of project management in NASA Manned Space Flight, and it will attempt to relate this to theories of management structure for large-scale, complex organizations and to the planning and organizing of future complex endeavors. The task requires the generation of a meaningful conceptual scheme from the insights and data now in hand, and the integration of a number of discipline perspectives.

Plans have been considered to shift the focus of the research to include unmanned space flight as well as manned. The precise nature of the future work will depend on the concepts now being developed. It is anticipated, though, that an attempt will be made to investigate a number of different programs and projects with a view to establishing both general and specific relationships that emerge from such a comparison. The interdisciplinary project team concept will be retained, because the experience thus far has shown that the various disciplinary perspectives do result in a deeper and more realistic appreciation of the problems.

Early in the period, a conference was arranged and held at the Minnowbrook Center of Syracuse University, between the research team members and NASA representatives from various organizations. It is described below. Also described in following sections are the various field trips undertaken in the reporting period. A brief review is given of the Working and Occasional Papers prepared, as well as of the student Theses and Dissertations in progress or completed.

Some changes in the make-up of the research team took place: Doctoral candidate Henry Anna accepted the position of Assistant Professor of Political Science at the University of Cincinnati; Professor R. J. Hopeman withdrew from the group because of administrative obligations placed on him by the College of Business Administration; Professor K. N. Tong left the group because of the pressure of other assignments; Professor Martin E. Barzelay phased out his work as he assumed his new administrative duties as Principal Investigator and Co-Director of the entire Syracuse/NASA Program; Mr. John Cicero transferred from Business Administration to another college. A new graduate student, Paul Nakai, became associated with the research team. The group consisted of the following individuals at the end of the reporting period:

Eugene Drucker (Professor) Mech. and Aerospace Engineering
George Frederickson (Assistant Professor) Political Science
Barry Kelmachter (Graduate Student) Mech. and Aerospace Engineering
Paul Nakai (Graduate Student) Mech. and Aerospace Engineering
William Pooler (Assistant Professor) Sociology
Alphonse Sallett (Doctoral Candidate) Sociology
David Wilemon (Assistant Professor) Business Administration
Bernard Wood (Professor) Mech. and Aerospace Engineering

In January of 1970, a new graduate student, Richard Loverd, from the Department of Political Science will be engaged on the project, working with Dr. Frederickson, his dissertation advisor.

THE MINNOWBROOK CONFERENCE - SEPTEMBER 2-5

Early in 1969, after a large number of field trips were completed and some anticipated for the near future, the group decided that a good

deal of data had been acquired and various conclusions were taking form in the minds of the researchers. From the point of view of contributing to the research results, the research team considered the desirability of a conference at which it could sit down with a corresponding number of NASA people to discuss project management in the Apollo Program in order to expose its impressions and early models to constructive NASA criticism.

The suggestion was made at a research group meeting in May, 1969, that the group sponsor a small, informal conference at one of the Adirondack Conference Centers in early fall of 1969. The objectives of the conference, whose participants were to be roughly divided between Syracuse University and NASA persons, were set forth as:

a) Feedback of information to NASA interviewees.
b) Evaluation and critique by NASA of preliminary Syracuse University reports.
c) Additional exchange of ideas on timely subjects not included in the earlier interviews.

Professors Drucker and Wilemon drew up a preliminary plan and developed the theme of the conference in greater detail. Comments on a draft agenda were sought from the NASA Office of University Affairs and Dr. Honey. By mid-July, letters of invitation and tentative programs were mailed to 34 NASA members; an additional 18 invitations were sent at the end of July, and 10 more in mid-August. These were primarily persons who had been interviewed by members of this team. Ultimately, 11 NASA members attended along with 14 Syracuse University members. The participants were:

Henry J. Anna
Graduate Student
Political Science
Syracuse University

Richard F. Baker
Program Support Division
Goddard Space Flight Center

Robert D. Balderston
NASA Special Trainee
Syracuse University

Martin E. Barzelay
Professor
Mech. & Aerospace Engineering
Syracuse University

W. C. Bradford
Engineering Directorate
MSC

John P. Cicero
Graduate Student
Business Administration
Syracuse University

Eugene E. Drucker
Professor
Mech. and Aerospace Engineering
Syracuse University

William A. Hagen
Management Analysis
MSFC

John C. Honey
Vice President for Government
Affairs and Research
Syracuse University

Richard J. Hopeman
Associate Professor
Organization and Management
Syracuse University

Barry L. Kelmachter
Graduate Student
Aeronautical Engineering
Syracuse University

Randolph P. Kucera
Graduate Student
Political Science
Syracuse University

Brian Lebert-Francis
Information Systems, AAP
NASA, Washington

Daniel A. Nebrig
Project Engineer, CSM
MSC

William S. Pooler
Assistant Professor
Sociology
Syracuse University

John G. Presnell, Jr.
LM Vehicle Manager
MSC

Donald F. Seaton
Program Control
NASA, Washington

Spencer E. Smith
Project Manager
Saturn V, GSE
MSFC

Arthur W. Thompson
Project Manager
SI/SIB Stage 5

Kin Nee Tong
Professor
Mech. and Aerospace Engineering
Syracuse University

David W. Walden
Manpower Utilization Division
Goddard Space Flight Center

David L. Wilemon
Assistant Professor of Marketing
Syracuse University

Bernard D. Wood
Professor
Mech. and Aerospace Engineering

Earle B. Young
Chief, Management Analysis
MSC

Program

The program format consisted of short sessions opened by a Syracuse University research team member's 15-30 minute presentation. Each talk was followed by comments from selected discussants from NASA and then by general discussion and questions from the floor.

The session topics and leaders were as follows:

A-1 "The Organizational Environment of the Apollo Project Manager," W. Pooler

A-2 "The Apollo Program and the Project Manager, A Theoretical View," H. Anna

B "Specific Environmental Interfaces of the Project Manager"

The Contractors - E. E. Drucker
In-House - B. D. Wood

C "The Apollo Project Manager: Anomalies and Ambiguities," J. Cicero

D "Project Management as a Transferable Management System," D. Wilemon

E "The Reality and Myth of Management Systems," R. J. Hopeman

The format proved to be very effective. In all cases the discussions were active and pertinent, and very good participation from the audience was achieved. Late afternoons were left free. Informal evening sessions were held, centered around the James Webb interview, NASA-University relationships, and other general topics. The program format contributed immensely to the informality of the entire conference and the free exchange of ideas that took place.

Notebooks containing outlines or abstracts of the lead-off talks were issued to each participant. All sessions were recorded. They are being transcribed, and a decision to publish or not will be made in the near future.

General Appraisal

The conference was of considerable value for the Syracuse University group. The frank criticism of the research models and of the tentative conclusions by the Syracuse University researchers was very useful. New information was gained both in the sessions and in informal discussion at meals and other times. Living together with the NASA people engendered a good deal of friendship among the particular persons involved. These friendships have already simplified communications.

The NASA people also gained new insights (particularly about the Centers) but it may not have been as great a learning experience for them as it was for the Syracuse University people. Nevertheless, they seemed to enjoy the opportunities provided by the conference.

TRIPS BY RESEARCH PARTICIPANTS TO INTERVIEW NASA AND CONTRACTOR PERSONNEL

Travel for data gathering through personal interviews in this report period was concentrated in the months of July and August. Six separate trips were taken and a large number of interviews were taped and subsequently transcribed. The remaining months, through December 1969, were required for editing and analyzing the accumulated information.

Two very useful trips were taken by W. Pooler and A. Sallett to NASA Headquarters, Washington during the month of July. The first trip was essentially exploratory, enabling the researchers to establish contacts and make appointments for the second trip, but at the same time there was an opportunity for extended interviews with two Headquarters men. The second trip (July 22 to July 25), produced several long interviews and an opportunity for examination of memoranda, policy statements, organization charts, etc., that provided data on the development of the Apollo management system which had not been available elsewhere. The cooperation of numerous NASA men was not merely accommodating, but was given enthusiastically. The timing was such that it was possible for the two researchers to be present at the Apollo Action Center for a review of the Apollo 11 splashdown the previous day. Some insights into the nature of such meetings were gained, although the meeting was short because of the outstanding success of that splashdown.

While on a trip to Texas in July, D. Wilemon took the opportunity to interview a key project manager working for the Ling-Temco-Vought Corporation whose contact with NASA has been in life-support systems and in the Scout program. A project manager's view of the company's organizational structure, the role of the project manager, the conflicts with functional branches, budgeting, "tiger teams", and NASA as a customer were all discussed.

In August, D. Wilemon, J. Cicero and R. Hopeman visited RCA facilities in Camden, N. J., and interviewed several RCA project managers. This helped in the examination of the contractor's view of project management and provided a comparison between operations related to NASA and those related to DOD.

The most extensive view of project management at contractor sites was obtained in a trip to the Los Angeles area, August 25-29. E. Drucker, G. Frederickson, A. Sallett, and B. Kelmachter visited four major Apollo contractor sites: 1) North American-Rockwell, Space Division, Downey (CSM); 2) North American-Rockwell, Space Division, Seal Beach (S-II); 3) North American-Rockwell, Rocketdyne Division, Canoga Park (Engines); and 4) McDonnell-Douglas Astronautics Company, Huntington Beach (S-IVB). Interviews were prearranged with the assistance of contacts made at MSFC and MSC during previous trips. On this trip, forty-six interviews were conducted by the research team. Forty-one interviews were held with contractor personnel whose jobs covered a variety of contractor functions; they were project/program managers, manufacturing managers, test managers, quality and reliability managers, and business operations managers. In general, contractor personnel were quite frank and straightforward; most had some criticism of NASA methods and procedures. The remaining five interviews were with NASA resident personnel at the contractor sites. The researchers found that this group of men had their own unique perspective of project management as it is conducted in the Apollo program, as well as a unique set of problems. All interviews were taped and transcripts have been sent to the interviewees for editing and comment. On the whole, the research team members found both contractor and NASA personnel to be very cooperative and believe that the research team members would be welcome again for future visits.

One member of this team, D. Wilemon, joined Professor E. B. Fredrikson of the Syracuse/NASA Technology Utilization study group in a trip in July to the Corning Glass Works, Corning, N. Y. The focus of the trip was on new product development and the managerial mechanisms used to effect technology transfer.

RESEARCH REPORTING AND DISSEMINATION

Several working papers and other publications were prepared and distributed during the report period.

Working Papers

(a) "The Apollo Project Manager-Contractor Interface," E. E.

Drucker, (Ocotber 1969), 6223-WP-4. In this paper the interface between Apollo program manager and contractor is discussed from two points of view. In one, the similarities and differences between the two types of managers are examined. Differences exist because there are government agency and private industry operations involved, with quite different motivation. This in turn leads to dissimilar organizational structure and manager authoritativeness.

Interfaces are also discussed with a view toward explaining existing variations at the NASA field centers of management style in contractor dealings. These variations result from the differences in institutional history and in key-figure characteristics.

In a separate listing, various items of contractor criticism of NASA are tabulated in a manner which intentionally emphasizes the sometimes biased contractors' problems with NASA.

(b) "The NASA Scheduling System: Scheduling in the Apollo Program," (Part 1 of 6), R. J. Hopeman, (July 1969), 6223-WP-10. This paper presents the NASA approach to scheduling in the Apollo Program. It begins with a development of program objectives and the major phases established for the program. How these phases are translated into mission launch dates is explored along with accomplishments to date. The development of launch schedules is the next stage in the progression to an ever-narrowing focus on detailed schedules. Major project management schedules are discussed, followed by development hardware end-item schedules. The paper contains many illustrative schedules from both long-range launch readiness schedules to detailed schedules for hardware end-items.

(c) "The NASA Scheduling System: Scheduling in Project Management," (Part 2 of 6), R. J. Hopeman, (August 1969), 6223-WP-11. This paper explores the approach to scheduling used in the management of large scale projects. The relationships of cost, schedules, and technical performance are presented with the management trade-offs required. Key document flows relative to the Apollo Program are traced including the Apollo Project Approval Document (PAD), Apollo Program Development Plan (PDP), and Apollo Program Directive Four Series (APD-4). These Headquarters information Systems components are then linked to Center level schedules. The paper concludes by setting sched-

ules in the context of Apollo Project Management Systems elements and contrasting this approach to typical industrial practice.

(d) "The Techniques of Scheduling in the Apollo Program," R. J. Hopeman, (December 1969), 6223-WP-12. The technical aspects of scheduling are explored in this paper as they have been developed and utilized in the Apollo Program. The detailed levels of schedules are presented on: 1) flight programs, 2) specific projects, 3) primary systems, and 4) subordinate systems. Milestone scheduling is discussed as a general approach to providing management visibility. The advantages and limitations in industry and within the NASA context are presented. Within this framework, specific NASA milestone scheduling techniques are explored. Methods of depicting schedule status, schedule changes, and detailed discussions of schedule symbology follow. NASA contributions to industrial scheduling practice are developed throughout the paper.

(e) "Project Management and the Organization, Part I," Henry J. Anna and H. George Frederickson, (August 1969), 6223-WP-20. This paper examines the organizational structure and relations to the total organization of the Apollo Program hardware research and development projects. It employs a refined model of matrix theory to relate the workings of the project groups to selected characteristics of their personnel and their tasks. This, in turn, is used to relate the project organization to a general theory of organization. The study particularly focuses on the relations between the project groups and the rest of the NASA organization. The data for the study was gathered in interviews with project managers, subsystems managers and related personnel at MSC and MSFC and Apollo Program and other NASA personnel at Headquarters.

Part I discusses organization, theory and project management theory and presents the refined model of the matrix approach to organizations. Succeeding papers in this series will discuss the application of this model to Apollo project management.

(f) "Project Management as a Transferable Management System," D. L. Wilemon, (October 1969), 6223-WP-21. Since its inception, there has been considerable conjecture on the potential scientific and technological spin-offs from the Apollo Program to the public sector. To aid in the

dissemination process, NASA established a technology utilization program. Most discussion on spin-offs and transfers have centered around new processes, new products, and new ideas developed from the NASA experience. Although NASA's technology utilization program has met many successes, some individuals are now beginning to believe that NASA's greatest spin-off will be the agency's project management systems--the sophisticated techniques utilized in planning, organizing, and controlling complex undertakings.

Addressing this proposition, this article has one basic objective: to discuss the transfer of project management techniques in a generalized way to the "sociotechnical" areas, i.e., urban redevelopment, housing, pollution control, and international economic development projects. The term "sociotechnical" is used since there is a complexity and interrelatedness of social and technical variables which require new management perspectives. That is, both social and technical management skills will be needed for effective problem resolution. A comparison of technical and sociotechnical task management is discussed.

Occasional Papers

(a) "Interdisciplinary Effort: Research or Problem Solving," E. E. Drucker, (September 1969), 6223-OP-6. This paper points out that interdisciplinary groups are ideally suited to attack and solve complex problems, because each member of the group works along the traditional lines of his discipline, on a task which is well defined and relatively independent of the others.

In order for an interdisciplinary group to successfully do true research, however, there must exist a combination of conducive physical and administrative facilities, compatible personnel, and above all a research topic whose investigation genuinely requires the cross-fertilization and critical "lay" evaluation of ideas by members of various disciplines. This combination is difficult to arrange, so that the existence of true interdisciplinary research is a rarity.

Interdisciplinary research is inefficient compared to conventional research, but it is of great benefit to individual participants.

In universities, the greatest stimulant to interdisciplinary research is administrative independence of the research organization from the Departments and Colleges.

Articles Accepted for Publication

(a) "Managing Product Development Systems: A Project Management Approach," D. L. Wilemon, (July 1969), 6223-OP-4. In an effort to look at alternative uses for project management techniques, this article suggests that project management has potential value in managing a "total" product system in industry--especially by those firms manufacturing technically oriented products. Rather than viewing the functions of new product research and development and product commercialization as distinct managerial activities, the paper suggests that project management is a potentially useful management approach that can integrate both the R&D and product commercialization processes. It is suggested that the proposed management approach will aid in mobilizing the organizational resources necessary for an efficient and effective product development system. Accepted for publication by: Business and Economic Dimensions.

(b) "Bureaucracy and the Urban Poor," H. George Frederickson and Henry J. Anna, (August 1969), 6223-OP-5. This article examines the relationship between widespread personal poverty and bureaucratic public administration in urban America. The urban poor are characterized by a distinct set of socio-emotional traits and constitute a peculiar and special kind of clientele for the organizations with which they interact. Bureaucracies are specialized, hierarchical, impersonal and slow. But the poor have immediate needs, and these needs are interrelated, not specialized. The paper examines alternatives to bureaucratic organizations which might prove more effective in meeting the needs of the urban poor. The first is a religiously based service or welfare organization which considers the client's needs as a whole. This approach is limited by its religious base and small size. The second alternative is the proposed application of project management at the community or client level. This approach seems to open the possibility of coordinated, systematic service to solve the problems of urban poverty on a personal level. Accepted for publication by: Urban Social Changes Review.

(c) "Project Authority: A Multidimensional View," John P. Cicero and D. Wilemon, (December 1969), 6223-WP-17. This paper delineates some basic authority relationships within five models of project management: 1) the individual model, 2) the staff model, 3) the intermix model, 4) the aggregate model, and 5) the NASA Apollo model. The authority construct is broken down into formal authority (authority inherent with the position and organizationally derived) and influence (authority generated by the individual through his own competence and human administrative skills).

The focus of the paper shows how the bases and functions of authority tend to shift within the various models of project management. An examination of the project manager's use of formal authority and influence in varying project contexts eliminates some of the ambiguity surrounding the concept of project authority by clearly presenting the influence alternatives available to the project manager. Accepted for publication by: Transactions on Engineering Management.

Thesis Completed

(a) "The Technical and Professional Qualifications of Apollo Project Managers," John P. Cicero, (Business Administration), (August 1969), 6223-TD-3. This thesis concerns itself with defining what the professional and technical qualifications of a project manager are if the office of project manager is viewed as a career objective in the same sense as "doctor" or "lawyer" or "engineer". The paper focuses on the demographic characteristics of a select group of Apollo Project Managers. From the demographic profile which emphasizes job experience and job-related qualifications, an effort was made to interpret professional and technical qualifications as displayed by the research sample. The findings of the study will add to the current thought and literature on what characteristics "should" be displayed by successful project managers.

Two basic sources of data were utilized, the Personnel Management Information System (PMIS) and the Executive Assignment System (EAS).

The significance of this study is enhanced by its focus on a select group of Apollo project managers. The Apollo program is clearly recog-

nizable as a large-scale endeavor, a project management organization. Apollo project managers represent what might be termed the first generation of career project managers.

B. NASA/BUSINESS RELATIONS

The evaluation of Government institutions furthering dissemination of new technology on the one hand and probing of the decision-making process of the large manufacturing firm, including public utilities, on the other, absorbed most of the staff input for the report period. The work was carried out under the direction of Professors Peter Franck, E. Bruce Fredrikson, and Eric Lawson.

1. Institutional Efforts

Our general approach in the area of institutional efforts continued to involve interviewing knowledgeable people and reviewing relevant literature. Technology transfer was found to be a truly multidisciplinary field in which knowledge is fragmented; consequently, new leads to information sources constantly arose.

No attempt was made to evaluate apparently competing programs on a comparative basis because, backed by varying resources, their objectives differed from program to program. From an academician's point of view, it does not matter which agency is involved in the program for fostering technology transfer. Results are what is important. It appears, however, that the existence of apparently overlapping responsibilities causes occasional friction on the part of operating personnel. We believe that each of the major programs considered--NASA's Technology Utilization Program, the Regional Dissemination Centers, the Small Business Administration's Technology Utilization Program, and the State Technical Services Program--has a useful role to play, and that more funding should generally go into them. Thus the following observations will focus on content rather than upon funding agency.

It is clear that field service programs are the most effective way to transfer a broad technology base to the commercial sector, particularly the small business component of this sector. It is also clear that even minimal programs of this sort must be expensive, involving as they do a large, inefficient input of personal, professional services. Those firms which receive subsidized counseling services clearly benefit from them, as the mounting files of case experience attests. From a broader stand-

point, one may ask whether it is government's role to, in effect, "spoon feed" technical information to firms which would otherwise fail to utilize it.

This suggests another important point. Technology must be actively disseminated; it must be "sold" to potential users if there is to be any thought of speeding up the notoriously slow process of natural diffusion. In all of the programs that we have examined, noticeable success is attributable principally to the individuals involved in the dissemination program. Passive programs, those which depend upon consumer initiative, have generally languished; yet this approach has characterized many efforts.

Again, a question of public policy arises. Should government interfere in the natural process of technology diffusion? Why should governmental agencies have to urge competent businessmen to utilize the services of TU agencies, when it is to their own benefit to seek out these information sources? Policy is obviously important here, because without constant cajoling most small businessmen will continue to do things as they always have.

Workshops and seminars often attract widespread interest, particularly when they deal with important scientific advances with commercial potential. But interest and potential does not always mean commercial exploitation. Two recent technological advances provide an interesting contrast. Seminars were presented during 1969 on rolamite and on neutron radiography. Both were "successful" in terms of attendance and general reaction of participants. Commercial rolamite applications are few and far between, however, while neutron radiography is becoming a widely used technology. Rolamite applications are hampered by patent uncertainties, which cause reluctance to risk capital for substantial product development costs. Neutron radiography is presently available as a non-destructive testing service being actively sold, and which to the potential purchaser means little risk and no capital commitment.

Professor E. Bruce Fredrikson visited NASA Headquarters in July to discuss the research with personnel at NASA Headquarters; and at the Office of State Technical Services.

In August, Professor Fredrikson interviewed Theodore Brown, Dean Coddington, James Freeman and M. Terry Heller at the Denver Research Institute; William Shinnick and W. W. Long at the Technology Application Center (Albuquerque); Lee Zink, formerly director of the Technology Use Studies Center; Jack Lang, Technology Utilization Officer, Small Business Association, Los Angeles; Ken Oulie and Charles Dole, Western Research Applications Center, Los Angeles; John Warden and John Draine, NASA Pasadena Office; Matt King and W. C. Fortune, Marshall Space Flight Center-West Coast Office; Paul Schwemler, North American-Rockwell; Carl Buckel, Rocketdyne Division, NAR; Nan McCandless, Pacific Technical Information Library; Joseph Hannauer, Technology Utilization Officer, Small Business Administration, San Francisco; George Edwards, Ames Research Center, Mountainside; Norm Fishman, Stanford Research Institute.

Two graduate students completed 3-credit theses during the period. Donald Andrews' paper is entitled, "Comparative Study of the Venture Capital Markets of Rochester and Syracuse." This paper is concerned with the interface of finance, technology, and small business. It demonstrates that the climate for technology utilization through the formation of "spinoff" small businesses is more favorable in Rochester than in Syracuse. Rochester investors have sufficient wealth to finance these ventures, and they are willing to supply venture capital.

Charles Larson examined "The Transfer of Technology in New Product Development," with specific reference to the Corning Glass Works. He considered various institutional strategies for employing technology in new product development. A major conclusion is that product development activities must be more closely correlated with market research.

2. Large Manufacturing Firms

In response to a growing need for sharing preliminary findings on the factors affecting technology decisions by large firms with other members of the Syracuse University/NASA research team and outsiders, an Occasional Paper, "The Process of Technology Transfer in the Large Firm," Peter Franck (May 1969), 6225-OP-2, was reproduced and circulated. It led to stimulating discussions since it incorporated several hypotheses on what should be considered very preliminary assumptions. The paper

grew out of a Syracuse University faculty seminar held in May but was not incorporated in the Third Semi-Annual Report. The major body of facts used in this analysis was the work carried forward by three different industries contributing to the Video-Tape Recorder. The innovation reached the stage of commercial utilization in 1956. Discussions with General Electric research staff members, referred to in earlier reports, encouraged the exploration of the many divergent strands of technological development converging on the VTR. This case also illustrated the close inter-relationship between non-mission oriented research ("basic research") and mission-oriented work. In concluding the report the author states that the VTR is a prime example of the essential role that apparently peripheral research can play.

In the course of search for unpublished findings of other research teams the NASA/Business Relations staff came upon the work undertaken under the auspices of the Illinois Institute of Technology and financed by the National Science Foundation (1966). The material was summarized in another Occasional Paper, "Technology in Retrospect and Critical Events in Science: A Summary and Critique of Findings by IIT," Peter Franck, (December 1969), 6225-OP-3, and revealed that, as in the case of the VTR, divergent streams of efforts led to a timely commercial application of the electron microscope and magnetic ferrites. These two cases seemed to bear out the contention by many R&D scientists that, while non-mission and mission-oriented research play a diminishing role in the last several years prior to commercial innovation, it nevertheless may prove crucial in the terminal period of the evolution. The report concluded that the large amount of interplay between areas of technical specialty and discrete research events in the ten or twenty years prior to innovation, together with the importance of instrumentation, strongly suggests the need for continuing overlap between the efforts of the experienced engineer and the inexperienced researcher, and therefore between industrial R&D teams and the academic communities.

3. Transfer of Nuclear Power Technology

During the period under review the problems of successful transfer of nuclear power technology into the area of electric energy production

received unexpectedly wide public attention. The upsurge of critical comments by scientists, public bodies and consumer groups dramatically put the spotlight on the decision of the industry, made in the late fifties, to develop the civilian application of what was basically a war-time innovation. The re-examination of the social cost of this transfer (pollution of air and water) revealed that technology transfer by industry, when unduly influenced by the private cost-benefit calculus, may backfire and cause losses to the industry pushing it. Staff members have arranged for visits with the original decision makers in the power generator industry. These visits are scheduled for early spring.

Meanwhile a graduate assistant, Louis Buttino, basically oriented towards political science and public administration, compiled a preliminary report "The Role of the Atomic Energy Commission in Technology Transfer: The Civilian Power Reactor Program," (October 1969), 6225-WP-9. The report provided a clear-cut evidence that the civilian power reactor program would have died in its infancy had it not been for what, in informal language, might be called "Spoon-feeding" by AEC. Further research will be needed to analyze the savings of cost AEC's role passed on to industry.

C. CASE STUDIES

Case Study Program activities under the Syracuse/NASA Program have been directed primarily to the production of two book-length "Decisions-in-the-Making" studies; one dealing with the evolution of Apollo decision-making to the end of the Johnson Administration. A second objective has been encouraging the preparation of individual cases about aspects of governmental policy-making and management in the science-technology area.

1. Weather Modification Decision-in-the-Making

Professor Bock reviewed Professor Lambright's first draft and the comments and suggestions received from the principal participants. The reactions from these people and other experts in the weather modification field were, in general, highly enthusiastic. So were the responses from some of the leading U. S. political scientists who serve on the Board of Trustees of the Inter-University Case Program. There appeared to be general agreement that Professor Lambright's study could become a book of great importance if the first draft were carefully revised. Professors Bock and Lambright conferred and agreed on a plan for revision of the manuscript. Since no Syracuse/NASA funds were available to complete the revision of the manuscript, Professor Bock secured agreement from the Board of Trustees of the Inter-University Case Program to fund additional work by Professor Lambright for preparation of a revised draft. (The ICP also supported Professor Lambright's work on weather modification for one semester when he was beginning his work in '68). The final revised version of the study will be published in book form by the ICP.

2. Post Apollo Decision-in-the-Making

Professor Redford spent the late part of the summer at NASA Headquarters in Washington gathering reactions from the principal participants to the first draft of the Redford-White study. Reactions were also secured from Huntsville and Houston Centers. During October and November, Professors Bock, Redford, and White consulted on several possible lines

that might be followed in revising the first draft. Professor Redford drafted sections for the revised version. At the close of the period covered in this report, Professor Bock and the authors were still considering how the substantial work of revision still to be done, could be accomplished within the budget set for this study.

3. Individual Case Studies

Support from the Case Study Program for individual cases has, as previously reported, concentrated on three studies being prepared by present or former Maxwell graduate students in Political Science and Public Administration. In the first two of these, the support has been primarily for trips to Washington, to R & D contractor installations, and "think tanks." Major Richard Head, who is preparing to assume responsibility for teaching defense policy and government-science-technology courses at the Air Force Academy, worked with Professor Bock in shaping a doctoral dissertation that would contain a case study of the top-level analysis and planning in the development of a major Air Force weapons system.

Mr. Randolph Kucera, a political science Ph.D. dissertation candidate, working under Professor Bock, continued his research and writing for a study of the interrelationships between government agencies (including NASA) and a so-called captive aerospace corporation (Grumman).

Support from NASA for the Case Program also enabled editorial and typing work to be done on a study by a recent Maxwell graduate, David Prestemon, of federal decision-making on the development of the Super-Sonic Transport. This study was in the second draft stage by December 1969. It includes 1969 decision-making by the Nixon administration.

4. Use of Case Studies in Teaching

Early drafts of most of the above-named case studies have been used in courses at the Maxwell School and at other institutions cooperating in the Inter-University Case Program. This is in keeping with one of the purposes of this program, which was to feed into university teaching as quickly as possible, studies of important government policy-making and management experiences in the science-technology field.

5. Exploration of Possible NASA Administrative History and Other Studies

During the report period, Professor Bock conferred with Messrs. Bingman, Frutkin, Stephens and others at NASA Headquarters about possible future studies of NASA activities. These included, an Administrative History of NASA from 1961-1969 and a study of the Indian Satellite Television agreement. During the December Christmas period, Professor Bock began reviewing some of the basic documentary materials available for preparation of the NASA Administrative History.

D. REGULATIONS IN SPACE

1. Research Personnel Activities

a. The research activities during the subject report period continued to be directed by Professor George J. Alexander.

During the summer of 1969 field research followed the general pattern of the prior summer except that it was conducted exclusively at NASA Headquarters. Two law students spent the summer in offices provided for them next door to the General Counsel's office. They were able to consult with the General Counsel and a number of the attorneys on his staff. While research was conducted in a number of areas, the effort concentrated mainly on problems related to: the legislative history of the NASA act with special concern for its implications on personnel policy, operational authority and the division of responsibility between it and the Defense Department; the patent problems of invention to be used in outer space; and the earth resource satellite program.

The field research was supported by additional research provided by a law student at Syracuse University. The director spent a portion of his time at Headquarters and a portion at the University.

In addition to the intensive work of the summer period, a group of three law students worked on translating the field research into case materials during the fall semester. They researched problems and found additional cases for inclusion. Each week a seminar meeting was held to discuss the problems under study.

In July, the director was invited to deliver a paper in a symposium on space law at Sir George Williams University, Montreal, Canada, in honor of the moon shot. In September, the director was invited to speak at a meeting of the Federal Bar Association in Miami Beach, Florida. The director also delivered an invited paper on legal problems connected with earth resource satellites at the XIIth Colloquium on Space Law at Mar del Plata, Argentina, in October.

The efforts of the project and the director have been the subject of television and newspaper coverage, as well as comment in Business Week.

b. Professor Malcolm D. Schlusberg spent the summer of 1969 gathering data for a study of Dispute Resolution in NASA Contract Administration and in the preparation of working papers based on that study.

During the first half of the summer the field work was concluded. Interviews were conducted at the Goddard Space Center and the Manned Space Center and a number of contractors were visited in Virginia and in New York. In addition, some time was spent at NASA Headquarters studying documentary materials in the offices of the General Counsel and the Board of Contract Appeals. The data gathering phase of the research was largely concluded by the end of July.

During August, Professor Schlusberg was engaged in collating the extensive interview data, bibliographical study and the preparation of initial working papers on Informal Adjudication in NASA Contract Administration.

2. Research Product

a. The teaching materials were in the process of preparation under the direction of Professor Alexander during this period. About 300 typed pages were completed by the end of the year. Memoranda were prepared on each of the areas researched during the summer but their reduction to "working paper" form was subordinated to their use in the teaching materials then in preparation.

A paper entitled, "Some Domestic Legal Problems in the Earth Resource Satellite Program," George Alexander and James P. McDonald (October 1969), 6224-OP-8 was filed as a Working Paper. "The Legal Frontier in the United States Space Program," George J. Alexander, (June 1969), 6224-WP-6 was published as the first lead article in the summer issue of the Syracuse Law Review.

b. Professor Schlusberg has completed his research preparation and is incorporating his material into a larger study which he expects to finish in the next report period (1970).

IV. ADDITIONAL RESEARCH

A. EXPOSITION AND REAL-TIME DECISION-MAKING

During the summer Professor McLaughlin visited the Manned Spacecraft Center for two working weeks gathering material for Working Papers which will describe real-time decision-making processes in Mission Control. The object of these papers is 1) to prepare a book discussing the implications for government of computer-assisted decision-making, and 2) to provide sufficient technical knowledge to identify principles of clear exposition exemplified by NASA training manuals and handbooks. To meet the second objective, a number of publications issued by Mission Simulations Branch have been studied. A number of papers to record ideas concerning communication principles and the instructional techniques that have come to mind while working on this project were prepared during the report period. Several have been submitted for publication as indicated.

(a) "How to Land on the Moon," (December 1969), 6227-WP-1. This account of the techniques used in the LM's Powered Descent to the Lunar Surface has been reviewed by members of the Flight Control Division at MCC, Houston, Texas. A revised version is in active preparation.

(b) "Correcting Word Frequencies to Take Account of Range," (August 1969), 6227-OP-1. Submitted for publication in Reading Research.

(c) "Temptations of the Flesch," (August 1969), 6227-OP-2. This comparison of a Simple Measure of Gobbleygook (SMOG) with other readability formulas is presently under revision. SMOG has already been validated for British readers; it is now being validated for American readers. Two different versions of the paper will be submitted for publication: one to an American Journal, the other to a British one.

(d) "Clearing the SMOG," (October 1969), 6227-OP-3. Published in the Journal of Reading, Vol. 13, No. 3, p. 210, December 1969.

(e) "Syntactic Rules for Formal Logic," (October 1969), 6227-OP-4. To be incorporated in the final report giving prescriptions for clear exposition.

(f) "Turing's Problem Solved?," (November 1969), 6227-OP-6. To be incorporated, together with the Working Papers produced in this project, in a book discussing real-time computer-assisted decision-making.

B. PARTITIONING NASA INCENTIVE CONTRACTS

This small interdisciplinary research project began in June, 1969. It is under the direction of Professor P. Bruce Berra of the Department of Industrial Engineering with the majority of the effort being performed by Mr. William J. Stevenson, a doctoral candidate in the College of Business Administration.

The principal aim of the research is to study a series of similar incentive contracts and to analyze the cost and timing of contract changes in an effort to develop a mathematical model that will predict uncertainty.

The research began by selecting a series of interrelated satellite contracts that have been administered by personnel at the Goddard Space Flight Center. During this reporting period several trips were made to NASA Headquarters and Goddard to obtain data on the cost and timing of changes. Data have been gathered on twelve (12) contracts which represent approximately eight hundred (800) changes. It is expected that the data-gathering phase of the study will be completed by the end of March 1970. Although initial data analysis began during this reporting period, full efforts cannot be devoted to the development of the predictor model until all the data are collected.

As so often happens, data of this sort may be far richer than originally expected. Based upon preliminary analysis this appears to be true and therefore, it is anticipated that many interesting results will be forthcoming that do not relate directly to the development of the predictor model.

Personnel at NASA Headquarters and at Goddard Space Flight Center gave excellent cooperation during the data-gathering phase.

C. MULTIDISCIPLINARY RESEARCH IN UNIVERSITIES: NASA'S EXPERIENCE WITH THE SUSTAINING UNIVERSITY PROGRAM

This study being conducted by William Davis, Graduate Student in Political Science, under Dr. John Honey, will be both a report to the Office of University Affairs and a Master's Thesis. It is intended to accomplish two purposes: 1) assess the degree to which a selected small sample of universities have engaged in, increased or expanded multidisciplinary research and teaching activity as a direct result of NASA/SUP research support; 2) identify some of the most important factors which appear to be linked to the successful accomplishment of multidisciplinary research in universities. In addition, it is expected that this study will suggest something about the ability of NASA, or other externally supporting agencies, to successfully advance multidisciplinary activity in universities.

Since the last reporting period, visits were made to the University of Tennessee, Knoxville (August 27-29) and Purdue University (September 22-25) to complete interviews with university personnel. At the University of Tennessee, 14 individual interviews were accomplished as well as an interview with the university's entire Space Science Advisory Committee. At Purdue, 14 university administrators and research personnel were interviewed.

Mr. Davis completed the first draft of his thesis during the reporting period and is presently revising it for submission to NASA and to the university during the spring 1970 semester. The report will contain four primary sections: a theoretical statement on interdisciplinary research; an examination of the university as a setting for such research; an exploration of the effects of interprofessional attitudes and an assessment of implications for universities and supporting agencies.

D. PUBLIC ADMINISTRATION, THE UNIVERSITIES, AND NASA

The research directed by Professor F. Marini may be subsumed under two general foci: education and research related to the future of Public Administration, and the context of multidisciplinary and interdisciplinary work in areas related to problem solving. The following work was accomplished during the period: The project design was prepared (drawing extensively upon the literature and upon consultation with NASA and University personnel) and data were collected. Frank Marini, and/or Frank McGee, research assistant, visited the following 24 universities.

University of Virginia; Federal Executive Institute, Charlottesville, Virginia; George Washington University; University of Pittsburgh; Drexel Institute of Technology; Princeton University; University of Michigan; Northwestern University; University of New Hampshire; Harvard University; New York University; American University; M.I.T.; San Diego State College; Fullerton State College; University of California, Berkeley; University of California, Los Angeles; University of Southern California; Arizona State University; University of Washington, Seattle; Syracuse University; University of Buffalo; Cornell University; Ohio State University.

Documents, curricula descriptions, plans, and other data were gathered at all these universities. In addition, in excess of 160 semi-structured tape recorded interviews were conducted. By December, data collection was complete and transcription of interviews was nearly completed.

Thus far, one occasional paper entitled, "The New Public Administration," Frank Marini, (November 1969), 6229-OP-1, has been prepared on this project and two lectures (one before the Maxwell Graduate School of Citizenship and Public Affairs as the first discussion in the Maxwell Forum series, October, 1969; and one before the NASA/OUA Meeting at the University Club, Washington, D. C., on December 11, 1969) have been delivered. Publication resulting from this project thus far is an article in the Maxwell Review (a rewritten version of the Maxwell Forum lecture aforementioned) and a substantial portion of the concluding chapter in Frank Marini (ed.),"A New Public Administration?" (San Francisco: Chandler, 1971, forthcoming). A dissertation entitled, "Dimensions of Group Research in

University Environments," and a report to NASA by Frank Marini entitled, "Developments and Problems in Public Administration and Management of Importance to NASA Support of Research and Teaching," are under preparation.

Professor Lambright and an advanced graduate student, Mrs. Roberta Reiner, initiated a study of "Schools of Public Affairs and Public Administration as Perceived by Other Professional Schools and The University Administration in Their Own Institutions." This study is intended to explore the present state of interactions between public administration and other professional schools in terms of teaching and research and to identify the factors that tend to encourage and impede interaction. Singled out for consideration in this context was the "image" of Schools of Public Affairs and Public Administration within their own universities. Universities contacted during the previous report period were: Harvard, Pittsburgh, Cornell, Pennsylvania, Princeton and Syracuse. During the current report period visits were made to the State University of New York at Albany, New York University, State University of New York at Buffalo, and Columbia University. In the next report period several Western universities will be visited, in particular the University of Southern California and the University of Washington. It is planned during this same Western trip to present a paper on Weather Modification at the Naval Graduate School in Monterey.

During the report period, Professor Lambright presented a paper entitled, "Public Administration and Science and Technology," (September 1969), 6230-WP-1, at the Annual Meeting of the American Political Science Association, New York, September 2-6, 1969.

Plans were made during the report period to enable Professor Lambright to engage in a period of research to begin February 1, 1970, in the Sustaining University Program at NASA Headquarters.

E. THE ACCURACY OF COST ESTIMATION FOR APOLLO DECISION-MAKING IN NASA

A graduate assistant, Ullik Rouk, under the direction of Professor Mohamed Onsi, worked during the summer on developing a bibliographical reference on the subject of cost estimation, in general, across different disciplines. The results were published as an occasional paper, "Bibliographical Reference of Accuracy of Cost Information for Decision Making," Mohamed Onsi, (September 1969), 6230-OP-1.

In the fall, work continued to be done, with the assistance of Stanley Michel, Graduate Assistant, in analyzing and evaluating the content of the articles and publications collected in the following areas: economics, engineering, mathematics and business. Professor Onsi's report is in the final stages and will be published as a working paper.

F. NASA'S INTERNATIONAL OPERATIONS: THE TRACKING SYSTEM

This study is being conducted at NASA's request in conjunction with the National Academy of Public Administration (NAPA) by Mr. Neil Hollander who is presently on the staff of the Academy and is a graduate student in Political Science at Syracuse University.

The study analyzes the actions of the Operations Support Division of the Office of International Affairs and the Office of Tracking and Data Acquisition. It is concerned with the methods used in achieving a highly reliable tracking system operating in many different political, administrative, cultural and geographic environs. Mr. Hollander's study assesses the extent to which the experience derived from the operations of tracking stations is more generally applicable to other international organizations.

Since the last reporting period, Mr. Hollander has devoted his major efforts to writing a case study on NASA's tracking system operations in Australia in June and July 1969. The first draft is completed and has been reviewed by appropriate NASA personnel. A review of the paper by Australian government officials is presently underway. In addition to the Australian case study, Mr. Hollander has completed chapters which will constitute an introduction to his larger "comparative" study and a general overview of NASA's tracking system operations abroad.

Travel plans have been modified during the past six months, and at the present time Mr. Hollander is awaiting clearance to make a field trip to NASA tracking stations in Chile. Visits to Mexico and Madagascar have been dropped. Plans for a projected field trip to Spain are still being pursued.

V. SYRACUSE/NASA PROGRAM REVIEW

October 23, 1969

Lawrinson Hall Penthouse

A G E N D A

9 - 9:30 am	Introduction Dr. John C. Honey - Prof. M. E. Barzelay Mr. Richard E. Stephens, NASA Office of University Affairs
9:30 - 10 am	Business Relations Prof. Peter G. Franck Prof. E. Bruce Fredrikson
10 - 10:30 am	Case Studies Prof. Edwin A. Bock
10:30 - 10:40 am	Program Relationship with NASA Trainees Prof. Edwin A. Bock
10:40 - 11 am	Coffee
11 - 11:20 am	Additional Projects Prof. E. Bruce Berra Mr. William E. Davis
11:20 am - 12:10 pm	Project Management Introduction: Prof. William Pooler Field Trip Reports and Publications: Prof. Bernard Wood Minnowbrook Conference: Prof. E. E. Drucker Comments: Prof. H. Anna, University of Cincinnati Continuities in Ongoing Research: Prof. Wm. Pooler
12:10 - 12:40 pm	Regulations in Space Prof. George J. Alexander Prof. Malcolm Schlusberg
1:15 - 2:30 pm	Lunch
3 - 4 pm	Meeting with Chancellor Corbally Dr. John C. Honey, Professors Barzelay and Bock, and NASA representatives
4:30 - 5:30 pm	Reception NASA House, 133 Stadium Place

SYRACUSE/NASA PROGRAM REVIEW

October 24, 1969

NASA House, 133 Stadium Place

A G E N D A

9:15 - 10 am	Social and Physical Processes in Systems Science Prof. Nathan Schwartz
10:15 - 11 am (15 minutes each)	Exposition and Real Time Decision Making Prof. G. Harry McLaughlin
"	Public Administration Prof. Frank N. Marini
"	Studies by Center for Instructional Communications Prof. Kenneth N. Fishell
11:15 - 12 Noon	Generic Study of Project Management Prof. Richard J. Hopeman Prof. David L. Wilemon

Washington Representatives

1. Mr. Charles Bingman
   Office of Organization and Management
   NASA

2. Mr. Joseph Carlson
   Office of Technology Utilization

3. Dr. Roy W. Crawley
   National Academy of Public Administration

4. Mr. Frank Hansing
   Administration and Management Research Branch
   Office of University Affairs
   NASA

5. Mr. Stanley Smolensky
   Policy Office

6. Mr. Richard Stephens
   Administration and Management Research Branch
   Office of University Affairs
   NASA

7. Dr. Stephen B. Sweeney (Consultant)
   Administration and Management Research Branch
   Office of University Affairs
   NASA