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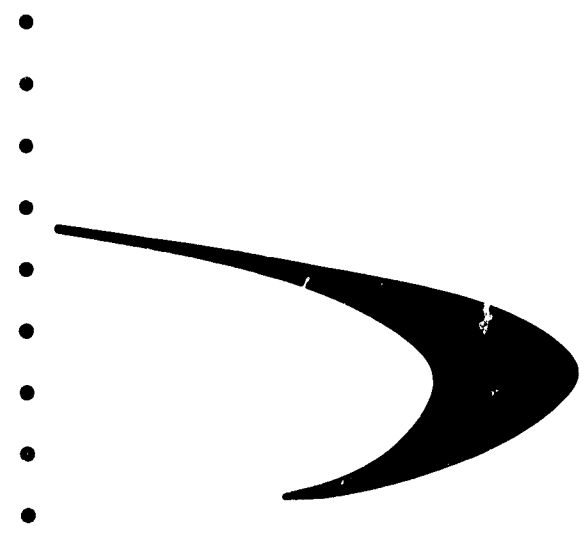

DREXEL INSTITUTE OF TECHNOLOGY

Center for the Study of Environment

TECHNOLOGY AND MANAGEMENT OF LARGE-SCALE PROGRAMS

NASA Grant NGL 39-004-020

First Semiannual Progress Report
June 30, 1969

W. W. Hagerty
E. S. Golden
A. J. Pennington
M. Silver

Approved: W. W. Hagerty

W. W. Hagerty, President
Principal Investigator

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INTRODUCTION

W. W. Hagerty
Principal Investigator

The history of this Grant begins at least as far back as June of 1967. At that time, Mr. James M. Webb, then Administrator of NASA, was Commencement speaker at Drexel. He expressed to me and several members of the Drexel Board of Trustees his strong conviction that the technology and management methods developed during the space program could be used to help solve many other challenges facing the nation, in particular, the problems of the urban environment. He asked us why universities were not doing more to bridge the gap between the practice of advanced technology and management, and the education and research programs needed to solve real problems. The present study is our response to that question, and we believe that the approach developed during the first six months will enable us to make a contribution during the three-year period of the Grant. Briefly, we have developed a balanced program of education and research which includes the following:

(1) technology

(2) management science

(3) behavioral science

For convenience, these have been identified as Tasks 1, 2, and 3 of the research program; they are discussed individually in the body of this report. Likewise, the educational program, described in Appendix A, reflects a balance among these fundamental elements of an effective approach to large-scale socially oriented programs.

In order to provide additional background on our approach, the text of a paper entitled "The Large-Scale Technology Program as an Educational and Research Laboratory" is presented as Appendix B. This paper was presented at the 1969 Annual Meeting of the American Society of Public Administration in a panel session chaired by Mr. Harry Finger of the Department of Housing and Urban Development which also included Dr. Thomas Paine and General Samuel Phillips of NASA, and Mr. Elwood Holstein of the Port of New York Authority.

DREXEL INSTITUTE OF TECHNOLOGY

Center for the Study of Environment

TECHNOLOGY AND MANAGEMENT OF LARGE-SCALE PROGRAMS

NASA GRANT NGL 39-004-020

Task 1: Technology
First Semiannual Progress Report

June 30, 1969

A. J. Pennington
Associate Investigator

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The principal activities under Task 1 (Technology) during the first six months of the Grant were as follows:

(1) Development of Educational Plan (with E. S. Golden, P. W. Purdom, M. Silver).

(2) Development of Research Plan.

(3) Experience with the urban simulation game, CITY I, at Envirometrics, Washington, D.C.

(4) Conceptual design of BUILD, A Community Development Simulation Game (with J. A. Orlando).

(5) Literature search on building materials and systems (utilizing NASA Regional Documentation Center, Pittsburgh).

(6) Development of the Community Development Workshop Concept for advocacy planning (with R. Brill and E. Castro, Node-Four Associates, Brooklyn, New York).

(7) Development of a new course, "Technology and Society," to be offered in Fall, 1969.

(8) Presentation of papers and lectures dealing with various technical and social aspects of large-scale programs.

These will be discussed in the above order.

***

(1) Educational Plan

The educational plan for the five Ph.D. candidates under the Grant is detailed in the "Information Note," included here as Appendix A. This document was developed in collaboration with Professors P. W. Purdom, Director of the Center for the Study of Environment, M. Silver, Associate Investigator, Task 2 (Management Science), and E. S. Golden, Associate Investigator, Task 3 (Behavioral Science). It is intended that this note be the basic guideline to the educational program, subject to additions or modifications as the need arises in the future.

Mr. J. A. Orlando has been selected as a candidate for the Ph.D. degree under the program, and as a Research Associate for Task 1. His work will be in the general area of urban simulation and gaming. He brings an excellent background to this effort, having spent the past five years on various aerospace computer simulation projects at the General Electric Company. His recent work has been on studies for post-Apollo mission-planning simulation using computer-driven graphic terminals.

Mr. D. A. Yost, a Senior in Electrical Engineering, has also participated in our preliminary work on simulation through an undergraduate research project during the Winter and Spring Quarters. It is our intent to involve other students on an informal basis in this way throughout the period of the Grant.

***

(2) Research Plan

The purpose of Task 1 is to study the direct and indirect application of aerospace technology to urban and other social problems. Since the possibilities are so diverse a "case-study" approach is being utilized.

Two areas have been identified for initial investigation:

(1) Mathematical modeling, computer simulation, and gaming.

(2) Building materials and methods, including complete industrialized building systems.

Area (1) has proven its usefulness in the space program in many ways. For us it has the great advantage of forcing the acquisition of a great deal of knowledge about urban affairs, and offers long-term possibilities for increasing our understanding of urban development problems, increasing our ability to train urban technologists, and improving our ability to arrive at sound decisions on community development. A community development simulation game to be called "BUILD" is now being constructed.

There is an obvious strong connection between work on simulation and gaming, and the areas of Management Science (Task 2) and Behavioral Science (Task 3) described below. It is our intent to pursue this research problem with a fully interdisciplinary approach.

Item (2) above, building systems, is being studied via literature search at the present time. Although it seems unlikely at first, a considerable amount of NASA technology is relevant, especially in the area of materials. A collection of reports and papers has been acquired for review by members of our Department of Civil Engineering and others. The NASA computerized documentation system is also being utilized. A search strategy has been constructed and entered at the NASA Knowledge Availability Systems Center at the University of Pittsburgh. The search is being conducted sequentially by years so as to permit modification of the strategy. It is hoped that some useful results on the general problem of information retrieval for urban technology applications can be obtained, as well as the specific information on building materials and methods.

Several other areas of NASA technology have been looked at in a preliminary fashion for possible urban system applications. The Electronics

Research Center, Cambridge, Mass. has done a considerable amount of work on graphic computer terminals, and also on voice recognition by computers. Both of these technologies have potential applications to urban simulation programs. These will be followed up during the next six month period and discussed in the First Annual Report.

Another area of interest is that of remote sensing for urban land use surveys. It has been noted by a number of people that spectrally selective visible or IR images from aircraft or satellites might prove useful for surveys of very large urban areas. Preliminary exploration of these ideas with interested persons at the Manned Spacecraft Center, Houston, Texas, and in two urban planning firms has been carried out. It is very unlikely that this will become an active area of the investigation here at Drexel, but perhaps we can serve as a "catalyst" to help others develop this application.

Finally, the area of "configuration management" appears to have considerable relevance to urban and other socially oriented problems. In NASA this concept involves to the largely technological problem of coordinating the design of the spacecraft so that all requirements (including human factors for manned missions) are properly considered. In the urban setting it is necessary to achieve not only technical feasibility, but also economic and social feasibility on a large scale. We propose to continue studying the NASA configuration management practices through discussions at NASA Headquarters, Kennedy Space Center, and other field centers in order to learn what aspects are, in fact, transferrable to areas such as urban planning.

***

(3) Experience with Urban Simulation

On January 16 and 17 the author participated in a session of "CITY I," an urban system simulation game developed by the Washington Center for

Metropolitan Studies (the simulation group is now reorganized separately as Envirometrics, Inc.). In order to make this experience available to others interested in simulation and urban affairs a special session was organized for April 10-11. The thirty participants were drawn from Drexel, NASA, the City of Philadelphia, Auerbach Corp., Philadelphia, Node-Four Associates, Brooklyn, N.Y., Doxiadis-SDC, Washington, and others. It was an extremely successful venture from the point of view of introducing a large number of people to the complexities of urban decision making, and to simulation technology. We are now exploring means by which a simulation such as CITY I can be incorporated as a regular part of our educational program. A brief description of the game is given on pages 7-8 of the paper, "The Community Development Workshop," included in this Report.

***

(4) Conceptual Design of BUILD, A Community Development Simulation Game

As indicated above, simulation is interesting both from the point of view of aerospace technology transfer, and because it focuses attention on the true nature of urban development problems. In particular, the technical complexity, the economic constraints, political power and territoriality, and other aspects of human nature become very evident during a simulation game. Some very interesting work has been done in this field, including CITY I, discussed above, METRO at the Michigan State University and the University of Michigan, CLUG and REGION I at Cornell, MICROPOLIS at Pittsburgh, and several others.

We are embarking on a program to study simulation by gathering information on current work elsewhere and by developing a new game to meet a need which appears to have been neglected by others. The game is tentatively called BUILD (not an acronym), and is

to be oriented toward community development within an existing urban complex. Hence, the emphasis will be on the economic and social transactions which take place at the interface between the developing community and the surrounding area. A minimum objective is to provide an educational vehicle for conveying the complexity of development decision making, and an "arena" in which conflicting positions can be examined and resolved. A more ambitious goal would be to actually produce policy decisions in the real world; the present state of the art of simulation does not permit this, and it may not in the future. In order to allow for this possibility, however, we intend to make BUILD data-base specific for an actual community with the option of changing the base to a new community of the same general type.

A prospectus for the game prepared by J. A. Orlando and the author follows.

BUILD

"BUILD" will be both a mathematical model and a role-playing computer game designed to assist in advocacy planning of new communities within the city. The model will be designed to represent the typical situation of extreme deterioration of housing, services, and economic activity in an urban area designated for rapid physical transformation, but with a major emphasis on preservation of community values. It is intended that the game itself will provide a communication medium among community members and outside professional planners.

The structure will be simple and yet will provide the minimal framework which still typifies the political/social/economic interactive nature of the "ghetto". The model roles are broadly divided into three classes - business, government, and people (residents). The residents are further divided into the roles of working force, agitators, and parents. Business roles include both national and local business interests, and the builders,

developers, or planners. Government roles include the local Mayor's office, Police Force, Board of Education, Health & Welfare, Zoning & City Planning, and the Social Planners' Office. This list identifies twelve distinct roles which broadly covers the community structure. It is easy to identify many more roles, however this list represents a compromise between accuracy and size.

Preliminary Data Base

Parameters

1. General income tax rate
2. General sales tax rate
3. General property tax rate
4. Size of police force
5. Average salary per man on police force
6. Fixed costs in police budget
7. Total number of teachers
8. Average teacher salary
9. Cost per child preschool education
10. Cost per person adult education
11. Cost per child remedial education
12. Cost per child capacity - overhead
13. H & W base costs
14. Unemployment rate
15. Total population
16. Unemployment benefit payment
17. Number of dependent children
18. Payment schedule for dependent children
19. Total number of children
20. Maintenance cost for park
21. Hospital costs/bed
22. Cost of average road construction
23. Cost of Highway construction

Unit Types

1. Residences
2. School
3. Hospital
4. Municipal Building
5. Police station
6. Fire house
7. Park
8. Business (resident - goods & services)
9. Industry
10. Vacant

Unit Phases

1. Planning
2. Cleared
3. Foundation

Unit Phases (continued)

4. Exterior Completed
5. Interior Completed
6. Operational

Unit Subtypes

Housing

1. Vacant
2. Slum inhabited
3. Low income
4. Middle income
5. High income

Industry

1. Non-manufacturing
2. Light manufacturing
3. Heavy manufacturing

Business

1. Locally owned small shops-goods
2. Locally owned small shops-services
3. Department stores (include chains)

Business Services/Goods

1. Food
2. Clothing
3. Drug - Rx
4. Restaurant
5. Bar
6. Movie House
7. Hardware
8. Theater
9. Doctor
10. Cleaners
11. Illegal

Unit Summaries

Schools

1. Total number of schools
2. Level of school
3. School capacity
4. School location
5. Phase of school (includes deterioration)
6. Number of teachers
7. Number of students
8. Adult education program size
9. Preschool program size
10. Remedial educational program size

Residence

1. Total number of housing units
2. Location of unit
3. Residence subtype
4. Deterioration level-phase
5. Capacity of unit
6. Number of residents
7. Number of employable residents
8. Number of employed residents
9. Number of school age residents
10. Number of children in school
11. Unit ownership
12. Value of each residence

Park/Police/Fire/Municipal/Hospital/Vacant

1. Number of units
2. Location of unit
3. Phase of unit
4. Size - capacity

Business

1. Number of business units
2. Location of business
3. Business service/goods
4. Business capacity - number people serviced
5. Phase of construction/deterioration
6. Value of each business unit
7. Total sales
8. Net income
9. Special taxes flag

Industry

1. Number of industrial cites
2. Location of cite
3. Type of cite
4. Number of employees-total
5. Number of local residents employed
6. Average salary per employee type (4 numbers)
7. Value of property
8. Total sales
9. Net income
10. Phase of construction
11. Special taxes flag

Social Indices

1. Crime rate
2. Per-capita income
3. Drop out rate-school
4. Level of civil disobedience
5. Unemployment rate
6. Home ownership rate

Social Indices (continued)

7. Birth rate
8. Population density
9. Education level

Functions

1. Building costs vs. phase
2. Maintenance cost vs. deterioration
3. Riot cost vs. intensity vs. duration

***

A paper, "BUILD -- A Community Development Simulation Game" is being prepared by J. A. Orlando and myself for submission to the 36th National meeting of the Operations Research Society of America, Miami Beach, Florida, November 10-12, 1969. The Abstract of the proposed paper as follows.

"BUILD" -- A Community Development Simulation Game

J. A. Orlando
A. J. Pennington

Drexel Institute of Technology
Philadelphia, Penna. 19104

Abstract

"BUILD" is a role-playing computer game designed to assist in advocacy planning of new communities within the city. The model is designed to represent the typical situation of extreme deterioration of housing, services, and economic activity in an urban area designated for rapid physical transformation, but with a major emphasis on preservation of community values. BUILD is intended to provide a mechanism for members of the community to actively participate in the decision making process, and as an educational tool.

The structure is relatively simple with roles divided into the three broad classes of business, government, and people (residents). If possible, a demonstration via time-sharing terminal will be arranged at the session.

Manuscript submitted to the 36th National Meeting, Operations Research Society of America, Nov. 10-12, 1969, Miami Beach, Florida.

(5) Literature Search on Building Materials and Systems (utilizing NASA RDC, Pittsburgh).

This project was undertaken for two reasons: (1) to extract specific information of possible value; (2) to determine the general applicability of the NASA Regional Documentation Center facilities for urban problem solving. A search strategy was constructed in January, 1969 through consultation with personnel at the Knowledge Availability Systems Center at the University of Pittsburgh. It was decided that the 10 year retrospective search would be conducted sequentially in order to permit modification of the strategy based on intermediate results. This procedure has given us valuable knowledge about the construction of serach strategies. Suggestions on retrieval procedures for urban related information will be reported at the completion of this sub-project.

The initial search strategy, consisting of a collection of NASA key words linked by logical AND and OR operators follows.

BUILDING MATERIALS AND SYSTEMS

Search Strategy

NASA Knowledge Availability Systems Center

University of Pittsburgh

SANDWICH STRUCTURES + SKIN (STRUCTURAL MEMBER) + THERMOPLASTIC RESINS + THERMOSETTING RESINS + PLATES (STRUCTURAL MEMBERS) + STRESS CONCENTRATION + FILAMENT WINDING + HONEYCOMB STRUCTURES + REINFORCED PLASTICS + REINFORCED PLATES + DOMES (STRUCTURAL FORMS) + SHELLS (STRUCTURAL FORMS) + POLYURETHANE FOAM + THERMAL INSULATION + CONCRETES + (BUILDINGS*(COLUMNS + SLABS + BEAMS + ARCHES)) + ARCHITECTURE + HABITABILITY + CITIES

The abstracts produced by this search are now being studied by members of our Civil and Metallurgical Engineering Departments. The results will be reported in our First Annual Progress Report.

In addition to utilization of the NASA information facilities, a parallel informal information gathering effort is being conducted in the area of building materials and systems. A substantial collection of reports and papers has been assembled. In addition, the author attended an International Exposition on Industrialized Housing sponsored by the Construction Specification Institute. This information is being developed partially in order to lay a base for future active research at Drexel if personnel and financial support become available. Meanwhile, some interesting examples of technology transfer may be uncovered simply through information gathering.

***

(6) The Community Development Workshop

This concept was developed in collaboration with colleagues at Node Four Associates, Inc., an urban planning, design, and construction firm in Brooklyn, New York. It refers to a collection of ideas and techniques for increasing community participation in the planning process. These include computer simulation and gaming, and also various psychological techniques. A paper, "The Community Development Workshop," was presented at the Environmental Design Research Association Meeting, June 9 - 11, 1969, Chapel Hill, North Carolina. Co-authors are E. Castro, President, Node-4 Associates, R. Brill, Vice President, and the author. The manuscript follows.

THE COMMUNITY DEVELOPMENT WORKSHOP

by
R. Brill
E. Castro
Node Four Associates, Inc., Brooklyn, N. Y.
and
A. J. Pennington
Drexel Institute of Technology, Philadelphia, Pennsylvania

Introduction

There are encouraging trends in our society toward expanded individual participation in decision making processes. The decentralization of business operations, the complexity and diversity of governmental structures, and more recently the demands for student participation in shaping educational programs are all symptoms. Perhaps the most significant of all is the assumption of responsibility by residents of urban communities for decisions affecting their own environment. These developments represent a revitalization of democratic principles and hence are greatly to be welcomed. Two great dangers exist, however. One is that the complexity and specialization of tasks in a technological society will prevent a true participatory community from emerging. Democratic forms flourished primarily in agrarian societies. Many people have taken the pessimistic position that democracy and freedom are inconsistent with an industrial civilization, and have proposed either accepting such a situation and learning to live with it, establishing small communities employing primitive technology (Skinner's Walden Two, for example), or violantly destroying the present economic base in hopes that somehow a more humane political structure will emerge from the ashes. We reject all of these.

Another obstacle to the development of a more participatory society is the great difficulty of communication among various sub-groups. This is particularly true with regard to emotional polarizations concerning race, class, and lifestyle, and also over the traditional issues of economic and political power. Again, the pessimistic position asserts that communication is fundamentally impossible on these questions, and hence that some form of passive or active despair is necessary.

Manuscript prepared for the Annual Meeting of the Environmental Design Research Association, June 8-11, 1969, Chapel Hill, N.C.

We also reject this position, but fully recognize that the pessimists may be right. There are certain problems for which no solution exists. The disadvantage of pessimism, however, is that it has a tendency to be self-fulfilling, i.e. the predicted and feared catastrophic outcome tends to come true through the prediction and fear itself. A realistic optimism, on the other hand, leaves two alternative futures open: failure, in which case we are no worse off than before, and success, in which case we are much better off. Hence, we have chosen to take the optimistic position. This paper describes some experiments designed to help overcome the two obstacles to realization of a humane, technologically based society which were stated above:

(1) The obstacle of technical complexity

(2) Emotionally based obstacles to communication.

The Community Development Workshop

The Community Development Workshop (CDW), now in its formative stages, is the name we have given to a collection of techniques designed to implement participation in the planning process. It is an eclectic approach, making use of current work in the psychology of groups, mathematical modeling and systems analysis, simulation gaming and other techniques. Hence, the CDW is more an attitude and orientation than a specific technical method. The following outline for one session indicates some of the psychological techniques employed, i.e. Confrontation, Synectics, and Encounter Micro-Labs.

COMMUNITY DEVELOPMENT WORKSHOP

Outline for February 22-23, 1969

Tarrytown House
Tarrytown, N. Y.

1. Format: Weekend marathon, 30 hours, noon Saturday to 6 P. M. Sunday.
2. Participants: up to 24 people drawn from Node Four Associates, Drexel Institute of Technology, and the future Marcus Garvey Gardens community.

3. Purposes:

(1) For the above to establish a working relationship.

(2) To develop new mechanisms for goal-directed group effort.

(3) To develop a proposal for financial support of the same.

(4) To develop specific task assignments in planning, technology, management, etc. for the community.

(5) To have fun.

4. Schedule (approximate):

1 1/2 hours. Lunch and socializing.

2 1/2 hours. Confrontation.

1 hour. Coffee break and party.

2 1/2 hours. Encounter Micro-Labs.

1 1/2 hours. Dinner and socializing.

1 1/2 hours. Synectics Groups.

1/2 hour. Music break.

1 hour. Art break.

1/2 hour. Snack and socializing.

2 1/2 hours. Confrontation.

3 hours. Sleep break.

1 hour. Breakfast and socializing.

1 1/2 hours. Synectics groups.

1/2 hour. Music break.

1 1/2 hour. Proposal and assignment writing.

2 1/2 hours. Encounter micro-labs.

1 1/2 hours. Lunch and socializing.

2 1/2 hours. Confrontation.

2 hours. Review and evaluation, written and oral. Party.

CONFRONTATION

Rule 1: No physical violence or threat of physical violence.

***

Background: Rule 1 above is superficially very simple, yet when explicitly stated becomes a powerful psychological mechanism for inducing "confrontation," i.e. a high degree of honest communication. The emotions involved may be hostile or cooperative. By explicitly recognizing the latent potential for violence in even the most "civilized" setting, and then overtly and emphatically ruling out such behavior small group interaction takes on many new dimensions. For this reason it is desirable that such a group contain several members with prior experience in Confrontation.

***

Note: It has been found that 12-15 participants is about optimum, and that 2 1/2 hours is a reasonable length of time for a session.

SYNECTICS

The Synectic process:

(1) Making the strange familiar (fact gathering and analysis).

(2) Making the familiar strange (creation.

Operational mechanisms:

(1) Direct analogy.

(2) Personal analogy.

(3) Symbolic analogy.

(4) Fantasy analogy.

***

Background: Synectics is a creative problem solving technique developed by William J. J. Gordon, President of Synectics, Inc. of Cambridge, Mass. The word "Synectics" was coined form "synthesis" and "eclectic" which refers to the creative technique involved, i.e. the synthesis of eclectic ideas. The concept is that creation implies the combination of diverse (and apparently improbable) ideas. The "operational mechanisms" above are designed to stimulate creative activity on the part of task-oriented small groups.

***

Note: A Synectics Group could range in size from three to about ten or twelve, depending upon the nature of the problem. Two and a half hours is a reasonable time for one session, but this can be quite flexible.

ENCOUNTER MICRO-LABS

Representative Experiments:

Physical unlocking, milling, blind walk, falling, lifting, stretching, pushing, breathing, association, fantasy, doubling, role playing, dyads, introspection, essence game, wordless meeting, inclusion/exclusion, verbal encounter, physical encounter.

***

Background: Encounter micro-lab exercises emerged out of the work of a number of groups including Esalen Institute, Big Sur, California; Orion, Tarrytown, New York; National Training Laboratories, Washington, D.C. and Bethel, Maine and others. They have been applied in a number of contexts and for a variety of purposes ranging from pyschotherapeutic to management development. The central theme is that of exploring alternate mechanisms for thinking, feeling, and relating.

***

Note: There is no specific group size of time period indicated. The emphasis will be on trying a variety of exercises under carefully controlled conditions.

Another major ingredient of the Community Development Workshop concept is technical gaming - the use of computer-based simulation games to enable planners, architects, engineers, government officials, and members of the community to work together. Although a game situation is necessarily "unrealistic" to some degree it does provide a very useful vehicle for communication on a variety of questions ranging from the concept and philosophy of technical projects to detailed resource tradeoffs. Preliminary experience of this type has been gained with the game "City I" developed by Peter House, Phillip Patterson and their associates at the Washington Center for Metropolitan Studies (now established as Envirometrics, Inc., Washington, DC). A description of City I follows.

CITY I

City I is played by nine teams with three to five members per team who act as entrepreneurs in a partially urbanized county divided into four political jurisdictions. The playing board is divided into 625 square miles most of which are unowned by the teams at the beginning of play. These land parcels may be purchased and developed by the teams during the course of the game. There are nine types of private land use which the teams can develop on a parcel of land: heavy industry, light industry, business goods, business services, personal goods, personal services, high-income residences, middle-income residences, and low-income residences.

Each of the nine teams is elected or appointed by elected officials to assume the duties of one of nine governmental roles, which are played simultaneously with the entrepreneurial functions common to all teams. The elected officials (the County Chairman and the Central City Councilman) must satisfy the electorate (the other teams) in order to stay in office each round. The Chairman team appoints other teams to play the roles of the School, Public, Works and Safety, Highway, Planning and Zoning, and

Finance departments. The two residual teams play the Mass Media and Citizen's Organizations. The governmental departments build schools, provide utilities, build and upgrade roads and terminals, maintain roads, buy parkland, zone land, and estimate revenues.

Teams set their own objectives for both the public and private actions they undertake. Team decisions are recorded each round (approximately two hours in length) by a computer, which acts as an accountant and indicates the effects of the teams' actions on one another and on the county itself. The interaction of public and private decisions and their influence over time is illustrated by regularly provided computer print-outs. Even though conflicts may develop between urban and suburban interests, among businesses, and among governmental departments, teams often find that cooperation is equally as important as competition in fulfilling their objectives.

Participants of a play of City I receive a comprehensive view of central city and suburban growth and development. Teams are free to try alternative solutions to problems created within the model by their own actions in previous rounds. The governmental, economic, and social systems of the model are defined broadly enough so that they may be altered by a team majority vote. Through their own actions players become aware of the interrelation of public and private decisions, the interdisciplinary scope of urban problems, and the effect over time of public and private decisions.

***

Another game, called "BUILD", specifically oriented toward local community development within the urban context is now under development at Drexel Institute of Technology. The prospectus for BUILD follows.

BUILD

BUILD will be both a mathematical model and a role-playing computer game designed to assist in advocacy planning of new communities within the city. The model will be designed to represent the typical situation of extreme deterioration of housing, services, and economic activity in an urban area designated for rapid physical transformation, but with a major emphasis on preservation of community values. It is intended that the game itself will provide a communication medium among community members and outside professional planners.

The structure will be simple and yet will provide the minimal framework which still typifies the political/social/economic interactive nature of the "ghetto". The model roles are broadly divided into three classes - business, government, and people (residents). The residents are further divided into the roles or working force, agitators, and parents, Business roles include both national and local business interests, and the builders, developers, or planners. Government roles include the local Mayor's office, Police Force, Board of Education, Health & Welfare, Zoning & City Planning, and the Social Planners' Office. This list identifies twelve distinct roles which broadly covers the community structure. It is easy to identify many more roles, however this list represents a compromise between accuracy and size.

The model will include the detailed functions and interactions, both dollar flow and communication, of each of these roles.

Conclusion

As indicated above the Community Development Workshop is a set of techniques designed to enhance community participation in the planning process. It is an experimental and formative state. As time goes on

we visualize the establishment of additional activities of the general type described above. These would be made available to the community on an essentially continuous basis. Preliminary experience with these methods has strengthened our original optimism. We hope that by this time next year it will be possible to report definitive positive results. Meanwhile, we would welcome comments and suggestions on any aspect of these proposals.

***

(7) Technology and Society (Environmental Engineering and Science F 225, scheduled for initial offering, Fall Quarter, 1969).

This course was developed to help meet the need stated in our proposal to NASA to explore the philosophic base of large-scale technology system activity. It was approved by the Institute Graduate Curriculum Committee on May 9, 1969. Unless our graduates acquire the intellectual resources to deal with fundamental issues and values of the technological society then their specific training in disciplines such as technology, management science, and behavioral science will have little value in the long run. The course "Technology and Society" was developed both as a means for contributing to this aspect of graduate education, and also as a vehicle for generating new and hopefully useful insights about the technological society. A relatively large number of faculty and students outside the NASA Grant will be involved in this venture. A portion of the course proposal and a notice indicating its content follow.

A course sequence, "Environmental Systems Design I and II," proposed by Professor E. Grossmann of the Department of Chemical Engineering was also approved. It will be offered in the Winter and Spring of 1970. This course will use the project approach to study a comprehensive technical and social system problem relating to the urban environment. It is anticipated that I will assist in the teaching of this sequence, and that it will serve as the vehicle for developing a number of ideas relevant to this Grant.

Drexel Institute of Technology
Philadelphia, Pennsylvania 19104

TECHNOLOGY AND SOCIETY

Proposal for a New Graduate Course

by

A. J. Pennington
Department of Electrical Engineering
and
NASA Grant -- Program in Environmental Engineering and Science

Rationale:

There is an obvious and ever increasing need to deal with the problem of making technology, which is a fact of life, truly serve the needs of man, i.e., fit the purpose of human life. Ultimately, this matching of resources and needs comes about through the thousands of decisions and actions made by individuals in their professional lives. An educational insitution, particularly a technologically oriented one such as Drexel, has at least two important responsibilities in this regard:

(1) To provide its graduates with the intellectual resources which will help them make wise, humane decisions in their professional lives. This includes ways of thinking and learning as well as factual information about the problems involved.

(2) To develop new knowledge and insight which will be useful to society in meeting the challenge of creating a humane technological society.

This course is proposed as one portion of Drexel's response to the above. It is designed to dovetail with related activities now existing or planned in the Institute, among them, the NASA Grant, "Management of Large-Scale Technical Programs," Professor Grossman's proposed case-study course in system design, etc. It might be said that the purpose of "Technology and Society" is to help establish a valid philosophic base for such related activity at Drexel.

Nature of the Course:

The course will be open to all graduate students in the Institute, and to Seniors by permission of the instructor in charge. It will be an intellectually demanding course, involving extensive reading and reflection, and the demonstration of "unitive" thinking. In addition students will be required to draw upon their own specialties, and begin to relate them to a larger context. For example, an electrical engineer might be asked to pursue in an essay the social and philosophical consequence of the greatly increased availability of computing capability (through a computer utility, for example). A student of human behavior and development might study the impact of information technology on the attitudes of high school students, a civil engineer might look at the effect of large domed structures on city life-styles, etc.

New Course, Fall, 1969

TECHNOLOGY AND SOCIETY

F225, Environmental Engineering & Science

Description:

Examination of technology as a cause and symptom of the economic and social order. Psychological and philosophic bases for technological activity. Possibilities for predicting and shaping the role of technology in the service of man. Lectures and small group case studies.

Staff:

A. J. Pennington, Associate Professor of Electrical Engineering

Others as guest lecturers and seminar leaders.

Time:

Lecture: Monday and Wednesday at 11

Seminars: to be arranged

Eligibility:

Graduate standing in any program.

Seniors, by permission of instructor.

Representative Readings:

Ellul, The Technological Society

Fromm, The Revolution of Hope

Ferkiss, Technological Man

Drucker, The Age of Discontinuity

Kahn, The Year 2000

Brzezinski, "The Technetronic Society"

A. J. Pennington
311 Stratton Hall
Ext. 661

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(8) Presentation of papers and lectures

During the initial six month period of the Grant a number of presentations were given which relate to various technical and social aspects of large-scale programs. These activities served to help develop and sharpen thinking on the direction of the education and research program under the Grant, and also to elicit valuable inputs from a variety of sources. A collection of texts and outlines follows. In some cases these are rather cryptic since they were intended to supplement the oral presentation, not replace it. It is hoped that their inclusion here will be useful even so.

IF WE CAN GO TO THE MOON WHY CAN'T WE LIVE IN THE CITIES?

(Former Title: Management of Large-Scale Technical Programs)

A. J. Pennington
Drexel Institute of Technology
Philadelphia, Pennsylvania 19104

(Talk to the Electrical Engineering Seminar, Drexel Institute of Technology, February 5, 1969)

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"Some men look at things as
they are and ask, 'Why?' I dream
of things that never were and ask,
'Why not?'"

G. B. Shaw as frequently quoted
by R. F. Kennedy

1. Possible meanings of the title question.

   Allocation of national resources (30 billion dollars).

   Technology (spin-offs, R & D capability).

   Management Science (systems approach, OR, etc.).

   Behavioral Science (adapting to change).

2. Authority for the NASA Grant, "Management of Large-Scale Technical Programs" to Drexel Institute of Technology.

   "Sec. 102. (a) The Congress hereby declares that it is the policy of the United States that activities in space should be devoted to the peaceful purposes for the benefit of all mankind.

   "Sec. 203. (a) The Administration, in order to carry out the purpose of the Act, shall --

   ...(3) provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof."

National Aeronautics and Space Act of 195 (P.L. 85-568)

3. Elements of the program

Administration: W. W. Hagerty, Principal Investigator

Education: Five doctoral candidates

Associated M.S. and B.S. students.

Research: A. J. Pennington: Technology

M. Silver: Management Science

E. Golden: Behavioral Science

Consultants in urban affairs: as needed.

4. Representative tasks -- technology.

Literature searches -- NASA Information System

Simulation and Gaming

"The City Laboratory"

5. The future: some suggestions.

A. J. Pennington
February 4, 1969

HUMAN BEHAVIOR VS. HUMANE BEHAVIOR

A. J. Pennington
Department of Electrical Engineering
Drexel Institute of Technology
Philadelphia, Pennsylvania 19104

(Informal lecture, Course H732, Human Behavior and Development II, Drexel Institute of Technology, February 6, 1969)

"Understanding of man in his relationship to other men is the concern of the Department of Human Behavior and Development."

Drexel Institute of Technology Bulletin
Undergraduate Curricula 1968-69

I. A Three Dimensional Model of Behavior (Function)

1. The dimension of method: objective vs. subjective.
2. The dimension of orientation: people vs. things.
3. The dimension of attitude: optimism vs. pessimism.

II. Human Behavior vs. Humane Behavior: The Issue of Freedom

1. Internal: heredity, environment, and the human condition.
2. External: society (the system) vs. community.

III. The Three Dimensional Model Revisited

1. Comparisons with the Freudian and Jungian models.
2. A fourth dimension: tough-minded vs. tender-minded (Wm. James).
3. The reason for models.

IV. What is to be done?

A. J. Pennington
February 2, 1969

SOCIETAL ENGINEERING: A NEW DIRECTION FOR TECHNICAL EDUCATION

A. J. Pennington
Department of Electrical Engineering
Drexel Institute of Technology
Philadelphia, Penna. 19104

(Outline for talk at IEEE Princeton Section, Panel Discussion in Trends in Graduate and Continuing Education for Engineers, February 11, 1969, Princeton, New Jersey)

"Engineering. 1. The art and science by which the properties of matter and the sources of power in nature are made useful to man in structures, machines, and manufactured products."

Webster's Collegiate Dictionary
Fifth Edition

"To plan, design, and manage within a given societal system, essential considerations . . . are technological, economic, human, social, political, and cultural sufficiency."

F. D. Lewis, Jr. I. Pinkau,
"Societal Engineering" in
Engineering Education, October,
1968.

I. The new vertical integration of engineering.
   - A. Intellectual: mathematics and science.
   - B. Physical: products and processes.

II. The new horizontal integration of engineering.
   - A. The "systems approach."
   - B. Functional interactions: economics, law, politics, etc.
   - C. Values.

III. The educational response.
   - A. Societal Engineering.
   - B. Pre-college education: making options available.
   - C. Continuing education.

IV. The research response.
   - A. Transfer of existing technology and methods.
   - B. Generation of new technology and methods.
   - C. The System, Man.

V. The future: a thought experiment.

ROLE OF THE ENGINEER IN THE DECISION MAKING PROCESSES OF SOCIETY

A. J. Pennington
Department of Electrical Engineering
Drexel Institute of Technology
Philadelphia, Pennsylvania 19104

(Talk to the course EE485, "Personal and Professional Problems of Electrical Engineering," Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia, Penna., February 13, 1969).

I. The decision making process.

   A. Political power.

   B. Economic power.

   C. Galbraith's thesis: the technical/managerial elite.

   D. Social decision making as a random walk process.

II. The issue of freedom (is the engineer <u>able</u> to affect society?)

   A. Internal: from heredity and environmental factors affecting personality.

   B. External: from the technical and social order.

III. Attitudes (is the engineer willing to <u>affect</u> society?)

   A Passive despair: settling for comfort.

   B. Active despair: settling for violence.

   C. Hope.

IV. A thought experiment: "act as if."

SYSTEM SCIENCE AND HUMAN VALUES: A THREE DIMENSIONAL MODEL

A. J. Pennington
Drexel Institute of Technology
Philadelphia, Pennsylvania

Summary

In recent years a great deal of attention has been given to the one dimensional polarization of human activity which places science and technology at one extreme and humanism at the other. This model goes under names such as "The Two Cultures" (Snow) and it is often assumed that a necessary and fundamental conflict exists (as in Mumford's "The Myth of the Machine"). The purpose of this paper is to establish a more meaningful basis for discussion of the issues, which, admittedly, are real and important. A three-dimensional model is proposed which includes the dimension of method indicated above, i.e. scientific (objective) vs. humanistic (subjective) inquiry, but adds two more: the dimension of orientation, i.e. to people vs. things, and the dimension of attitude, i.e. hope vs. despair. Although these coordinates may not be completely orthogonal they do appear to lead to much more interesting classifications than the customary one-dimensional model. For example, the optimistic, objective orientation toward people (psychiatry), the optimistic, objective orientation toward things (technology), the pessimistic subjective orientation toward people (paranoia), etc.

Manuscript prepared for the Third Annual Princeton Conference on Information Sciences and Systems, Princeton, N. J., March 27-28, 1969.

The paper pursues implications of this model for development of a valid philosophic base for the work of technologists, including those in the information system sciences. Particular attention is given to problems of serving very large aggregations of people, i.e. the problems of the urban environment: transportation systems, security and protection systems, educational systems, etc. The paper is deliberately speculative.

January 13, 1969

MISCELLANEOUS

Travel

The following trips were taken between January 1 and June 30, 1969. Trip Reports, including a list of persons contacted, are available in our files.

January 10, 1969:	New York, Node-Four Associates
January 16-17, 1969:	Washington, NASA Headquarters Washington Center for Met. Studies
January 30-31, 1969:	Pittsburgh, NASA Knowledge Availability Systems Center GSPIA, University of Pittsburgh
February 11, 1969:	Princeton, N.J., Princeton University
February 14, 1969:	New York, Node-Four Associates
February 22-23, 1969: (with J.A. Orlando)	Tarrytown, New York, Community Development Workshop
March 18-19, 1969: (with J.A. Orlando)	Washington, NASA Headquarters HUD (Research & Technology) Washington Ctr. for Met. Studies
March 25-26, 1969:	New York, IEEE Int'l. Conv. Node-Four Associates
March 27-28, 1969:	Princeton, N.J., Conf. on Info. Sci. & Syst.
April 10-11:	Washington, Washington Center for Metropolitan Studies
April 18:	Washington, NASA Headquarters, HUD, House of Representatives (Subcommittee on Housing, House Banking and Currency Comm.)
April 22-25:	Cape Kennedy, Florida, Kennedy Space Center, NASA - Univ. Conf. on Public Administration
May 2:	New York, Node Four Associates
May 13-14:	Boston, NASA Electronics Research Center IEEE Spring Joint Computer Conference
May 18-19:	Miami Beach, American Society for Public Administration Annual Meeting

June 2-3: Houston, Construction Specification Institute International Exposition on Industrialized Housing NASA Manned Spacecraft Center

June 9-10: Chapel Hill, North Carolina, Environmental Design Research Association Annual Meeting

Future Plans

1. Writing of the community development simulation game, "BUILD."

2. Further experience with the Community Development Workshop.

3. Initial offering of the course, "Technology and Society," Fall Quarter, 1969.

4. Development of working papers on various topics related to the above.

5. Continued literature search, interviewing, and development of research ideas in the areas of building materials and systems, remote sensing, configuration management, etc.

6. Participation in the Operations Research Society of America Meeting, November, 1969, the Simulation Conference, December, 1969 and others as appropriate.

DREXEL INSTITUTE OF TECHNOLOGY

CENTER FOR THE STUDY OF ENVIRONMENT
TECHNOLOGY AND MANAGEMENT OF LARGE SCALE PROGRAM

NASA GRANT NGL 39-004-020
Task 2: Management Science

First Semi-Annual Progress Report
June 30, 1969

M. Silver
Associate Investigator

The principal activities under Task 2 during the first six months of the Grant were as follows:

(1) Development of Educational Plan (with E. S. Golden, P. W. Purdom, A. J. Pennington)
(2) Development and Performance of Research Plan
(3) Recruiting of NASA Research Associates
(4) Course Development and Conduct
(5) Travel
(6) Miscellaneous Talks

The above topics are discussed in detail:

(1) Development of Educational Plan - Base lines for the general educational program of Ph.D. candidates were completed. (See A. J. Pennington's Task 1, First Semi-Annual Progress Report).

A tentative curriculum has been structured for Mr. S. R. Siegel, Research Associate, which covers the academic years 1969-71. In maintaining the desired program flexibility, several courses for Mr. Siegel's plan will be taken at the University of Pennsylvania and other regional schools.

A similar plan will be developed for Mr. G. Mason Cadwell.

(2) Development of Research Plan - (See Statement of Objective, enclosed)
(a) Initial formulation of Research Plan is attached (report of S. R. Siegel to M. Silver).

(b) Performance to date has been focused on:
1 - Intensive review of NASA literature, reports, studies, etc.
2 - General study of urban systems simulation and gaming as a vehicle for understanding and evaluating NASA management systems.

3.- Participated in "City I", an urban system simulation game developed by Washington Center for Metropolitan Studies. (Follow-up of this experience with an additional session is anticipated in the next six-month period).

4 - Conducted review of simulation as a training technique for Urban problem solvers.

5 - Met with staff of "Metropolitan Associates of Phila elphia" (jointly with Task 3 members). This is a non-profi organization engaged in the introduction of humanitarian change into organizational structures. Future meetings are anticipated.

6 - Attended "Orientation Meetings" at NASA Washington headquarters. Purpose was to introduce Drexel Ph.D. candidate to NASA Organization. Conducted lengthy interview session with responsible NASA officials for such programs as Apollo, TIE and Configuration Management as well. Additional follow-up visits and interviews are anticipated as a routine part of our research program. Next trip scheduled for July 8, 1969.

7 - Established preliminary working relationship with Managing Director's Office, City of Philadelphia, and Model City Organization (HUD).

(3) Recruiting of NASA Research Associates

(a) As previously reported, Mr. S. R. Siegel is a full-time research associate. In addition, a second Ph.D. candidate for Task 2, Mr. G. Mason Cadwell, is expected to join our group on August 1, 1969. A biographical Statement will be included during that period report.

(b) A graduate student has been hired to spend the summer working on the program in the area of literature search as defined in the program plan.

(4) Course Development and Conduct

(a) Seminar in Management Information Systems - Management C680, Summer 1969.

(b) Seminar in Management and Organization Processes - Management C681, Fall 1969.

(c) Introduction to Systems Analysis - Number to be assigned Fall/Winter 1969.

In addition, several courses in Urban Psychology, Urban Sociology and Urban Economics are being developed by the Drexel faculty and are expected to be available in late 1969. (See Task 3 report for other course development).

All of the Ph.D. candidates are enrolled in at least one of the above courses as part of their summer educational plan.

(5) Travel

April 18 - 19, Washington, D. C., Participated in City I Game.
April 21 - 22, Washington, D. C., GAO, Participated in Program Analysis Seminar - Study of OEO, etc.
May 13, Washington, D. C., Army Materiel Command - Review of Project Management Systems and Techniques.
May 27, Washington, D. C., GAO - Program Analysis Seminar
June 16 - 18, Washington, D. C. - NASA Project Orientation Meetings.
Miscellaneous Trips - City of Philadelphia - Municipal Government Agencies, HUD, etc.

(6) Miscellaneous Talks

1. "Use of Simulation Models To Support Decision Making by Federal Executives", CSC Executive Seminar, Boston, Massachusetts, April 17, 1969.

2. "Systems Analysis for Urban Decision Making", ASPA Meeting Philadelphia Chapter, April 18, 1969.

3. "Development and Use of Cost Determining Models", GAO Executive Seminar, May 21, Washington, D. C.

4. "Is Systems Analysis Cost Effective?", CSC Executive Seminar Washington, D. C., June 26, 1969.

DREXEL INSTITUTE OF TECHNOLOGY

CENTER FOR THE STUDY OF ENVIRONMENT

TECHNOLOGY AND MANAGEMENT OF LARGE-SCALE PROGRAMS

NASA GRANT NGL 39-004-020

TASK 3: Human and Organizational Behavior

First Semi-Annual Progress Report

June 30, 1969

Edward S. Golden
Associate Investigator

1. Student Recruitment and Selection

Two candidates were selected for NASA Research Associates.

Thomas A. Michael, age 34, began his work on May 28. Mr. Michael Graduated from Wabash College Magna Cum Laude, Phi Beta Kappa. He was a Fulbright Scholar in Germany and graduated from Union Seminary with a B.D. He resigned his position as Assistant Personnel Director to enter the program. His special interest is in communication systems and theory, educational systems, and human relations training.

Hugh H. Annett, age 36, began his work on June 16. Mr. Annett graduated from University of Pennsylvania in Philosophy, having first entered Drexel in Engineering. He received his B.D. from Harvard in Sociology and Ethics. Mr. Annett's work experience has been in urban planning and social action, and more recently resigned his position as Staff Director for the Organizational Change of the structures and agencies of the United Presbyterian Church. His interests are in the planning progress and management of urban projects.

2. Research Objectives and Definition

Since the ultimate objective is the transfer of NASA's technological and management innovations to urban systems, it was essential to first study NASA as a total management system. This study is presently underway by means of documentary search and interviews with key NASA

officials. Our research is centered around three questions. 1) What kind of management system maximizes the creative energies of its personnel?; 2) What kind of management system facilitates the resolution of inevitable conflict?; 3) What management system facilitates the planning process regarding the base line plans which have broad support?

Furthermore, the researchers are attempting to identify the major management principles which operate in NASA and then to assess the behavioral consequences for NASA personnel.

Out of these investigative efforts, interface executive groups are to be identified as possible research targets. Matrix management as practiced in NASA and particularly in the Apollo program provide a gold mine of researchable subjects.

The immediate research plans call for further investigation into NASA's total organizational and management system, and specifically Apollo. Special attention will be given to configuration management which has great transfer possibilities. Attention will be given to configuration management as practiced at the Field Centers and in a number of the major contractors.

3. Educational Plan

a) The educational plan for Annett and Michael is in process and it is hoped that by October 1 will be finalized.

b) Immediate involvement includes researching both the human and material documents at NASA in order to fully comprehend NASA organization and its various subsystems. Participation in graduate seminars in organizational theory and interpersonal theory and practice.

4. Literature Search

a) Literature search of NASA's publications regarding historical development, organizational changes structures, and management technological developments.

b) Literature search on project management, interface executive, and conflict reduction through decision making. This has been contracted through management Research of Dalton, Illinois.

5. Consultative Relationships Developed and in Process

a) The Menninger Foundation, Topeka, Kansas regarding their research in organizational diagnostics for large social and military systems. Dr. K. Mitchell and Mr. T. Klink.

b) Management Development Associates of MIT and Harvard about possible consultative relationship regarding NASA and urban systems. Dr. I. Rubin and J. MacIntyre.

c) Sheldon Davis of TRW and Ed Lindamen of North American.

6. Urban Transfer Possibilities in Process

a) Development of consultant relationship to Trenton Board of Education to include organizational change study to ultimately include 800 administrative and faculty personnel, Board of Education, and community leaders.

b) Tentative conversations have been held with Art Bailey, Vice President for Planning and Management Development for McClosky Construction Company, to study and help develop that company become a more effective management operation. This is undertaken to understand the construction industry and specifically as to how it relates to urban planning, economics, and political effect.

c) Engaged in organizational diagnostic studies in some of Delaware Valley's major industries in an effort to test out some innovative diagnostic methodologies and their behavioral consequences on Task achievement for large organization, as a pre-test for possible use with NASA research.

Summary

The NASA research is merely in the initial phases of investigation. Present involvement points to exciting possibilities. By October, it is planned for final research definition and possible alternative models for conducting the research. Concurrently, efforts are underway to relate to possible urban systems to which possible transfer can be made. Present efforts are focused on NASA's organizational and management systems and styles, out of which researchable areas will emerge.

APPENDIX A

Information Note

DREXEL INSTITUTE OF TECHNOLOGY
Philadelphia, Penna. 19104

Center for the Study of Environment

RESEARCH AND EDUCATION IN THE TECHNOLOGY AND MANAGEMENT OF LARGE-SCALE PROGRAMS

Sponsored by: The National Aeronautics & Space Administration

NASA Grant NGL 39-004-020

"Sec. 102. (a) The Congress hereby declares that it is the policy of the United States that activities in space should be devoted to peaceful purposes for the benefit of all mankind.

"Sec. 203. (a) The Administration, in order to carry out the purpose of the Act, shall --

.. (3) provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof."

National Aeronautics and Space
Act of 1958 (P.L. 85-568)

Introduction

On January 1, 1969 Drexel Institute of Technology began a three-year program of research and education in the field of large-scale technical program management. A primary purpose of the program is to help direct the technological results and managerial methods of the national space program toward the solution of other pressing national problems, in partilar the problems of the cities. The second purpose is to train mature individuals at the Ph.D. level so that they can function affectively as decision makers in the technolgical and managerial environment of large social system projects and programs. Examples are urban housing, transportation, health-care, and environmental control projects. A career orientation toward scholarship and teaching in the area of large-scale social systems also falls within the scope of the Grant.

We recognize that these goals are ambitious, and that the obstacles are many. We are well aware, for example, that urban problems have technical, economic, political, and social dimensions which are quite different from those of the space program, and that a person who is effective in one arena may not be so in another. Still, we believe that by making a strong commitment to these goals that specific positive results will occur, not all of which can be anticipated at this time.

We do feel that the research results obtained and the graduates produced during this program for NASA will represent a contribution to the solution of the pressing problems of the cities. Hopefully, the momentum developed during the next three years will result in increased long-term involvement by Drexel Institute of Technology in the solution of the technical and managerial problems of the urban environment.

Research Program

Three primary research areas have been identified for attention: technology, management science, and behavioral science. W. W. Hagerty, President of the Institute and Professor of Mechanical Engineering serves as Principal Investigator. The remainder of the project organization at this time is as follows:

Task 1: Technology

A. J. Pennington, Associate Professor of Electrical Engineering

J. A. Orlando, Research Associate

Task 2: Management Science

M. Silver, Professor of Management

S. Siegal, Research Associate

Task 3: Behavioral Science

E. S. Golden, Professor of Behavioral Science

T. Michael, Research Associate

Other Drexel faculty and consultants from organizations such as the Fels Institute of The University of Pennsylvania are being called upon to provide expertise in human behavior, sociology, government, and urban affairs.

Academic Program

An academic program leading to the Doctor of Philosophy with special emphasis on public administration relative to technology and management of large-scale programs has been developed by the Research Faculty listed above. The program is administered by the Center for the Study of Environment, Professor P. W. Purdom, Director.

It is our view that the research areas identified above correspond to the three things which are necessary for a person to be effective in the context of large-scale social systems: (1) an understanding and awareness of the basic components of modern technology -- information processing, automatic control, materials, and environmental factors; (2) an understanding and awareness of economics and management science -- national income economics, urban economics, project evaluation, management control, and the systems approach; (3) an understanding and awareness of the philosophic, psychological, and social functioning of the person, the small group, and the community in a technological society. The latter is most important. The graduate must have the philosophic and intuitive base which assures that the project in which he is involved will truly serve human needs. For this reason the program will include work with concepts of individual and social value, socio-economic decision making, the political process, the nature of man, and his relationship to his environment and to his fellow man.

These goals dictate that the candidate's learning experience not be confined to formal courses. Independent study, small-group problem solving, field experience in NASA, the aerospace industry, and in actual socially-

oriented projects will be utilized in addition to course-work at Drexel and the University of Pennsylvania. The structuring of each individual's program is the primary responsibility of his Supervising Professor, aided by advice from other members of his doctoral committee and the program faculty members. A Candidacy Committee will be formed for each participant to advise him in developing a formal Educational Plan.

A qualifying examination is set for each candidate by the Candidacy Committee which may include the Drexel faculty members listed above along with others at Drexel and the University of Pennsylvania. Examination questions will be based upon the actual program of courses and independent study followed. It is expected that the qualifying examination will be taken during the second year of study beyond the Master's degree. In general four of the following areas will be chosen, and these must adequately reflect the educational goals stated above. That is, the candidate must demonstrate an awareness and understanding of technology, management science, and behavioral science as related to large-scale urban programs.

A typical selection to implement these goals is the following:

I. Area 1 or 2

II. Area 3 or 4

III. Area 5, 6, or 7

IV. Area 8

Areas and Representative Topics

1. Technology

   -materials science
   -construction methods
   -computer technology
   -systems engineering
   -transportation
   -environmental control

2. Quantitative Analysis

   -dynamic systems analysis (linear and nonlinear differential equations)
   -matrix analysis
   -probability and statistics
   -optimization theory
   -numerical analysis and programming

3. Economics

   -evaluation of project alternatives (engineering economics)
   -urban economics
   -macro economics (national income theory)
   -econometrics and modeling

4. Management Science

   -mathematical programming
   -theory of management planning and control
   -management information systems
   -decision theory
   -modeling and simulation

5. Behavioral Science

   -theory of personality
   -group behavior and decision making
   -organizational dynamics
   -social theory

6. Urban Environment and Sociology

   -urban ecology
   -social measures
   -psychological and social aspects of environment
   -community development
   -aesthetics and design

7. Technical and Social Philosophy

   -history of technology
   -philosophy of science
   -social and political philosophy
   -ethical philosophy
   -the technological society
   -human needs and values

8. Governmental Organization and Programming

-Federal, State, and Local governmental structures
-public policy analysis
-planning, programming, and budgeting
-the political process

Administration

The research activity is intimately associated with the educational program since each candidate will carry out a major study as his doctoral thesis. It is intended that the students will have had significant experience in technology, management, interpersonal relations (counselling, etc.), or public administration prior to entering the program, and that they be strongly oriented toward careers in large-scale socially-oriented program management. Hence, it is anticipated that the research studies will be action-oriented, and that they will include realistic feasibility considerations for specific projects, provided that this can be accomplished within the context of normal scholarly standards for doctoral research.

It is the responsibility of each candidate to select a Doctoral Research Committee which can adequately supervise his dissertation, and which represents sufficient breadth to meet the stated objectives of the research program. Committee members can come from any Department at Drexel or the University of Pennsylvania, provided they are willing to serve, and meet the above criteria.

The nominal stipend for the program is $7200 per year plus tuition. There may be limited opportunities to supplement this with teaching or short-term employment, provided these activities are consistent with the educational objectives of the program. It is understood, however, that the program represents an essentially full-time commitment of effort throughout the year.

Other administrative details and requirements are given in the Graduate Catalog of Drexel Institute of Technology. These include a residency require-

ment of one year, a reading ability in at least one foreign language (French, German, or Russian), and submission of the doctoral dissertation in standard form to the Supervising Professor.

Questions about the program can be directed to the principal faculty participants. Their names, addresses, and phone numbers at Drexel (EV 7-2400) are as follows:

W. W. Hagerty, Principal Investigator

Main; 1st Floor; President's Office; Ext. 500.

P. W. Purdom, Director, Program in Environmental Engineering and Science.

Abbotts; Rm. 301; Ext. 780.

A. J. Pennington, Associate Investigator, Task 1, Technology

Stratton; Rm. 311; Elec. Eng'g. Dept.; Ext. 661.

M. Silver, Associate Investigator, Task 2, Management Science

Matheson; Rm. 105G; Mgt. and Op. Res. Dept.; Ext. 2229

E. S. Golden, Associate Investigator, Task 3, Behavioral Science

Matheson; Rm. 02; Behav. Sci. Dept.; Ext. 2239.

AJP, 5/16/69

APPENDIX B

THE LARGE-SCALE TECHNOLOGY PROGRAM AS AN EDUCATIONAL AND RESEARCH LABORATORY

by

WILLIAM W. HAGERTY
President, Drexel Institute of Technology
Philadelphia, Pennsylvania 19104

My theme this morning is that large-scale technology programs, such as the space program, provide an important laboratory which can help universities meet the future needs of our society. The traditional contributions of universities are of two kinds: first, the production of graduates who are educated in the various curricula; and second, the production of knowledge to develop the research skills of graduates. To say no more than this would imply an "ivory tower" attitude which would let the university divorce itself from real problems of society. Of course, we are always confronted with real problems, some more urgent than others. When the problem becomes sufficiently urgent, all or nearly all universities forego their traditional academic detachment and work on the problems at hand, although still in the two ways mentioned above.

For example, in the case of an all-out war, such as World War II, the universities directly engaged in all types of military and military-related research, and in addition to their normal teaching programs worked on the direct production of personnel useful in wartime. These included a wide range of programs such as the ASTP, the Navy V12 Program,

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Manuscript prepared for Panel Session G-2, "Large-Scale Technology Management," at the National Conference on Public Administration, Miami, Florida, May 20, 1969.

programs designed to train young Turkish Navy officers, and so on. I was personally engaged in several of these programs.

At the present time there is an urgency in the area of social, and particularly urban, problems which may be less than that of all-out war, but is still of great concern. Society has not yet said to the universities that they must work on these problems, but the implication is getting stronger all the time. Universities may again be asked to forego their academic detachment and become acquainted with the real problems that are facing us, and indeed many universities have already taken steps in this direction.

In fact, there are some who would go so far as to say that university faculties and students should become "activists" in the sense that they must become personally and directly involved in the solution of these problems. While admitting that the motivation of some people in this direction is very strong and genuine, I think this is an improper function of the university. To go back to World War II, it was recognized that the best use of our faculties and students was not to march them immediately off to war. If this had been done our academic and intellectual seed would have been consumed. Again today I feel that universities should concern themselves with society's problems, and that this is best done through research which endeavors to find solutions, and through creation of educated people who can work at the problems.

There are other possible roles for higher education. Research implies that the universities might develop new relevent technology and new methods. In addition, the university might assist in the transfer of technology and management methods from one large-scale program to another.

The tendency of university faculties to generalize their thinking and to articulate their ideas through speaking and writing should be helpful in this respect.

Finally, the university provides a neutral arena for the development of new ideas and the resolution of conflict which could lead to the development of a valid philosophic base for the technological society in which we find ourselves. The development of these fundamental ideas and values has always been one of the most important functions of the university.

In order to implement some of the thinking which I have just set forth, Drexel Institute of Technology has recently begun work, in January of this year, on a Grant from NASA which is concerned with the technology and management of large-scale programs. The justification for this work comes directly from Section 203 of the Space Act which charges NASA to "provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof." This project is concerned first of all with the study of large-scale technology programs, and second with the production of some doctoral candidates whose thesis material will concern itself with various aspects of the application of large-scale technology programs. These candidates will obtain their thesis material from two laboratories. One of these laboratories will be NASA itself or some appropriate part of it; the second laboratory will be the city or some appropriate part of it. The academic backgrounds of the candidates will be such fields as public administration, management behavioral science, and engineering. At

Drexel we have broken the over-all project down into three parts. The first, called technology, includes such things as mathematical modeling, computer simulation and gaming, building materials and building systems, remote sensing, etc. The second, management science, includes areas such as information systems, decision theory, systems analysis, and operations research. The third, behavioral science, includes organization theory and diagnostics, the management of change, organizational communications, and interpersonal skills. In addition, we are giving direct attention to the development of concepts and educational programs relating to the fundamental issues of the technological society. As an example, a new graduate course called "Technology and Society" has been developed under the Grant to help our students deal with these questions.

The faculty researchers come from all parts of Drexel; at the present time the Departments of Electrical Engineering, Management Science, and Behavioral Science are represented. The students will work in NASA, where they will become familiar with NASA techniques, and very likely also in the city where they will take the same techniques and attempt to apply them to problems of society. As the entire group considers each thesis problem, the variety of inputs should produce much more meaningful results than are possible from the typical academic graduate program. A profound benefit may be obtained if Drexel can learn to focus a large share of its talents and resources on a given broad-scale problem, rather than simply the talents or resources of one man or one department, or even one college. In the long run, this project may serve to change Drexel as much as it changes any city, and certainly the graduates of this program will be better equipped to

work on the problems of society than many we are now putting forth.

As a final topic, it is interesting to consider why these large-scale problems are both interesting and difficult. I suspect that one of the reasons why academicians prefer a certain amount of detachment is that they can conceptualize and thereby handle an idealized problem much better than a real one. It can be kept simple, the number of variables reduced, and frequently some of the human factors eliminated altogether. In real large-scale problems, however, the sheer qualitative features are different from those of small ones. As an example, in a complex system involving a thousand critical components, the probability of non-failure or the degree of perfection of any one component has to be one thousand times greater than that desired for the over-all system to achieve the same lifetime as the componenents. The problems of time scaling enter in in a most important way. To complete a complex event on a given time schedule requires a degree of programming and coordination that is almost entirely foreign to the traditional academic problem.

The human factors enter in a different way. The behavior of very large groups and the constituent subgroups are interlocked in ways which are numerous, complex, and subtle. The magnification factor of any subtlety may make it very important in determining the success of a given project.

These considerations have become very evident in the space program. In conclusion, this is the reason for our interest in using NASA as a laboratory which may provide valuable ideas for helping to solve other problems. In doing this, we fully recognize that these new problems have economic, political, and social dimensions which are quite different

from those of the space program. Even if we were to achieve the upper limit of our estimates concerning the applicability of aerospace technology and methods, we would still have a very long way to go in solving society's problems. Still, we believe there is merit in being ambitious--it tends to be a self-fulfilling position. Hopefully, time will prove that our optimism was justified.