Research Program on the

ORGANIZATION AND MANAGEMENT OF R AND D

Semi-annual Progress Report

June 30, 1964
In the spring of 1962 the MIT School of Industrial Management, with the encouragement and financial support of the National Aeronautics and Space Administration, undertook to develop a program of research and education on the problems of organizing and managing large-scale technology-based enterprises. The studies now in progress and planned for the future are focused on the broad objective of understanding and improving the effectiveness of R & D activities. Statements of the underlying concepts which guide the program appear in talks delivered at the 17th Annual Conference on the Administration of Research, September 1963 (Marquis, 1964),* and at the September 1963 international convention of The Institute of Management Sciences (Roberts, 1963).

The principal researchers are faculty members whose backgrounds are in a variety of disciplines: mathematics, sociology, operations research, psychology, statistics, economics and engineering. Research assistants are selected from graduate student candidates for the S.M. or Ph.D. degree. A list of personnel active during the period of this report is presented in Appendix 1.

The program is administered by a research director and an associate director, guided by a Steering Committee of seven faculty members (Appendix 1). Coordination is achieved by a weekly research seminar, by many small ad hoc groups, and by numerous informal consultations. The"Friday Seminar" is regularly attended by the faculty and student staff and by a number of guests from other MIT schools and Harvard, from industry, and from NASA. The seminars serve as a forum for reports of progress and plans, with discussion and debate on

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* Citations are to reports and papers listed in Appendix 5.
questions of research design, methods, and interpretation. Outside guests are frequently invited to present papers growing out of operating experiences or relevant research. A list of topics and speakers is presented in Appendix 2.

EDUCATIONAL ACTIVITIES

A series of 14 weekly lecture-discussions on the organization and management of R and D, each led by a different faculty member, is regularly offered each spring semester. The series is open to graduate students, Sloan Fellows, and guests from other departments and universities and from local industrial and government laboratories. The topics and session leaders for the 1964 series is presented in Appendix 4.

A one-day seminar for 200 industrial research executives was presented in the Kresge Theater March 5, 1964 under the auspices of the MIT Industrial Liaison Office. Current research findings were described by Professors Evan, Marquis, Muller-Thym, Roberts, and Stedry.

Sessions on research management have been introduced into the curriculum of the Program for Senior Executives and the Sloan Executive Development Program, and the advanced Industrial Dynamics course offered during the spring featured use and analysis of an R and D management game designed by Professor Roberts.

RESEARCH PROJECTS

In the following pages each of the research projects is described in terms of its current status, the nature of present results, and plans for the immediate future.
1. **Dynamic Models of R and D Systems**  
E. B. Roberts

Continuing the application of the philosophy and methods of Industrial Dynamics to the problems of R and D management, the investigator has been developing dynamic system models of three different problem areas. The first model of a general dynamic theory of project management is described in a book published in June (Roberts, 1964). The associated system modeling effort is now completed.

The second study is aimed at development of a general model of a technology-based enterprise, one in which the creation and use of technical know-how is essential to organization effectiveness. The model includes consideration of management policy for allocation of engineering and management resources, technical recruiting and marketing, internal stress on product quality and schedule performance, etc. The initial model developed in this research has been modified for use as a Research and Development Organization Management Game, and tested in the advanced Industrial Dynamics course. Further development of the model and game will continue during the coming year.

The third systems model to be constructed will include government and industry aspects of the government R and D contracting system. This model, part of the investigator's research program on the contracting system, is now in its formulative phase.

In association with this project two Sloan Fellows completed theses which further advance the state-of-the-art of system models of technology-based enterprises. Fryling (1964) examined the management problems of introducing technical products into competitive markets. Kanter (1964) investigated management of commercial R & D with emphasis on engineer allocation between product improvements and new product developments.

Research on this project is supported in part by a grant from the National Aeronautics and Space Administration.
This project is obtaining systematic information from a number of research organizations for comparative statistical study. Data have been collected from 20 laboratories which are performing contract R and D for the government. In the immediate future, the emphasis will be placed on industrial laboratories which are primarily engaged in commercial R and D but also perform government-funded R and D.

A question of major concern is whether government funds for R and D in industry stimulate privately-financed R and D expenditure or are merely a substitute for it. Blank and Stigler, using 1952 aggregate industry data, concluded that there was a considerable but uncertain amount of substitution. Re-examination of the earlier data and analyses of more recent data indicate that when the data are structured by industry they reveal a relationship which differs according to industry. There is an apparent positive relationship in those industries where R and D is supplementary to normal commercial activity, but a substitution effect in those industries heavily committed to R and D (Black, 1964).

The investigation will, for the near future, concentrate on the following special points: the interaction of private-funded and public-funded R and D within single industrial laboratories; differences in policy, planning, and control that seem appropriate to the different types of laboratories; the effect of these differences on laboratory performance; and the influence of the competitive environment in which the firm operates. Inquiries will be focused on firms in a selected small industry which has a well defined common technology. The study will be extended by adding additional such industries.

After July 1, 1964 the research will be directed by Dr. Guy Black, replacing Dr. Maffei who has resigned. The project is supported by a grant from the National Aeronautics and Space Administration.
Methods of obtaining comparable data on a large number of projects have been devised in order to carry out statistical analyses of the effect of important variables on performance of R & D.

A preliminary formulation of critical variables was first prepared on the basis of published literature and interviews with experienced research managers. Field work has been concentrated on projects in industrial laboratories which are (1) conducted under contract with a government agency (or a prime), (2) between $1 million and $25 million in size, and (3) completed or nearly completed. Data have been collected on about 20 projects, and during the summer of 1964 the number will be increased to 50.

Project performance is measured in several ways: (1) objective records of cost, time, and technical accomplishment are compared with the estimates and requirements in the contract; (2) judgments of performance are obtained from the project manager, the laboratory director, and the government technical representatives; (3) an account of the critical problems, slippages, and failures in the course of the project, together with the steps taken in response, are obtained from the project manager and the technical monitors.

Information on a number of features of the organization and management of each project is obtained from laboratory records, from government contracting offices, and from interviews with project managers, and will be analyzed in relation to project performance.

This project is supported by a grant from the National Aeronautics and Space Administration.
The goal of this project is the design of policies for a more effective government contracting system. The current research is divided into three phases: (1) determination of the decision process used for government award of research and development contracts; (2) study of company strategy and decision-making aimed at obtaining government contracts, including the role of company beliefs regarding the government award process; (3) development of a dynamic system model for computer simulation analysis of the contracting system, using the results of the phase one and two empirical studies as inputs.

Work on the first phase of the research program has included interviews and record analysis at three large government centers, one in NASA and two in DOD field centers. Project records have been studied in more than 100 competitive cost-plus R and D contracts which range in size from $100 thousand to $40 million. An additional sample has been developed for a study of sole-source R and D awards. Data extracted from agency records and interviews with source evaluation board members, project managers, negotiating officers, and others is producing a view of the actual system underlying contract awards, which differs markedly from the formal contracting system (Roberts, 1964 (b)).

The second phase of the research program involves an intensive interview program in cooperating companies to study corporate proposal strategy and R and D marketing activities. Preliminary findings are reported in two theses by Berger (1963), and Sloat (1964). In addition the companies that were the principal competitors for several contracts analyzed in phase one of this project will be contacted and key personnel interviewed to determine company views on government award decisions. A mail questionnaire will be used to gather additional information on company proposal decisions.

This project is supported by a grant from the National Aeronautics and Space Administration.
This project deals with the relationship between work and the space in which it is done. The research is focused on: (1) the identification of features of a project's spatial environment and how people feel about them; (2) the relationship of the dispersion of project personnel and their physical travel paths to the project's work-structure; (3) the relation of both (1) and (2) to the project's success or failure; and (4) the development of a system for classifying competences, and a language for describing their interaction, which may be used to construct general models of project structure.

Information on these subjects has been derived from an analysis of interview material gathered at the Goddard Space Flight Center. The analysis indicates that project personnel are far less concerned with environmental conditions such as noise or crowding than with the impact of physical constraints on the flow of work and communication. It further demonstrates that problems such as crowding, as perceived by project personnel, bear little relationship to the actual measured conditions. For one project crowding actually led to a beneficial flow of information and a highly integrated work structure.

In addition, the evidence indicates that campus plan research centers may be detrimental to the performance of project-organized R & D work. It suggests that one or more buildings of such a campus plan be completely reserved for project work in order to more effectively match space structure with project work structure.

Current results are presented in a thesis by Puffer (1964), and a more complete report is in preparation. The project is supported by a grant from the National Aeronautics and Space Administration.
Research has demonstrated that the proposal competition provides an excellent opportunity for the study of factors influencing success in problem-solving. It is one of the rare real-life situations (along with multiple award contracts) in which a number of different firms work on the same task and can therefore be directly compared. Technical evaluations are obtained from the responsible government agency, and questionnaires completed by each firm provide information on the relevant characteristics of the firm and of the proposal effort.

Twenty-two USAF and NASA competitions were selected and approximately 200 questionnaires were mailed to the competing firms. Returns have been received from about 90 per cent. Analysis of these returns shows substantial agreement with results reported earlier (Allen and Marquis, 1964). Technical competence, as evidenced by use of company specialists and by size of technical work force, far outweighs other factors such as company size, proposal team size and technical man-hours of effort in influencing the technical quality of proposals; there is a strong indication that attempts to substitute for in-house competence by use of outside consultants are unsuccessful. The time spent examining literature is not correlated with the quality of the proposal.

A U-shaped relationship is found between the level of effort expended on the proposal and its technical rank. Firms in the upper half of the rankings show a direct relation between man-hours expended and technical ranking; firms in the lower half show an inverse relation. Apparently there exists a "threshold of competence", only above which does it pay to increase one's expenditure of effort.

This project was initiated with the support of a grant from the National Aeronautics and Space Administration and currently receives support from the National Science Foundation (Office of Science Information Services).
Parallel contracts afford the researcher an opportunity to make direct comparisons of the way different R & D groups perform the same tasks. In this project comparisons are sought between the technical approaches considered, the strategies employed, and the information sources utilized by the competing research groups.

Major NASA centers were visited and thirteen instances of multiple award contracts were selected. The contractors were visited to obtain their cooperation. Seventeen major companies are presently cooperating with the project. Project managers and lead engineers in each organization report their progress toward solution on specially designed Solution Development Records. Engineers working on the task maintain a record of their time spent in various information gathering activities and keep a log of literature sources employed. Each project manager is called by telephone once a month and asked to provide orally a resume of activities and technical decisions made during that month.

Preliminary results indicate a very high incidence (much higher than anticipated by the project managers) of complete reversals and re-reversals in decisions on technical approach. There is some indication that these changes are periodic, that the frequency of change in the parallel firms is correlated, and that the changes are a result of interaction among subsystem designs. In a final interview each major change is being linked to the relevant information sources.

This project was initiated with the support of a grant from the National Aeronautics and Space Administration and currently receives support from the National Science Foundation.
The project is examining the role of the information system for planning and control in a large hierarchical organization having multi-dimensional goals. The initial phase of the study was devoted to the development of a conceptual model of the planning and control process which provides a means for assessing the technological requirements of the information system and its relation to the human decision maker.

The next phase of the research program will be devoted to the implementation of prototype components of the information system. The most important objective is the development of an information system that allows the manager to retrieve primitive data from the organization's data base. The retrieval request is expressed in a language permitting the flexible specification of logical search criteria. The language must further allow the specification of operations on the data in order to transform them into information useful for planning and control. A subsidiary project will examine the usefulness of such a man-machine system in a highly complex, interacting and stochastic environment.

This project was initiated with support of a grant from the National Aeronautics and Space Administration and is currently supported by the Sloan School of Management.
The purpose of this project is to develop information concerning the career patterns of engineers, scientists, and administrators in NASA which would enable an individual to view more realistically his career development possibilities within the organization, thus contributing to greater effectiveness, creativity, and growth. A broader objective is to facilitate the design of organizational policies and procedures to increase the competence and contribution of researchers throughout their entire careers.

The first phase of the project was an exploratory one, undertaken in the summer of 1962, involving open-ended interviews, up to 2½ hours in length, with 96 men at the Langley and Lewis research centers. Results are reported in two papers (Peters, 1963; Schein, et al, 1964).

The second phase of the project includes the development of a questionnaire which will reliably and validly measure the career orientation variables that have now been isolated. Finally, a more extensive questionnaire survey will be undertaken to provide data for a systematic analysis of the relationship between career orientations, perceptions of rewarded activity, and objective and demographic variables. It is expected that this phase will be substantially complete by October 1964.

The project is supported by a grant from the National Aeronautics and Space Administration.
A common structural feature of R & D laboratories, particularly those engaged in applied research and development, is the organization of personnel according to projects or tasks rather than, or in addition to, departments or disciplines. To achieve the objectives of a project, members of more than one discipline must interrelate and coordinate their activities.

In the performance of project research at least four types of conflict may arise: (a) task conflict among peers--disagreement among project members as to how to achieve the objectives of the project; (b) task conflict between one or more project members and the project director; (c) interpersonal conflict among peers--personal dislikes or mutual distrust among project members; (d) interpersonal conflict between one or more project members and the project director.

A questionnaire designed to measure personal, motivational and organizational factors affecting conflict and performance was pretested and administered to project groups in two industrial laboratories and two NASA centers. Preliminary findings, based on a relatively small number of cases, indicate that none of the four types of conflict seems to have a direct effect on the performance of project teams, but rather that the effect of conflict on performance is contingent upon several intervening or conditioning variables. For example, in project groups engaged in basic research technical conflict is associated with a higher level of performance, whereas in project groups engaged in applied research, conflict of any kind tends to lower performance. Similarly, the correlation between conflict and performance appears to be positive in teams whose members have a high tolerance for complexity, whereas it is negative in the others. Additional data are being collected in other R & D organizations.

This project is supported by a grant from the National Aeronautics and Space Administration.
Study of unprogrammed problem-solving behavior under carefully controlled laboratory conditions is one approach to understanding the creative research process. Previous experimental studies have made use only of short, relatively simple, and usually single-solution problems which do not approximate the complex processes involved in research and development work.

A problem-solving environment has therefore been designed which is: (a) sufficiently complex and flexible to provide opportunity for long-term systematic investigations of human thinking processes; (b) sufficiently well specified to permit application of rigorous experimental controls; and (c) sufficiently quantifiable to allow explicit measurement of behavior as well as direct comparison of alternative strategies of problem-solving. Parametric forms of such an experimental environment are programmed and have been run on both real-time and time-sharing computer systems.

Data have been obtained on the problem-solving performance of 18 men, each working over time periods extending to eight weeks, on a series of four problems in which prior knowledge would be either facilitating, interfering, or neutral for the solution process. Verbal protocols have been analyzed to determine the different types of strategies employed, and to construct flow charts of the observed processes. A tentative revision of the theory of problem solving has been formulated to account for the observed diversity of decision behavior, and to serve as an organizing framework for the next stage of research (Soelberg, 1964).

This project was initially supported by a grant from the National Aeronautics and Space Administration and currently receives support from M.I.T. Project MAC.
In the process of research and development there is a succession of decisions involving various degrees of uncertainty. To supplement the several field studies of decision making, a series of experimental researches is being conducted to clarify particular questions.

Uncertainty, defined as incomplete information on the probabilities or values of the outcomes of a set of alternatives, has been found to have certain regular effects on decision choices and on strategies for reaching decisions. For example, individuals are found to choose less risky alternatives in the face of uncertainty than in comparable risk problems with greater certainty.

When five or six individuals who have already indicated their own decision choices are formed into a group which is instructed to discuss the problems and agree on a unanimous choice, the group decision is more risky than the average of the individuals' decisions. This effect is true only with problems involving uncertainty; there is no group effect with problems of pure risk choice.

Preliminary work indicates that there are clear differences among people. Anxious individuals (Alpert-Haber test) show a larger effect of uncertainty, and social conforming individuals (Marlowe-Crowne test) show a larger shift from individual to group decisions. Continuing experimental work is directed to the study of decision choices among sure wins (all alternatives have positive expected value) compared with choices among sure losses (negative expected value).

This project was initially supported by a grant from the National Aeronautics and Space Administration, and currently is supported by M.I.T. Project MAC and by a grant from the Los Altos Foundation.
The problems at the focus of this research are: (1) in what firm can (and should) organization goals be communicated to subordinate levels in the organization; (2) how do these communicated goals interact with goals of the subordinate organization and the individual aspirations of members of the subordinate organization; and (3) how do all of these goals taken together affect the total amount of effort managers will expend in goal attainment and the allocations of effort among the various areas of activity in which goals exist.

Theoretical work, assuming response to goals to be "quasi-rational," has investigated a function of reward based upon goal attainment to determine how a superior would allocate his effort to best attain his various budgets and how higher management could best utilize the budget-setting mechanism to influence the effort allocation processes (Stedry and Charnes, 1963). Further investigation was undertaken to determine the optimal allocation of managerial effort in order to maximize the probability of attaining all goals--i.e., the contract specification problem (Charnes and Stedry, 1964).

Experimental work has attempted to show the effects of goals on individuals under various conditions in the laboratory. Gawron (1964) reports the effect of participation in goals setting and commitment to goals on performance. Gold (1964) found that instructions to play a role (e.g., sales manager) affected the subjects' willingness to call in an "outside consultant" to help attain his goals. Gold, Levy and Stedry (1964) found that setting goals (quotas) produced decision rules and effort allocations different from a piecework-type reward situation. Summaries of work on goal structures applied to the practical problems of budgetary control are reported by Stedry (1964 a,b).

This project is supported by a grant to M.I.T. from the National Aeronautics and Space Administration. The theoretical work is also supported in part by a grant to Northwestern University (Charnes) from the Office of Naval Research.
During the past year a new study has been initiated with the purpose of investigating and developing improved approaches to the management of R & D projects. The investigator intends over the next several years to explore aspects of effort and cost estimation, program budgeting, and performance measurement and evaluation. These form a closed feedback-loop of project control which is central to the R & D process.

Two studies under this general program are underway at present. The first is examining the impact of incentive contracting on project control and the results of a series of NASA CPFF contracts which have been converted to an incentive basis. Government and contractor personnel and records are providing the data for this inquiry, the initial results of which are reported in a thesis by Sloat (1964).

The second study undertakes to develop an overview of the NASA budgeting process and at the same time to improve cost estimating and program planning methods. The over-all Apollo Program and its sub-components, such as Mercury, Gemini, and Saturn I, are being used as case studies for the research being carried out largely by A. L. Wood.

This project is supported by a grant from the National Aeronautics and Space Administration.
The Impact of R and D on the U.S. Economy

W.H. Gruber
L.H. Perry

This study has attempted to analyze the impact of R & D by examining the functioning of the economy in the areas of economic growth, productivity increases, changes in the composition of the labor force, and changes in the quality and the role of education (with emphasis on science and engineering).

The findings thus far indicate that the economy has been functioning more efficiently in the postwar period than between 1909-1929, the first "normal" period before R & D became a significant activity and for which there are good data. The measures of efficiency utilized were economic growth, stability, and increases in productivity. Long run trends in changes in the composition of the labor force appear to have accelerated and these trends have been linked to sectoral productivity increases and the changed role of education. Results are reported in two papers (Gruber, 1963; 1964).

Substantial progress has been made in the study of manpower requirements, and a monograph is nearly complete on productivity, education, and changes in the labor force in the postwar United States. The findings indicate that the sectors of the economy with the faster increases in productivity have experienced slower increases in employment. The net result of sectoral and occupational changes has been a more rapid transformation in manpower requirements in the postwar period than the long-run shifts that have occurred since 1900.

A review of the findings to date indicates that R and D has been a powerful force for economic change. The understanding of the changes fostered by R and D will be used in next steps to consider the future role of R & D and the ways in which its usefulness in the economy can be maximized while minimizing the disruptions which it causes.

This project is supported by the Sloan School of Management and by the M.I.T. Center for Space Science.
APPENDIX 1
PERSONNEL

STEERING COMMITTEE
Jay W. Forrester, Professor of Industrial Management
Howard W. Johnson, Dean, Sloan School of Management
Donald G. Marquis, Professor of Industrial Management, Chairman
James McCormack, Vice President, Massachusetts Institute of Technology
Max Millikan, Professor of Economics and Director, Center for International Studies
Bernard J. Muller-Thym, Visiting Professor of Industrial Management
Edward B. Roberts, Assistant Professor of Industrial Management
John M. Wynne, Associate Dean, Sloan School of Management (absent on leave 1963-1964)

ADMINISTRATIVE STAFF
Donald G. Marquis, Research director
Edward B. Roberts, Associate research director
Joanne Fay, Secretary
Betty Benedetto, Clerk-typist
Hannelore Machotka, Clerk-typist

FACULTY RESEARCH STAFF
Thomas J. Allen, Jr.
Research Associate, Sloan School of Management
David Berlew
Assistant Professor of Industrial Management
Guy Black
Research Associate, Sloan School of Management
Irena Dubska
Research Associate, Sloan School of Management
James C. Emery
Assistant Professor of Industrial Management
William M. Evan
Associate Professor of Sociology and Industrial Management
Richard B. Maffei
Lecturer, Sloan School of Management
Donald G. Marquis
Professor of Industrial Management
Bernard J. Muller-Thym
Visiting Professor of Industrial Management
Edward B. Roberts
Assistant Professor of Industrial Management
Edgar H. Schein
Associate Professor of Industrial Management
Peer Soelberg
Assistant Professor of Industrial Management
Andrew C. Stedry
Assistant Professor of Industrial Management
Charles Ying
Research Associate, Sloan School of Management

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STUDENT RESEARCH ASSISTANTS

Dan Abramovitch  
S.B. Electrical Engineering, McGill, 1961
Maurice P. Andrien  
S.B. Electrical Engineering, MIT, 1963
Laurence E. Berger  
S.B. Industrial Management, MIT, 1963
Richard J. Bjelland  
B.A. General Science, Oregon State University, 1962
Robert Blain  
B.A. Sociology, University of Massachusetts, 1960; M.A. Sociology, University of Wisconsin, 1962
J. Randall Brown  
S.B. Electrical Engineering, MIT, 1963
James F. Burns  
S.B. Math, University of Michigan, 1961; S.M. Economics, Columbia, 1963
James M. Gross  
Douglas T. Hall  
S.B. Industrial Administration, Yale, 1962; S.M. Industrial Management, MIT, 1964
Adolph Hansen  
S.B. Chemical Engineering, MIT, 1956; S.M. Industrial Management, MIT, 1964
James E. Mahoney  
S.B. General Business, Florida State University, 1958; M.S. Industrial Management, Florida State University, 1961
William McKelvey  
A.B. Physics and Economics, Monmouth College, 1960
James R. Miller  
John E. Osborne  
A.B. Bethany College, Economics, 1963
Robert W. Puffer III  
B.S. Electrical Engineering, MIT, 1962; S.M. Industrial Management, MIT, 1964
Lewis G. Pringle  
B.S. Chemistry, Harvard University, 1963
William D. Putt  
S.B. Industrial Management, MIT, 1959; S.M. Industrial Management, MIT, 1964
Irwin Rubin  
S.B. Electrical Engineering, Tufts University, 1961; S.M. Industrial Management, MIT, 1964
Herbert L. Selesnick  
S.B., Physics, MIT, 1962
J. Barry Sloat  
John Thomas  
S.B. Industrial Administration, Yale University, 1960

January 17, 1964  Richard S. Morse, Chairman of the Board, Cryogenics Corporation; Lecturer, M.I.T., Sloan School of Management. Problems of Conversion from Defense and Space R & D.

February 14, 1964  General James McCormack, Vice President, M.I.T. The Role of the Special Non-Profit Corporation.

February 21, 1964  Robert W. Miller, Corporate Director of Management Science, Raytheon Company. Pros and Cons of Multiple Incentive Contracting.

February 28, 1964  Discussion session on the nature of possible management research that could be carried out with the NASA Electronics Research Center.


March 13, 1964  Peer Soelberg, Assistant Professor of Industrial Management, M.I.T., Sloan School of Management. Toward a General Theory of Problem-Solving.


April 10, 1964  Dr. Guy Black, Research Associate, M.I.T. Sloan School of Management. Substitution of Public for Private R & D Expenditures.


May 1, 1964  Dr. Homer E. Newell, Associate Administrator, Space Science and Applications, NASA
Some Aspects of the NASA Space Science Program

Introduction of Computers in a Large Corporation: Organizational Response to Technological Innovation.

May 15, 1964  Andrew C. Stedry, Assistant Professor of Industrial Management, M.I.T. Sloan School of Management
Resource Allocations Where All Product Specifications Must be Met.

May 22, 1964  Dr. Austin W. Fisher, Jr., Corporate Vice President for R and D, Ludlow Corporation.
Factors Influencing the Rate of Diffusion at the R & D Interface.
SLOAN SCHOOL OF MANAGEMENT THESES COMPLETED 1964

Graduate Students

Larry Berger, S.B., Industrial Administration, M.I.T., 1963
A study of company strategy toward research and development proposals
Professor Roberts

The effects of participation and commitment on organizational performance
Professors Evan and Stedry

Robert E. Good, B.A., Business Administration, Antioch College, 1962
Creativity and individual differences in problem solving
Professors Marquis and Soelberg

Marvin Hersh, S.B., Chemical Engineering, M.I.T., 1961
Investigation into PERT, a new management technique for R & D programs
Professors Maffei and Smith

J. Steven Ott, S.B., Labor Management Relations, M.I.T., 1960
A questionnaire study of organizational climate
Professors McGregor and Schein

Robert W. Puffer, S.M., Industrial Management, M.I.T., 1964
Work, space, and communication: a study of research and development
Professors Muller-Thym and Roberts

William Putt, S.B., Industrial Management, M.I.T., 1959
Managerial reactions to reductions in resources in research and development
Professors Marquis and Stedry

A study of the solutions to PERT networks
Professors Little and Pounds

J. Barry Sloat, S.B., Engineering, UCLA, 1961
Incentive contracting for research and development procurements: a case study
Professor Roberts, T.J. Allen

Sloan Fellows in Executive Development

Nicholas Baracos, Manager, Suspension and Steering Department, Ford Division
Product Engineering Office, Ford Motor Company
The dynamic behavior of an automotive engineering organization
Professors Muller-Thym and Roberts

Steve Cenko, Chairman, Mechanical Engineering Laboratories Department,
General Motors Institute
Factors in obsolescence of engineering knowledge
Professors Schein and Smith
George P. Fryling, II, Vice President--Operations, Erie Technological Products Corp.
The dynamic problems of introducing a competitive product to the market
Professors Pounds and Roberts

Lawrence Kanter, Program Manager, Data Systems Division, Product Development
Laboratory, International Business Machines Corporation
An investigation of the interaction between the depth and breadth of
R & D endeavor and the growth of the company
Professors Roberts and Smith

T. Frank Morring, Technical Staff Assistant, George C. Marshall Space Flight
Center, National Aeronautics and Space Administration
The impact of space age spending on the economy of Huntsville, Alabama
Professors Evan and Siegel

David H. Oswalt, Assistant for General Research Agreements, Pricing Division,
Air Force Systems Command, United States Air Force
Analysis of Department of Defense policies toward independent research
and development
Professors Marquis and Muller-Thym

Robert E. Pace, Jr., Assistant Agena System Manager, George C. Marshall
Space Flight Center, National Aeronautics and Space Administration
A study of the project manager's influence on technical support groups
in a project overlay organization
Professors Marquis and Berlew

Philip A. Piro, Program Manager, Range Instrumentation Program, Radio
Corporation of America
The military electronics industry and foreign markets
Professor Bowles and Maffei

Andrew G. Swanson, Assistant Head, Vehicle Performance Branch, Applied
Materials and Physics Division, Langley Research Center, National
Aeronautics and Space Administration
Selection of project managers in a government research laboratory:
a study of the decision process
Professors Marquis and Pounds
ORGANIZATION AND MANAGEMENT OF RESEARCH AND DEVELOPMENT

A Series of Lecture Discussions
Course 15.384

Thursdays, 3:30-5 p.m., Room 52-161
Donald G. Marquis, Moderator

February 13, 1964  Introduction: Nature of R and D
February 20, 1964  Thomas J. Allen, Research Associate, SIM
                    The R and D Process: Problem Solving
February 27, 1964  Donald G. Marquis, Professor of Industrial Management
                    Evaluation and Prediction of Individual Performance
March 5, 1964      Andrew C. Stedry, Assistant Professor of Industrial Management
                    Motivation and Performance
March 12, 1964     William M. Evan, Associate Professor of Sociology
                    Effectiveness of R and D Groups
March 19, 1964     Edgar H. Schein, Associate Professor of Industrial Management
                    Supervisory Management
March 26, 1964     William F. Pounds, Assistant Professor of Industrial Management
                    Project Organization and Management
April 9, 1964      Edward B. Roberts, Assistant Professor of Industrial Management
                    Government-Industry Contracting Process
April 16, 1964     Bernard J. Muller-Thym, Visiting Professor of Industrial Management
                    Space, Communication, and Work
April 23, 1964     James C. Emery, Assistant Professor of Industrial Management
                    Management Information Systems
April 30, 1964     Martin H. Weingartner, Associate Professor of Finance
                    Construction of the Corporate Research Program
May 7, 1964        Donald G. Marquis, Professor of Industrial Management
                    Corporate Organization and Policy
May 14, 1964       William H. Gruber, Lecturer in Industrial Management
                    Impact of R and D on Economic Growth
May 21, 1964       Robert C. Wood, Professor of Political Science
                    National Policy and Organization
APPENDIX 5

PUBLICATIONS

Single copies of available publications will be supplied on request.


Stedry, A.C. Aspiration levels, attitudes, and performance in a goal-oriented situation. Industrial Management Review, 1962, 3, 60-76.

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