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ALFRED P. SLOAN SCHOOL OF MANAGEMENT

ORGANIZATION RESEARCH PROGRAM

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INSTITUTE OF TECHNOLOGY
50 MEMORIAL DRIVE
CAMBRIDGE, MASSACHUSETTS, 02139

ORGANIZATION RESEARCH PROGRAM

School of Industrial Management, MIT

In the spring of 1962 the MIT School of Industrial Management, with the support of a grant from the National Aeronautics and Space Administration, undertook to develop a program of research and education on the problems or organizing and managing large-scale technology-based enterprises. The studies under way and planned for the future are focused on the broad objective of understanding and improving the effectiveness of R & D activities relative to their goals. Statements of the underlying concepts which guide the program appear in the report of March, 1963 (Working Paper 15-63), and in talks delivered by E. B. Roberts at the September 1963 meeting of the International Management Society (Working Paper 34-63), and by D. G. Marquis at the 17th Annual Conference on the Administration of Research (September 1963, to appear in Proceedings, 1964).

The administration of the Organization Research Program is vested in a Steering Committee of seven members, and in a research director and an associate director, who are also members of the Committee (see Appendix 1, page 15).

The research associates are faculty members whose backgrounds are in a variety of disciplines: mathematics, sociology, operations research, psychology, statistics, economics, engineering, and philosophy. Research assistants are selected from graduate students who are candidates for the S.M. or Ph.D. degree. A list of all personnel is presented in the appendix. Several students who have become involved in the research have modified their career plans in order to continue work for the Ph.D. degree.

Coordination is achieved by a weekly research seminar, by many small informal ad hoc groups, and by numerous luncheon 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, leading to discussion and debate on the research design, methods, and interpretation. On several occasions an outside guest has been invited to present a paper growing out of his operating experience or relevant research. A list of topics and speakers is presented in Appendix 3.

EDUCATIONAL ACTIVITIES

In addition to the weekly seminar of the research staff and guests, several activities of a more formal educational nature are in operation or are planned for the near future.

A series of fifteen 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 for course credit and to guests from other departments and universities and from local industrial and government laboratories.

Sessions on research management have been introduced into the curriculum of the Program for Senior Executives and the Sloan Executive Development Program.

The advanced Industrial Dynamics course to be offered by Professor Roberts in the Spring Semester 1964 will feature use of a Research and Development Management Game. The game is being developed under Professor Roberts' project, "Dynamic Models of R and D Systems", and will include management decision-making in the areas of resource allocation, bidding, emphasis on product quality, and others. After course usage, the game will be made available for general distribution to those interested.

SPECIFIC RESEARCH PROJECTS

In the following pages each of the research projects is described in terms of its current status and plans for the immediate future.

1. Dynamic Models of R and D Systems

E. B. Roberts

Continuing his research in applying the philosophy and methods of Industrial Dynamics to the problems of R and D management, the investigator has under development dynamic system models of three different problem areas. The first model is based upon earlier work by Roberts on a general dynamic theory of project management, described in his forthcoming book, The Dynamics of Research and Development, to be published in early 1964 by Harper and Row. Current work with this model is oriented toward creating more simplified representations of important aspects of project dynamics for use in teaching both R and D and systems management.

The second model effort 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 principal aspects of policy with regard to allocation of engineering and management resources, technical recruting and marketing, internal stress on product quality and schedule performance, etc. The initial model developed in this research is now being modified for use as a Research and Development Organization Management Game.

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.

2. Laboratory Management and Effectiveness

R. B. Maffei
D. G. Marquis
J. R. Brown
A. J. Hansen
K. R. Hootnick (summer)
J. E. Mahoney
K. H. Marquis (summer)
I. M. Rubin
M. C. Simon (summer)

This research is obtaining ten-year histories of a number of industrial, government, and university laboratories performing contract R & D for government agencies. Relevant information on proposal success, project performance, personnel competence, growth, etc. will be related to ratings and other indexes of laboratory performance in order to build up a factual basis for formulating criteria to be used in source evaluation.

Data have been obtained on about 20 laboratories in as many firms selected from a list of the 100 firms performing the largest amount of contract research (NASA and DOD).

At the same time information is obtained on a large number of organizational and policy characteristics of the laboratory. Analysis of the present data is in process to discover which characteristics are related to the evaluation of the laboratories.

3. Project Management and Performance

R. B. Maffei
D. G. Marquis

This research, utilizing the same assistants as No. 2, is devising methods to obtain comparable data on a large number of projects 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 in the laboratories studied in research No. 2.

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.

4. Government-Industry Contracting System

E. B. Roberts
L. B. Berger
J. B. Sloat

The goal of this project is the design of policies for a more effective government contracting system. The 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; and (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 two large government centers, one in NASA and one in the Air Force. Project records have been studied and more than thirty competitive cost-plus R and D contracts (each over one million dollars in initial magnitude in the NASA case and over $100 thousand in the Air Force center) have been selected for detailed investigation. Data extracted from agency records and interviews with source evaluation board members, project managers, negotiating officers, and others is producing a view of the [illegible] system underlying contract awards which differs markedly from the formal contracting system. Data gathering for this phase of research will be completed by the end of 1964.

The second phase of this research program was undertaken during the past year. A number of companies were approached to enlist cooperation in a study of corporate proposal strategy and R and D marketing activities. An extensive interview program has been initiated with cooperating companies. The first completed company study was described in a thesis by Berger (1963). 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.

Phase three of this investigation, development of an Industrial Dynamics model of the contracting system, is now in its formulative stage.

5. Space and Work in R & D

B. J. Muller-Thym
R. W Puffer

This project, which deals with the relationship between work and the space in which it is done, is entering its final phase. 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 four subjects is derived from the continuing analysis of interview material gathered at the Goddard Space Flight Center and of data from the activities logs kept by selected Goddard personnel.

Preliminary results indicate that project personnel are acutely aware of physical constrictions which occur in the flow of work and communication but are far less concerned with actual environmental conditions such as noise or crowding. Further, there seems to be little relation between the severity of environmental problems, such as crowding, felt by project personnel and the actual measured conditions. For example, the members of one of the most successful projects, which is characterized by a perfect flight record, are among the least concerned with their working conditions while they are, by actual measurement, the most crowded.

Another finding is that project members mentally quantize space and the length of their physical travel paths rather than thinking of them as a continuum. People are "next door", "on another floor", or "in another building" rather than a specific distance away, and the difficulty in seeing them in person is quantized accordingly.

The analysis of subjects (1), (2) and (3) is now complete and writing is under way on (1) and (2). A report on(1) will be available in February, with other reports to follow in the spring.

6. Factors Influencing Technical Quality in Proposal Preparation

T. J. Allen
D. G. Marquis
M. P. Andrien

Preliminary 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.

To date, twenty-two USAF and NASA competitions have been selected and approximately 200 questionnaires have been mailed to the competing firms. Returns have thus far amounted to about 60 per cent and are still coming in at a high rate. Preliminary analysis of these returns shows substantial agreement with results reported earlier, i.e. technical competence, as evidenced by use of company specialists, and by size of technical work force, far outweigh other factors such as company size and proposal team size in influencing the technical quality of proposals; there is also an indication that attempts to substitute for in-house competence through use of outside consultants have been unsuccessful.

A V-shaped relationship has been found between the level of effort expended on the proposal and 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", above which it pays to increase one's expenditure of effort.

7. Problem Solving in Parallel R & D Contracts

T. J. Allen
D. G. Marquis
M. P. Andrien (fall)
R. J. Bjelland
W. D. Putt

Replication of problem solving is easily achieved in laboratory experimentation, but in such experiments the problems have been trivial and have not approximated the complexity of even the simplest research. Real-life opportunities for the comparative study of differing approaches to the same problem exist in government R & D proposal competitions and in miltiple award contracts. The research reported here deals with the latter situation. Parallel contracts are usually awarded for feasibility studies or preliminary designs. Since this phase of the R & D process is one that contains many of the more difficult components it is of considerable research interest.

The situation of parallel contracts affords the researcher the opportunity to make many comparisons of the way R & D groups perform their tasks. Comparisons are being made of the technical approaches considered, of the global strategies employed and of information sources utilized by the competing research groups.

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.

Each of the major NASA centers has been visited and thirteen instances of multiple award contracts have been selected. Each of the contractors has been visited and their cooperation solicited. Seventeen major companies are presently cooperating with the project. Preliminary results indicate a very high (much higher than anticipated by the project managers) rate of complete reversals and re-reversals in technical approach. There is some indication of periodicity in these changes and of their being a result of interaction among subsystem designs. Each major change will be linked by post-mortem interview to the information sources responsible.

8. The Role of the Information System in Managing an Organization

J. C. Emery
M. Gold (summer)
C. Ying (fall)

This project is examining the role of the information system in managing a large hierarchical organization having multidimensional goals. The initial phase of the study has been devoted to determination of the state of the art of information technology and its implications for planning and control. Technical constraints on planning-control systems have been investigated as have the information value-cost relationships in an organization.

The continuing research program includes consideration of use of the information system for reducing problems of suboptimization arising out of the hierarchical planning process. Computer simulation techniques may be useful here to indicate the dynamic effects of a decision in one unit on other units of the organization.

Management control activities involve comparison of actual results with the plan, and determination and reporting of significant deviations. The information system is conceived as an appropriate means for management decision analysis with an adaptive system employed for indicating recommended managerial actions.

Work has been initiated on some aspects of a computer model that will be used to simulate organizational behavior. This model will be used with an information system prototype for further study of planning and control activities.

9. Career Development of R and D Personnel

E. H. Schein
W. W. McKelvey

The purpose of this project is to develop basic information about the career patterns of scientists, engineers and administrators in NASA with a focus on those factors which enable them to maintain effectiveness, creativity and growth. The ultimate objective is the design of organizational policies and procedures to increase the competence and the contribution of researchers over their entire career.

An exploratory study using open-ended interviews, supplemented by a brief questionnaire, was undertaken during the summer of 1962. About 100 interviews ranging in length from 1 to 2½ hours were conducted at Langley and Lewis Centers.

Interview data have been coded in terms of six career orientation variables: (1) institutional -non-institutional, (2) managerial-technical, (3) movement-complacency, (4) task-interpersonal, (5) idealistic-cynical, and (6) active-passive; and four career path variables: What does it take to get ahead in NASA? (1) technical competence and performance, (2) personality, (3) visibility, recognition getting, and (4) organizational circumstances, luck.

Correlations have been obtained between orientations, career path variables, and selected demographic variables in order to determine the relationships between orientations and how the person views the organization. No significant relationships were found between orientations and ratings of the importance of technical competence and performance or personality. Ratings of the importance of recognition getting were significantly correlated with being non-institutionally oriented (+ .24), movement oriented (+ .25), and cynical (+ .29). Ratings of the importance of organizational circumstances and luck were correlated with cynicism (+ .52). Other results are currently in the process of being written up in a final report of this study and as preliminary for replicating and broadening it with a more extensive questionnaire survey.

10. Conflict and Performance in R & D Organizations

W. M. Evan
R. R. Blain
E. R. MacKethan (summer)

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 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 was designed to measure personal, motivational and organizational factors affecting conflict and performance. Following an elaborate pre-test, it was 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 and significant effect on the performance of R and D project teams Instead, it seems 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 tends to raise the level of performance, whereas in project groups engaged in applied research, conflict of any kind tends to lower performance.

A new measure of tolerance for ambiguity was developed which appears to mediate the effect of conflict on performance. Under a condition of high tolerance for ambiguity, conflict seems to be positively correlated with performance, whereas it is negatively correlated under a condition of low tolerance for ambiguity.

11. Complex Problem-Solving

O. P. Soelberg
R. E. Good

Study of unprogramed problem-solving behavior under carefully controlled laboratory conditions is one approach to understanding the creative research process. Previous experimental research has 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 strategie of problem solving. Parametric forms of such an experimental environment are programed for 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 his 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 general theory of problem solving has been formulated to account for the observed diversity of decision behavior, and to serve as an organizing framework for formulating further research questions. Results of the first experiment indicate that problem solvers who have been "shocked" by exposure to task situations in which their past experience interfered with finding viable solutions tend to be more effective than non-shocked subjects when dealing with novel (neutral) situations. However, the shocked problem solvers tend to become less efficient when returned to solving "old" familiar problems.

12. Risk and Uncertainty in Research Decisions

D. G. Marquis
J. Burns (summer)
J. Miller (fall)

In the process of research and development there is a successsion of decisions involving various degrees of uncertainty. How do research managers handle decisions requiring estimates of feasibility, cost, and schedule? 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 choose less risky alternatives in the face of uncertainty than in comparable risk problems with no uncertainty.

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-Crown test) show a larger shift between individual and group decisions.

13. Researchers' Goals and Effort Allocation

A. C. Stedry
M. M. Gold (summer)
R. H. Gawron (fall)
S. M. Levy (summer)

The purpose of this research is to gain greater understanding of managerial response to budgeted goals. Theoretical studies already undertaken (Stedry and Charnes, 1963) have investigated the kinds of effort or resource allocations that would represent rational behavior in response to a set of goals in several activities competing for scarce resources Generalization to broader classes of goal structures and the introduction of dynamic multiple budget structures is underway. Field research on effort allocation of engineers at four levels of supervision was completed in 1962 and a report was prepared as a thesis (Rubin, 1963).

Laboratory research during the summer yielded extensive data from 60 subjects in an "experimental game" modeled after a contract competitive bid situation. Subjects "win" an amount of money they bid if they submit a sufficiently low bid (bidding against a set of preselected numbers) in each trial The effect of establishing goals for winning over a set of several trials and goals for a minimum number of winning bids during a set of trials were investigated. Also the effect of running two bidding games simultaneously, with the subject restricted to a move in only one of them per trial, was studied with a goal in one game and not in the other and with both identical and disparate goals in the two games. Additional experimentation is planned with three or more games and different types of goal structures. Computer simulation of subject behavior patterns has resulted in valuable insights.

COMPLETED AND TERMINATED PROJECTS

Research Laboratory Design. John P. Eberhard, in cooperation with four graduate students in the MIT School of Architecture under the direction of Professor Eduardo F. Catalano, have completed an analysis of criteria currently used in planning research buildings. The study was based on a search of published literature and a survey by interview or questionnaire of 32 architects who had each recently designed a research building. The final report is now in draft form and will be adapted for publication. In addition each student completed a thesis which explored in concepts, drawings, and models, a possible architectural solution, using precast concrete construction, to the design of "dynamic" research buildings which would be flexibly adaptable to the requirements of the work to be done. Mr. Eberhard resigned July 1, 1963, to accept a position in the Department of Commerce.

Policy Decisions in a Government Research Agency. The support of Professor Robert Wood's project was transfered July 1, 1963 to the M.I.T. Center for Space Research, in which it will be part of the social science program of the Center. Since Professor Wood is a member of the Technical Committee of the Center, and Dean Johnson is a member of the directing Committee, close working relations between the Center and the Organization Research Program are already well established. A project on the impact of R and D on the national economy is also supported by the Center, and its director, William H. Gruber, is a member of the SIM faculty and closely related to our program.

The Process of Managerial Decision-Making. This project, in which extensive data from observation and interviews with about 50 managers were obtained, has been discontinued because Professor Bowman is on leave of absence this year.

Personality and Social Determinants of Problem Solving. Support of this project was terminated September 1963 when Professor Saltzstein accepted a full-time position teaching in Psychology at M.I.T. He is, however, continuing the work as his personal research and plans to write it up for publication.

PERSONNEL

STEERING COMMITTEE

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

ADMINISTRATION STAFF

Donald G. Marquis, Research director
Edward B. Roberts, Associate research director
Joanne Fay, Administrative secretary
Betty Benedetto, Clerk-typist
Joyce Vancini, Clerk-typist (Sept. 1 - Dec. 1)
Hannelore Machotka, Clerk-typist

FACULTY RESEARCH ASSOCIATES

Thomas J. Allen, Jr.
Research Associate, School of Industrial Management
David Berlew
Assistant Professor of Industrial Management
Irena Dubska
Research Associate, School of Industrial Management
James C. Emery
Assistant Professor of Industrial Management
William M. Evan
Associate Professor of Sociology and Industrial Management
Richard B. Maffei
Lecturer, School of Industrial 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
Herbert Saltzstein
Assistant Professor of Economics
Edgar H. Schein
Associate Professor of Industrial Management
C. Peer Soelberg
Assistant Professor of Industrial Management
Andrew C. Stedry
Assistant Professor of Industrial Management
Charles Ying
Research Associate, School of Industrial Management

RESEARCH ASSISTANTS

Maurice P. Andrien
S.B., Electrical Engineering, MIT, 1963
Laurence B. 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
B.S., Electrical Engineering, MIT, 1963
James F. Burns
B.S., Math, University of Michigan, 1961; S.M. Economics, Columbia, 1963
Arthur Capone
B.A., Physics, Amherst College, 1960; S.M., Industrial Management, MIT, 1963.
R. H. Gawron
B.S., Industrial Management, MIT, 1962
Robert Eugene Good
B.A., Business Administration, Antioch College, 1962
Michael M. Gold
B.S., Engineering Management, Boston University, 1962
James M. Gross
S.B., Industrial Management, MIT, 1961
Adolph Hansen
S.B., Chemical Engineering, MIT, 1956
Kenneth Hootnick
B.S, Chemical Engineering, MIT, 1961
Jerome Kaufman
B.S., Metallurgy, MIT, 1962
Stephen M. Levy
B.S., Economics, MIT
William S. Lewis
B.S., Electrical Engineering, University of New Brunswick, 1962
Edwin R. MacKethan III
B.E., Mechanical Engineering, Yale, 1962
James E. Mahoney
B.S., General Business, Florida State University, 1958; M.S. Industrial Management, Florida State University, 1961
Kent H. Marquis
B.A., Psychology, Yale University, 1961
William McKelvey
A.B., Physics and Economics, Monmouth College, 1960
James R. Miller
A.B., Princeton University, 1959; M.B.A. Harvard Business School, 1963
Robert W. Puffer III
B.S., Electrical Engineering, MIT, 1962
William D. Putt
S.B., Industrial Management, MIT, 1959
Randall S. Robinson
B.S. General Science, MIT, 1959

Irwin Rubin
B.S., Electrical Engineering, Tufts University, 1961
Herbert L. Selesnick
S.B., Physics, MIT, 1962
J. Barry Sloat
B.S. Engineering, UCLA, 1961
Marshall Simon
A.B., Chemistry, University of Rochester, 1962
John Thomas
B.S., Industrial Administration, Yale University, 1960
Robin Willits
A.B., Physics, Middlebury College, 1947; B.S., Business and Engineering Administration, MIT, 1948

RESEARCH SEMINARS

September 27, 1963	Edward B. Roberts, Assistant Professor, S.I.M. Review of Current Research on R and D Management.
October 4, 1963	William H. Gruber, Lecturer, S.I.M. Impact of R and D on the National Economy.
October 11, 1963	Louis B. Barnes, Associate Professor of Organizational Behavior, Harvard Business School. Early Social Factors in the Career Development of Technical Men.
October 18, 1963	Richard B. Maffei, Lecturer, S.I.M. Measures of Effectiveness in Research and Development Projects.
October 25, 1963	Ingard M. Clausen, Jr., Manager, Management Systems, General Electric-Valley Forge Space Technology Center. What's Wrong with Program Controls?
November 1, 1963	William M. Evan, Associate Professor of Sociology and Industrial Management. Conflict and Performance in R and D Organizations.
November 8, 1963	William F. Pounds, Assistant Professor, S.I.M. Problem Solving Control Processes.
November 15, 1963	Thomas J. Allen, Jr., Research Associate, S.I.M. Problem Solving in Parallel Research Projects.
November 22, 1963	Edward B. Roberts, Assistant Professor, S.I.M. Gov't Decision-Making in the Award of R and D Contracts.
December 6, 1963	James R. Bright, Professor of Business Administration, Harvard Business School. What Shall We Teach: R & D, Technology, Innovation, or Nothing?
December 13, 1963	David E. Berlew, Assistant Professor, S.I.M. Research in Career Stress and Coping Behavior of Managers.
December 20, 1963	Ernest D. Phelps, Assistant to the Dean of the School of Engineering, M.I.T. Movement of Professional Personnel and Knowledge in an Electronics Laboratory.

APPENDIX 4

THESES CURRENTLY IN PROGRESS

Graduate Students

Larry Berger, S.B., Industrial Administration, M.I.T., 1963.

A study of company strategy toward research and development programs.

Professor Roberts

Rudolph H. Gawron, S.B., Industrial Management, M.I.T., 1963.

The effects of budgetary participation on performance: a laboratory experiment.

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.

Nature of parameter estimation in program planning techniques.

Professors Maffei and Smith

Leon H. Liebman, S.B., Economics, University of Pennsylvania, 1962.

Resource allocation and control with a PERT network.

Professors Amstutz and Little

James Mahoney, M.S., Industrial Management, Florida State University, 1961.

A study of the relationship between laboratory organization and project effectiveness.

Professor Marquis

J. Steven Ott, S.B., Labor Management Relations, M.I.T., 1960.

A questionnaire study of organizational climates.

Professors McGregor and Schein

William Putt, S.B., Industrial Management, M.I.T., 1959.

Managerial response to reductions in resources in research and development.

Professors Marquis and Stedry

Graciano Sa, S.B. Electrical Engineering, U. Rio Grande de Sul, 1958.

Solutions to network schemes of control.

Professors Little and Pounds

Barry Sloat, S.B., Engineering, UCLA, 1961.

The effects of company contract procurement strategies on the research and development contracting process. Professor Roberts

John Thomas, S.B., Industrial Administration, Yale University, 1960.

Project manager relationships in formal organizations.

Professor Marquis

Archie Wood, S.B. Military Engineering, M.I.T. 1950; Weapon Sys. Eng., M.I.T., 1955.

Professor Roberts

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.

Obsolescence of engineering knowledge: a management problem.

Professors Schein and Smith

George P. Fryling, II, Vice President - Operations, Erie Resistor Corporation.

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 Machine's Corporation.

The financial consequences of depth versus breadth in R and D activity.

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.

Professor Evans

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 Systems Manager, George C. Marshall Space Flight Center, National Aeronautics and Space Administration.

The influence of the project manager on technical support groups in a project overlay organization.

Professors Berlew and Marquis

Philip A. Piro, Program Manager, Range Instrumentation Program, Radio Corporation of America.

Factors in successful marketing of military and space electronic equipment in Europe.

Professors Bowles and Maffei

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