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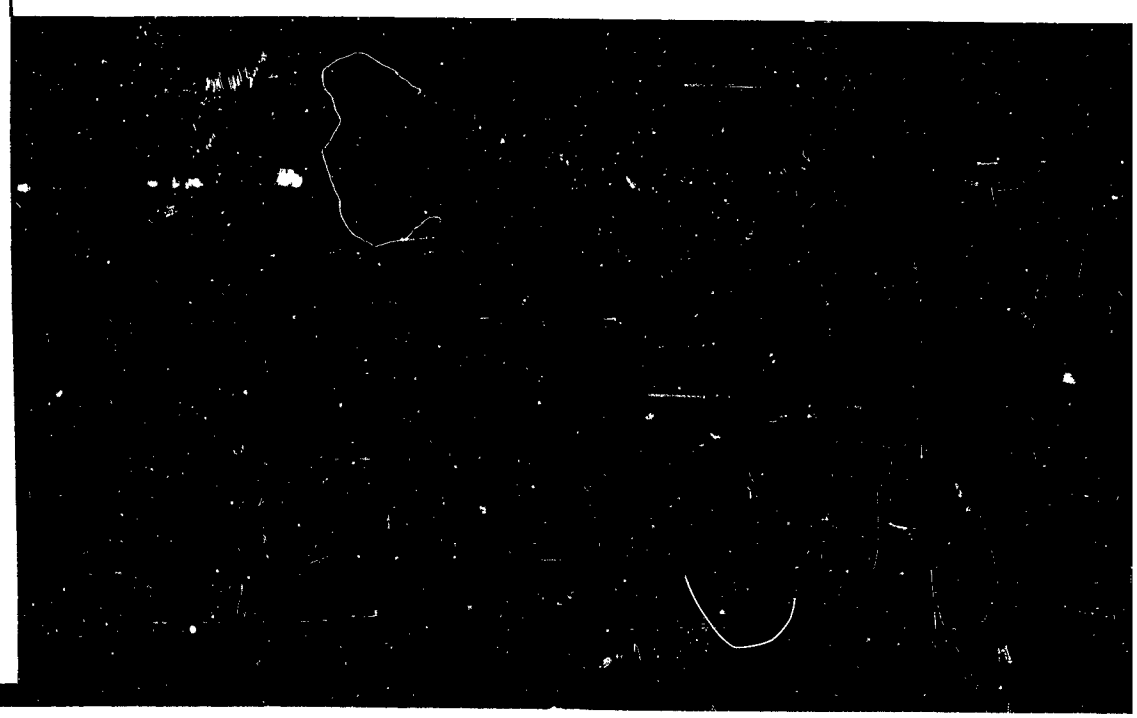
LONG-RANGE PLANNING AND TECHNOLOGICAL FORECASTING: AN ANNOTATED BIBILIOGRAPHY

SPECIAL RESEARCH BIBLIOGRAPHY
SRB-63-12

NOVEMBER 1963



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Compiled by
PETER R. STROMER

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Lockheed

MISSILES & SPACE COMPANY

A GROUP DIVISION OF LOCKHEED AIRCRAFT CORPORATION

SUNNYVALE, CALIFORNIA

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ABSTRACT

A survey has been made of the recent aerospace and business management literature covering the broad spectrum of long range planning and technological forecasting. While emphasis has been placed on applicability to the aerospace and defense industry, additional inputs detailing the general philosophy and techniques of industrial and government planning and related subject-fields of economic projections, resource allocations, and cost analyses have been included. A subject index facilitates use of this material. The resources of the Lockheed Missiles & Space Co., Technical Information Center, were utlized in the bibliographic preparation.

Search was completed in November 1963.

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LITERATURE SEARCH CAPABILITY DEFINED

The engineering/scientific staff of LMSC is supported by a strong corps of research information specialists whose members ferret out precise information or data pertaining to the bench effort of scientists and engineers. These information sleuths operate in close and constant liaison with the scientist/engineer. The parameters for each search are specified by the engineer or scientist whereupon the information specialist examines the world-wide literature and forwards to him citations and abstracts relating to the subject; language is no barrier. The search also often identifies other authorities in the subject field, recent and current contracts responsive to similar research efforts, and corporate groups or agencies having high capability [illegible]

Throughout the literature search, the requester is continuously advised of new findings, chiefly in abstract format. At the conclusion of the search, the information specialist organizes these abstracts and prepares for publication an annotated bibliography, a literature review, or other suitable reports as required. Publication is advisable even if the search is not a specified end item of the contract, since it proves LMSC's concern for quality and non-duplicative effort. Furthermore, the printed special bibliography is given standard internal distribution, including the TIC, which, via the cataloging technique, makes the information available to others at LMSC and, of course, serves to eliminate repetition and possible duplication of research which the bibliography itself supported. It is also preferably initially distributed to key government agencies and institutions, as well as to the major federal documentation centers from whence wide and deep national and international dissemination is effected on a need-to-know basis against specific request. Such dissemination assists in the control of literature on related research underway elsewhere in the scientific community.

1. Aerospace Industries Association (AIA)
AEROSPACE TECHNICAL FORECAST 1962-1972.
Washington, D.C., AIA, 1962.

Long term predictions of the precise directions in which technology and industry will develop under the impetus of space travel and high speed flight are an obvious impossibility. However, the broad trends in technical development and a general outline of the technology required by 1972 can be presented. Emphasis is given to engineering interpretation of future trends in operating environments and systems design, which will require new demands in the fields of materials, components, subsystems, design, manufacturing and testing. A life-cycle chart of a typical aerospace vehicle is included.

2. Arms Control and Disarmament Agency
ECONOMIC IMPACTS OF DISARMAMENT.
Washington, D.C. Jan 1962, 28p.

Am important pamphlet worthy of consideration in aerospace long range planning programs. The reports panel concludes that while economic problems following general disarmament are not insuperable, they do require the development of sensible adjustment policies and vigorous government leadership for solution.

3. Barach, A.B.
1975 AND THE CHANGES TO COME. New York,
Harper & Brothers, 1962

An imaginative book including illustrations and photographs of the designs, plans, and equipment foreseen in use in 1975. The author takes the facts of the past and present and projects them into the future.

4. Beckwith, W.C. and H. L. Johnson
ADVANCED SPACE MISSION CAPABILITIES
OF NUCLEAR ROCKETS. Presented at the AIAA
Summer Meeting, Los Angeles, June 17-20, 1963.
(AIAA Paper 63-286). 24p. (Also available from
NASA as N63-17813)

A study has been conducted to provide performance, operational cost and reliability data for the SATURN V and NOVA launch vehicles using nuclear engines, and to estimate the possible mission capabilities. Results indicate the following: (1) The

SATURN V chemical/nuclear system yields approximately a 60%-payload improvement over the all chemical SATURN V. This ratio is seen to decrease on the NOVA vehicle to about 50%. This reduction is primarily a reflection of the reduced thrust of the nuclear stage relative to the first stage vehicle. (2) Nuclear propulsion has a unique position operationally and economically, particularly in the velocity range of V_{OO} = 0 to 40,000 ft/sec, and (3) Lunar manned and logistics flights, Mars/Venus flights, and deep space probes with increased payload capabilities will be possible.

5. Black, T. Jr.
OUTER SPACE: THE PROSPECTS OF INTERNATIONAL REGIMES. American Institute of Aeronautics and Astronautics, Summer Meeting, Los Angeles, Calif., June 17-20, 1963, Paper 63-244. 10p.

Brief consideration of the state of international relations in terms of outer-space conquest and communications satellites. The pre-emptive approach to satellite launchings, nuclear testing, and space probes under conditions of greatest secrecy and with minimal feedback of scientific information is exposed, and its dangers for the future are considered. It is believed that the ultimate result of the nationalistic approach is likely to lead to attempts at world domination, and thus to all-out conflict. It is concluded that the state of mind among world powers will not be ready for acceptance of regulation prior to the 1970's and that, by the time they acquiesce, we shall have seen landings on the Moon and shall be looking for other worlds to conquer. The establishment of an International Astronautics Control Commision is questioned, as is the ability of the United Nations to develop acceptable standards for the control of outer space.

6. Bowman, D. O.
Organization and steps in long-range planning, Autonetics Division of NorthAmerican Aviation, Inc. In MANAGERIAL LONG RANGE PLANNING, Steiner, G.A., Ed., N.Y., McGraw Hill, 1963, p.141 - 162.

North American Aviation requires that each of its divisions prepare and submit annually a 1, 5, and 10 year plan. Contents of the Autonetics 10 year plan, 1963-1972 are reviewed. The one-year plan enables each executive to review last year's accomplishments against those planned for the new year and to consider both in relation to his long-range plan.

7. Bright, J. R., ed.
TECHNOLOGICAL PLANNING TO THE CORPORATE LEVEL. Boston, Division of Research, Harvard Business School, 1962.

Proceedings of a conference sponsored by the Harvard Business School. Papers vary throughout the spectrum of the title topic, from the broad viewpoint of corporate philosophy down through specific tasks such as evaluating research proposals and results. (Selected papers have been abstracted separately within this bibliography.)

8. Brooks, D. L.
Choice of pay-offs for military operations of the future. OPERATIONS RESEARCH, 8:159–168, 1960.

Studies which relate to decisions affecting the course of possible military operations in the distant future face the familiar pitfalls of operations research in a particularly aggravated form, due principally to the broad context in which such decisions typically appear. This paper discusses means for avoiding undesirable suboptimization, for including the effects of feed-back and competition, and for introducing the effect of significant constraints when choosing criteria on which to base long-range planning decisions. Several new measures of merit are presented which emphasize the feature of "R and D" leverage over potential enemy countermeasure developments. For decisions affecting possible near-term military operations, it is suggested that operations-research studies can profitably emphasize the optimization of (a) deployment of existing forces, (b) military decision-making processes. These near-term problems, like their long-term counterparts, must also be studied with reference to future goals.

9. Burke, W. F.
General management of space programs industry viewpoint. In 2ND MANNED SPACE FLIGHT MEETING. New York, American Institute of Aeronautics and Astronautics, 1963, p. 364–369.

Consideration of the need for expanding the boundaries of the aerospace industry. Tables and graphs show the increase in production, expenditures for missile and space studies, salary classifications, and companies gained by acquisition, from 1951 to 1961, with extrapolations for expenditures to 1970. Examples of the growth in test facilities discussed include those for the Gemini and Mercury projects. The need for more trained manpower is emphasized.

10. Bush, G.A.
Prudent-manager forecasting; new approach to long-range planning. HARVARD BUSINESS REVIEW, 39:57-64, May-Jun 1961.

Lockheed LRP technique which brings together a small group of seasoned specialists representing such functions as marketing, research, finance, engineering, and administration and asks them to assume the role of decision-making managers in a customer firm that is evaluating one of the firm's products for purchase. Prudent evaluation of the facts available lead to preferred procurement decisions from the customer's point of view.

11. Clark, F.W.
PLANNING CONCEPTS FOR ASD INFORMATION/DECISION SYSTEMS. Aeronautical Systems Div., Air Force Systems Command, Wright-Patterson Air Force Base, Ohio. Jan 1963, 20p. ASD PN ASOP63 1. ASTIA AD-405 614

A foundation for the planning effort needed to furnish ASD with a management system which takes fullest advantage of the best tools available is presented. Thirteen categories of concepts pertaining to the ASD decision system in the 1965-75 time period are identified. Each category is described and the ASD concept stated in terms broad enough to retain validity for an extended period of time, yet in sufficient detail to provide a preliminary basis for describing or measuring progress toward the attainment of an adequate information/decision systems.

12. Deutsch, K.W.
Outer space and international politics: a look to 1988. In OUTER SPACE IN WORLD POLITICS. J. M. Goldsen, ed. N.Y., F.A. Praeger, Publisher, 1963, p.139-174.

Author is Professor of Political Science at Yale University. He assumes there will be no total nuclear war in the 1963-1988 period and bases his predictions on that assumption.

13. Drucker, P.
Long-range planning, challenge to management science. MANAGEMENT SCIENCE 5:238–249, 1959.

Author defines long range planning as the organized process of making entrepeneurial decisions. He also attempts to show what long range planning is not-namely, it is not forecasting, it does not deal with future decisions, but with the futurity of present decisions.

14. Electronic Industries Association
PROCEEDINGS OF THE DEFENSE PLANNING SEMINAR, 13 MARCH 1962. Washington, D.C. (Available from the Electronics Industries Association.)

Proceedings volume includes papers delivered by representatives of government and industry on the general subject theme, the new look in defense planning. Of particular interest is the paper by W. F. Ballhaus, Northrop Corp. entitled "Industry's role in defense planning."

15. Ewing, D.W., ed.
LONG-RANGE PLANNING FOR MANAGEMENT. New York, Harper & Brothers, 1958.

The contributors to this book analyze a series of long range planning problems, suggest ways of coping with them, and seek to stimulate fresh thinking about management's approach. The aerospace industry is represented in an article by L. Eugene Root and George A. Steiner entitled, "The Lockheed Aircraft Corporation Master Plan." (p. 136–156).

16. Evans, M.K.
Profit planning. HARVARD BUSINESS REVIEW 37:45–54, Jul – Aug. 1959

Earnings, the ultimate goal of long range planning, can easily become obscured in management plans. This article depicts the concepts used by Westinghouse to provide for systematic analyses of costs and evaluations of the effects of alternative proposals on profits.

17. Fisher, G. H.
ANALYTICAL SUPPORT FOR DEFENSE PLANNING. Rand rept. P-2650, 6p.
Nov 1962

A discussion of analytical techniques to assist in the defense-planning process. The paper describes (1) the complex problems, formal analytical structure, and contributions of systems analysis and (2) the application of war gaming to limited war problems. The side benefits that have come about concurrently with the development and use of systems structure cost analysis and program budgeting, Monte Carlo methods, new computational techniques, dynamic-programming concepts and methods, and new concepts and methods for measuring system effectiveness. The shortcomings of these analytical methods are discussed. Presented before a long-range planning meeting, held at the Allison Division of General Motors Corporation at Indianapolis, Indiana, October 17–18, 1962.

18. Fisher, G. H.
Aspects of corporate planning in the defense industry. In PLANNING AND FORECASTING IN THE DEFENSE INDUSTRIES. Stockfish, J. A., ed. Belmont, Calif., Wadsworth Publishing Co., Inc. 1962. p.67–87.

Author is with Rand Corp. One of the primary objectives of this paper is to indicate the importance of viewing the bases for long range corporate planning in a context that takes explicit account of uncertainty. An appendix is entitled "Decision Making Under Conditions of Uncertainty" with brief discussion on modern decision theory.

19. Fisher, G. H.
A DISCUSSION OF UNCERTAINTY IN COST ANALYSIS: A LECTURE FOR THE AFSC COST ANALYSIS COURSE. Rand rept. no. RM-3071-PP DDC AD-279936, Apr 1962. 33p.

One of a series of studies to assist with the preparation and teaching of a course in cost analysis concepts and techniques at the Air Force Institute of Technology. This memorandum discusses the problem of uncertainty in cost analysis of future military systems and forces. Two major source of uncertainty are outlined: requirements uncertainty and cost-estimating uncertainty. Several proposals for dealing with the problem are also presented.

20. Fisher, G. H.
MILITARY SYSTEMS COST ANALYSIS (A SUMMARY LECTURE FOR THE AFSC COST ANALYSIS COURSE).
Rand rept. no. RM-2975-PR. 22p. Jan 1962.

A discussion of cost analysis as it refers to the determination of the probable economic resource impact of future Air Force weapon and support systems. Five major aspects of cost analysis are stressed: understanding the problem or context in which the cost estimates are to be used, assembling the basic data, deriving cost-estimating relationships, using these relationships to make an estimate, and presenting the results. Both hardware and nonhardware system cost components are discussed, and the sensitivity of total system cost to variations in the cost and characteristics of these components is considered.

21. Fisher, J. L., and H. H. Landsberg
Natural resources projections and their contribution to technological planning. In TECHNOLOGICAL PLANNING AT THE CORPORATE LEVEL, Bright, J. R., ed., Boston, Harvard Business School, 1962. p. 118-145.

Natural resource projections are defined as disciplined, systematic forward estimates of demand for and supply of land, water, energy commodities, and metallic and nonmetallic minerals. A few specific projections for 1980 and 2000 are presented.

22. Focusing farther and sharper; Stanford Research Institute has developed ways to organize long-range planning. BUSINESS WEEK 1761: 54-61, 1 June 1963

Brief description of Stanford Research Institute's Long Range Planning Service. By use of an elaborate series of plans, one for each corporate activity, the SRI Service attempts to put the planning process into an orderly series of steps, giving executives the information they need for decision-making.

23. Friedman, J.J.
Long range planning and cloudy horizons.
DUNS REVIEW AND MODERN INDUSTRY, 81:42–43 ff, Jan. 1963.

Brief survey of various companies' approaches to long-range planning, including GE, IBM, W.R. Grace, AMF. Distinction is made between economic forecasting and long range planning, i.e., forecasts help to define the environment, but they don't dictate your decisions.

24. Galt, J. L.
Advanced planning charts path to new markets and profits. IRON AGE 191:70–72, 16 May 1963.

Planning at General Electric Co.'s Missile and Space Division, Philadelphia, Pa. Author's formula for successful LRP: Getting and keeping the best planners, developing a dynamic program looking 5 to 10 years ahead, and earning the buyer's confidence with performance, service, and cost control.

25. Gilmore, F. F., and R.G. Brandenburg
Anatomy of corporate planning. HARVARD BUSINESS REVIEW, 40:61–69, Nov 1962.

By proposing a planning framework, this article attempts to organize concepts which can contribute to the body of useful definitions and assumptions about business cited by Peter Drucker as prerequisites for a more effective discipline of management. Authors developed their project with an intensive study of the military decision-making process and then compared their analog of the military model with the top management planning process employed by Lockheed Aircraft Corp.

26. Gray, E. Z.
Future spacecraft design requirements and trends-manned systems. In 2ND MANNED SPACE FLIGHT MEETING. New York, American Institute of Aeronautics and Astronautics, 1963. p.351–359.

Operational considerations for military and scientific manned space missions are presented. The future space program plan is outlined and is seen to include Earth-to-orbit shuttle-type spacecraft, permanent orbiting stations, orbit-to-orbit shuttles, longrange interspace transports, and fixed lunar bases. Environmental

requirements, including meteoroid and radiation data, are considered. A description of suborbital operations includes present studies and trends in launch and injection operation, space propulsion, reentry vehicles, and vehicles for the landing phase. It is expected that manned spacecraft of the future will emphasize operation at high-orbit altitudes. They will require use of space propulsion for rendezvous, space maneuvers, and return. The propulsion units will be separable and disposable for high-altitude operation, even when recoverable first stages are used. Re-entry spacecraft will require use of lift to provide sufficient corridor width for superorbital re-entry. For operational systems, the L/D range over 1.0 appears the most attractive, considering all the variables affecting re-entry accuracy. Variable geometry plus rocket augmentation will be used to provide landing-site acquisition and all-weather landings.

27. Hauer, S., G. Tabata and R. Waters
Launch vehicle cost analysis and system evaluation.
In 2ND MANNED SPACE FLIGHT MEETING.
New York, American Institute of Aeronautics and Astronautics, 1963. p.51-56.

Summary of a technique for developing cost category models for performing cost analyses and system evaluations for different launch vehicle designs in the Saturn and Nova classes. Design values for the C-1 launch vehicle are used, and estimated costs for this system are listed.

28. Herwald, S.W.
Appraising the effects of the technological state of the art on the corporate future. In TECHNOLOGICAL PLANNING AT THE CORPORATE LEVEL. Bright, J.R., ed., Boston Harvard Business School, 1962. p.52-69.

Author's guidelines: (1) choose those areas of technology that bear on a particular functional performance. (2) Be aware of proper timing for profitability considerations and (perhaps most important in the aerospace industry,) (3) pay particular attention to those technologies that are likely to change the mode of the business we're in.

29. Hitch, C. J. and R. N. McKean
THE ECONOMICS OF DEFENSE IN THE NUCLEAR AGE. Cambridge, Mass., Harvard U. Press, 1960

Authors regard military problems as economic problems in the efficient allocation and use of resources. Projections include possible Gross National Products of major world powers for 1965 and 1975; possible defense budgets, 1965 and 1975. Essentially this is a good text on applied military operations research.

30. Hoeber, F. P.
POTENTIAL FOR EXPANSION OF NATIONAL SECURITY PROGRAMS – A STUDY OF ECONOMIC FEASIBILITY. Stanford Research Inst., Menlo Park, Calif., Oct 1960. 165p. (Contract DA04 200 5060RD710, proj. IU2351 101) ASTIA AD-408 725.

This study was designed to investigate the total amount of resources that the United States could devote to national security programs, assuming continuing peacetime, cold-war conditions during the decade of the sixties. Specifically, it considers the feasibility of achieving certain levels of expansion of total national security expenditures, within the short leadtimes of a three-year buildup, as well as the longer-run rates of continued growth of these expenditures that could be sustained thereafter. Feasibility is evaluated in terms of resource availabilities and tax requirements, monetary policy, inflation, need for direct controls, the international balance of payments, and associated levels of other government activities and of private investment and consumption. No attempt is made here to evaluate the necessity for any given defense programs or any particular level of security expenditures. Efficiency in existing and new programs, and economics in government operations are considered to be outside the scope of this inquiry.

31. Hoffman, F. S.
THE ECONOMIC ANALYSIS OF DEFENSE: CHOICE WITHOUT MARKETS. Rand rept. P-1582. 18p. 19 Dec 1958. (The American Economic Review; May 1959). Published in proceedings of American Economic Association, Chicago, Ill., 27 Dec 1958.

The application of some of the more general concepts and propositions of economic theory to military decision making, with particular attention given to the allocation of scarce resources for research among competing uses. Research on defense problems must be carefully defined by the construction of a preference ordering, a knowledge-getting

process to discover more about alternatives. In turn, this knowledge suggests new objectives and instrumentalities to make a preference ordering possible in the face of inherent uncertainties. Objectives of this research must be appropriately modest by measuring our desire for ever better decisions against the limited resources available to improve these decisions.

32. Huntington, S. P.
THE COMMON DEFENSE, STRATEGIC PROGRAMS IN NATIONAL POLITICS. N. Y., Columbia Univ. Press, 1961.

This book's purpose is to analyze some of the patterns of politics and decision-making which shaped the speed and the nature of changes in American military policy between 1945 and 1960. Author focuses specifically on decisions affecting the overall size of the military effort, force levels, and weapons.

33. Hyatt, Abraham
Planning for the future goals of NASA. In NASA AND THE UNIVERSITIES, PRINCIPAL ADDRESSES OF THE GENERAL SESSIONS, NASA-UNIVERSITY CONFERENCE ON THE SCIENCE AND TECHNOLOGY OF SPACE EXPLORATION, CHICAGO, ILL., 1 Nov 1962. NASA EP-5. p. 15-24.

Paper explains the broad objectives and goals of NASA and some of the principal constraints which must be considered in planning for their attainment, namely annual funding appropriations and the physical constraints of time and energy.

34. Ikle, D. M.
HOW ARMS CONTROLS WOULD AFFECT THE NATIONAL SECURITY BUDGET. Rand rept. P-2255. 14p. 21 Mar 1961. (Air Force and Space Digest, Oct 1961).

An attempt to estimate the impact of arms controls on the future budget by considering (1) the savings resulting from the specific restrictions imposed by the agreement, (2) the cost of the inspection and control system, (3) the change in military requirements resulting from the agreement, and (4) the institutional factors which influence the level of the budget. All types of arms control agreements are likely to increase military

budgetary requirements in the first year, including general and complete disarmament. In the long run, arms controls may reduce the national security budget substantially if agreements are aimed at curtailing the ability to wage war. However, if the agreements are designed only to reduce the likelihood or destructiveness of war, expenditures may even increase in the long run.

35. Joy, D.P and F. D. Schnelly
A COMPREHENSIVE ANALYTICAL BASIS FOR LONG-RANGE PLANNING DECISIONS IN FUTURE MANNED SPACE AND LUNAR-BASE PROGRAMS. Presented at the American Rocket Society 17th Annual Meeting, Los Angeles, Calif., Nov 13 – 18, 1962. ARS Preprint 2714-62.

Authors develop a formalized systems approach to decision-making for second-generation, post-Apollo manned space programs. A comparative evaluation is made of ten alternative candidate manned space program plans. Forecast are manned earth orbital space stations (1968 to 1970) manned lunar bases (1970 to 1972) and manned planetary expeditions (1972 to 1974).

36. Kahn, Herman
MAJOR IMPLICATIONS OF A CURRENT NONMILITARY DEFENSE STUDY. Rand rept. P-1497-RC. (Bulletin of the Atomic Scientists, Jan 1959) 14p. 20 Jan 1959.

A study suggesting that for the next 10 or 15 years feasible combinations of military and nonmilitary defense measures can preserve society. The measures discussed are intended as insurance against the possible failure of first-priority measures and as a complement to them. It is suggested that $500 million be spent in the next 2 or 3 years, over and above current budgets, to achieve (1) the creation of modest but worthwhile capabilities by reorienting and strengthening the current civil-defense programs; (2) research and development on all aspects of the state of the art of nonmilitary defense; (3) an effort to develop systems design of various combinations of military and nonmilitary defense; (4) the proper balance between military and nonmilitary expenditures; and (5) inexpensive preparatory actions for use in the 1965 to 1970 time period.

37. Klein, B. H.
POLICY ISSUES INVOLVED IN THE CONDUCT OF MILITARY DEVELOPMENT PROGRAMS.
Rand rept. no. P-2648, Oct 1962. 29p.

A discussion of some issues involved in the conduct of military research and development. In examining the essential nature of this activity, the author attempts to determine (1) why weapon systems undergo pronounced changes in the course of development and (2) when in the development process it can be determined if the product is going to work and how much it will really cost. The implications of these problems for research and development policies are twofold. The government should be devoting a significant proportion of its R and D expenditures to research and development activities falling outside the major weapon systems programs. In addition, the approach taken in systems development projects should be experimental. The obstacles in getting R and D policies better oriented in these directions are indicated. Presented before the Conference on Economics of Research and Development at Columbus, Ohio, October 15-17, 1962.

38. Koelle, H. H.
LONG RANGE PLANNING FOR SPACE TRANSPORTATION SYSTEMS. National Aeronautics and Space Administration.
Jan 1961. 36p. (NASA TECHNICAL NOTE D-597).

Integrated space operations planning is based upon balancing the available resources with expected expenditures in the areas of research and development, facilities, payloads, and basic space transportation. Some system parameters effecting long-range planning for launch vehicles are discussed in detail. Trends in space transportation cost for earth-orbital, earth-lunar, and earth planetary missions for the next decade are given, based on typical programs.

39. Koelle, H. H.
TRENDS IN EARTH-TO-ORBIT SPACE TRANSPORTATION SYSTEM. Deutsche Gesellschaft für Raketenechnik und Raumfahrt, European Space Flight Symposium, 3rd, Stuttgart, Germany, May 21-24, 1963, Paper 1503(63.) 12p.

Critical review of the accomplishments of space flight in the past 5 years. A general examination of launch-vehicle development trends is given, indicating further

reduction of space transportation cost. The trends which can be expected for characteristic system parameters of Earth-to-orbit space transportation systems are then projected on the basis of a hypothetical launch rate model. It is shown that the "specific direct operating cost" for cargo transportation to Earth orbit should improve by four orders of magnitude in one generation (25 yr) and that our capabilities for accomplishing space missions should increase by five orders of magnitude in 20 yr. It is concluded that the space transportation capacity for multiple orbital, lunar, and planetary programs should become available in the late 1970's.

40. Lenz, Ralph Charles, Jr.
TECHNOLOGICAL FORECASTING.
Aeronautical Systems Div., Air Force Systems Command, Wright-Patterson Air Force Base, Ohio. Jun 1962. 106p.
(ASD TDR 62-414) DDC AD-408 085.

This study presents several methods of forecasting rates of technological advance. The methods include forecasting by extrapolation of existing rates; by analogies to biological growth processes; by precursive events; by derivation from primary trends; by interpretation of trend characteristics; and by dynamic simulation of the process of technological improvement. The investigation included a search of the literature for references to principles of technological progress and for methods which have been used for predictive purposes. Each method of forecasting is first presented from the standpoint of the logic which supports its use for predictive purposes. This presentation includes a criticism of errors made in prior exposition or use of the method. Each method is next presented in terms of the technique used to forecast. The application of the method to typical forecasting problems is presented in general terms, followed by examples which demonstrate the use of the method in specific cases. Each of the methods offers the opportunity of making a forecast of progress which explicitly predicts quantitative improvements of technical performance to be achieved at definite future times. The use of multiple methods for prediction of a single quantity offers confirmation of results, or alternatively, establishes a range of possible rates of progress. The forecasting methods in this investigation favor the conclusion that prediction of technological progress can be extended beyond the limits of purely intuitive processes. The application of the methods presented should substantially improve long range plans not previously supported by carefully established forecasts.

41. Linstone, H. A.
An approach to long-range planning, a discussion of the MIRAGE 70 study.
In PLANNING AND FORECASTING IN THE DEFENSE INDUSTRIES, Stockfisch, J. A., ed.
Belmont, Calif., Wadsworth Publishing Co., Inc., 1962. p. 89–133.

Paper based on a Hughes Aircraft Co. study to facilitate long-range corporate planning. The study was for the 1965–1970 period. Completed in Feb 1960, it emphasized items in several areas, e.g., counter insurgency, which are only now receiving publicity. Thus a potential gain of at least one year in company lead time was possible by taking the "right risks".

42. Little, Arthur D., Inc.
HOW SICK IS THE DEFENSE INDUSTRY?
Arthur D. Little Rept. no. C-57904-51.
10 May 1963.

The United States Department of Defense is the biggest customer for goods and services in the free world. A vast industry has sprung up in the past 25 years to satisfy the demands of this monolithic consumer. Because of the very size of DOD, its unique requirements, and the necessity that it be primarily concerned with the quality of an intangible product – defense – rather than normal commercial goals, the defense industry has, in turn, developed some curious attributes.

This report consists of eight sections devoted to: an introduction, a description of the defense market as it currently exists, a survey of the legal framework that surrounds defense contracting, a discussion of industry profitability, a suggested approach to realistic financial analysis of the industry, an evaluation of the risks involved in serving the market, a brief look at what the future will hold for contractors, and, finally, some thoughts relevant to planning for profitable participation in tomorrow's market. An extensive bibliography is provided for those who wish to pursue the subject further.

43. Management Systems Corp., Cambridge, Mass.
DEVELOPMENT COST ESTIMATING SURVEY.
24 Jun 1963. 1v. Contract SD142, Task 3.
DDC AD-408 987.

The primary objective was to provide data and techniques which will permit ODDR&E to better appraise development cost estimates on future weapon systems. The initial

scope was defined in three parts: (1) A survey and evaluation of cost estimating techniques already developed and sources of pertinent historical data; (2) Collection and analysis of past data; development of p. ametric estimating relationships; and (3) A plan for enhancing future ODDR&E car ility through data collection and iterative revision. This report documents a survey of development cost estimating techniques and sources of pertinent data on past weapon systems. It catalogues and codifies most of the available information on this subject and outlines the sources of appropriate historical data. In addition, the survey provides a basis for defining the analytical and data collection program to follow.

44. Marshall, A. W. and W. H. Meckling
PREDICTABILITY OF THE COSTS, TIME, AND SUCCESS OF DEVELOPMENT. Rand rept. no. P-1821. 11 Dec 1959.

Results of some recent research into the extent and nature of the uncertainty in new developments, with emphasis on problems of development in the Air Force. "Early" estimates of important parameters are usually quite inaccurate because they are "biased" toward overoptimism and because the errors in estimates evidence a substantial variation. The accuracy of estimates is found to be a function of the stage of development, i.e., estimates improve as development of the item progresses. 24 pp. Tables. Presented before the Conference on the Economic and Social Factors Determining the Rate and Direction of Inventive Activity, held at the University of Minesota, Minneapolis, Minnesota, May 12–14, 1960.

45. Martin, B. P.
Manned flight to Mars and Venus in the 1970's.
In 2ND MANNED SPACE FLIGHT MEETING.
New York, American Institute of Aeronautics and Astronautics, 1963. p. 236–253.

Velocity requirements, associated with various flight paths to Mars and Venus, and the resulting propulsion and re-entry weights are combined and varied with other mission system weights which are a function of mission goals, trip time, and environmental protection. From these weight trade-off analyses there are evolved spacecraft design concepts and total mass requirements on Earth orbit to accomplish the various missions. Mass requirements, so established, are compared with launch rocket capabilities. System requirements described, to determine total mass requirements for Earth orbit are: (1) propulsion systems for Earth-orbit departure; (2) Earth-entry systems for different missions; (3) life-support systems; (4) navigation and control systems; (5) reconnaissance and scientific instrumentation for gathering data during

course of missions, and requirements for storage and/or readout; (6) space power-supply systems; and (7) vehicle-design concepts.

46. Mason, J. L. and W. L. Burriss
Problems and progress with long-duration life-support systems. In 2ND MANNED SPACE FLIGHT MEETING. New York, A.I.A.A., 1963. p.329–340.

Life-support systems designed for long durations will be required for such future manned missions as the space station, the lunar base, and the expeditions to Mars and Venus. In order to realize the full scientific potentialities for these missions, the life-support systems should be designed for essentially indefinite operation, with a minimum consumption of stored or resupplied expendables, to reserve vehicle payload capability for scientifically meaningful equipment. Of course, there are state-of-art limitations imposed on system design for a particular mission.

Spacecraft life support encompasses the functions of thermal and atmospheric control, water management, waste management, food supply, and personal hygiene. Because these functions are fundamentally interrelated by energy and material balances that may override other considerations for long-duration missions, functional comparisons on a system basis are necessary. The relationships between the life-support system and other vehicle systems such as the power system are extremely important in arriving at an integrated optimum vehicle system.

For missions beyond the two-week class now under development there will be a strong tendency toward further conservation of expendables. This development is, necessarily, at the expense of power consumption substantially higher than the power requirements for current life-support systems.

In advanced life-support systems for long-duration missions, emphasis will be placed on the processing of waste products to conserve essential materials such as oxygen and water. Closure of the oxygen and water loops will be essential to avoid excessive penalties. Complete closure of the material loop by food production appears to be in the distant future because of the complexity of man's dietary requirements.

This paper discusses recent progress and present status, and presents many of the development problems that must be solved to achieve a completely integrated and reliable life-support system for long-duration missions.

47. McClenon, P. R.
COST FINDING THROUGH MULTIPLE CORRELATION ANALYSIS. Rand rept. no. P-2619. Aug 1962. 18p.

An attempt to show that analyses of multiple correlation might, under some circumstances, supply cost estimates that could not be obtained from the same data by traditional accounting techniques. Multiple correlation analysis is, therefore, a possibly useful tool. Accountants are urged, however, to obtain adequate assistance from statistics textbooks or from trained statisticians in deriving cost estimates of this sort. Employed reasonably, this tool may furnish information useful for management planning and decisionmaking.

48. McClurg, G. H.
A basis for the long-range planning of military research. In PROCEEDINGS 1963 WINTER CONVENTION ON MILITARY ELETRONICS, I. E. E. E., Jul 20 to Jul 26, 1963.

A. The over-all planning of Army research can be a meaningful and useful procedure, and normal planning methods can be adapted to the purpose.

B. For use in research planning, a permanent list of Army operational capabilities can probably be constructed, which will provide a more direct and fruitful link between the resources of science and the long-range interests of the Army.

C. Technological forecasting and research planning are new and important disciplines requiring the development of a specialized professional competence within the Army.

49. McGruder, J. L.
Long range planning in the Atomic Energy Commission. In MANAGERIAL LONG RANGE PLANNING. Steiner, G. A., ed., New York, McGraw-Hill, 1963. p. 127-140.

A single long-range plan integrating all AEC programs for the 1963-1967 period - essentially a compilation of individual program plan resumes - was recently completed. Although optional at present, future plans are expected to include proposed alternate courses of action, thereby contributing importantly to improved decision making. Planning steps and procedures, coordination, and self-appraisal of efforts to date are included.

50. McLaughlin, J. R.
SIZING OF NUCLEAR ORBIT LAUNCH VEHICLES FOR INTERPLANETARY MISSIONS. Los Angeles, Calif. American Institute of Aeronautics and Astronautics, Summer Meeting, Jun 17–20, 1963. Paper no. 63-256. 12p.

Analysis of the sizing requirements of nuclear orbit launch boosters for interplanetary round-trip flyby and stopover missions. The requirements for four power levels are specified for (1) two types of Mars "lighted-side" flybys for 1971, 1973, 1975, 1988, and 1990; (2) Venus lighted-side flybys during any conjunction period; (3) a two-planet flyby in 1972; and (4) some stopover missions. These requirements are matched with the estimated capabilities of a presently conceived operational nuclear stage, and with the launching capabilities of the Saturn V.

51. Meltsner, A. J. and H. R. Swaine
NAVY COST MODEL. RAND Corp., Santa Monica, Calif. Memo no. RM3660ASDC. Jun 1963, 1v. Contract SD83. DDC AD-407 323.

The purpose of this briefing is to present a description of the preliminary work on a Navy cost model. This cost model is to be used for rapid cost estimating of alternative forces for use in cost-effectiveness studies and for projecting approximate budget levels. In the initial development of this model, a determination was made as to the kinds of output the model should have. In general, these outputs are to be compatible with those of the OSD programming system. The model is structured to simulate Navy processes in a simplified manner, the structure being based on a study of the organization, policies, and procedures of the Navy. Finally, highly summarized statements of research projects are presented for the over-all model development work.

52. National Industrial Conference Board
FORECASTING IN INDUSTRY. Business Policy no. 77. New York, National Industrial Conference Board, 1956.

A somewhat outdated study of the forecasting methods used in industry. The study analyzes the problems, reports the solutions which have proved most helpful, and contains several case examples.

53. Novick, D.
COSTING TOMORROW'S WEAPON SYSTEMS.
Rand rept. no. RM-3170-PR. Jun 1962. 15p.
DDC AD-287 997.

The text of a briefing to an Air Force Systems Command's (AFSC) Management Conference held at Monterey, California, May 2-5, 1962. Methods are discussed for costing future weapon systems and for considering uncertainties in advance of final decisions on system development. It is concluded that with the greater emphasis given to future system costing, the AFSC should have a strong in-house cost analysis capability within the foreseeable future. This should have a salutary effect on financial management throughout the Command.

54. Novick, D.
NEW TOOLS FOR PLANNERS AND PROGRAMMERS.
Rand rept. no. P-2222. 14 Feb 1961. 21p.

A discussion of conditions which make current machinery inadequate for handling problems involved in U.S. security planning and of new tools which can meet the needs of the planners and decision-makers. While in no sense a panacea, these new tools should facilitate dealing with the uncertainty of defense fund requirements in the nuclear-rocket-space age. With an understanding of the potential decision points available, together with time-phased resource impacts of new systems, it should be possible to avoid the necessity of delays in important programs and of cancellation of others. Published in The Executive, September 1961.

55. Novick, D.
PROGRAM BUDGETING: LONG-RANGE
PLANNING IN THE DEPARTMENT OF DEFENSE.
Rand rept. no. RM-3359-ASDC. Nov 1962.

This Memorandum describes a new planning and programming process that was initiated within the Department of Defense in early 1961. The significant feature of this process is the approach that is taken to decision-making and control in the vital area of defense expenditures. Planning is considered in long-range terms of missions, forces, and weapon systems, i.e., resource outputs, rather than in terms of the standard appropriation categories of procurement, construction, personnel, etc., i.e., resource inputs. In the course of budget review, the need for quick decisions, with their obvious drawbacks, on major programs has been reduced considerably. The annual budget is now only an increment of a longer-range plan.

The new process incorporates an up-to-date, five-year force structure and financial program, expressed in terms of forces, manpower, and dollar requirements. Since

this program requires a continuous type of budget review, a program change control system was developed to aid in achieving this requirement. In this system, approval thresholds are established to concentrate attention on the major current or prospective issues, this being an obvious application of "management by exception." These thresholds are in terms of total obligational authority requirements, for the current or budget fiscal year and on a total basis. A progress reporting procedure for about 200 of the most important materiel items is employed. Milestone schedules are established to reflect the events and activities upon which the financial plan is based. Actual accomplishment is reviewed monthly against the milestones and remedial action is taken or revisions are made to the five-year plan as necessary.

Although the new process is having a very large impact on financial management, as now administered it is leaving the traditional fiscal process relatively unchanged.

56. Novick, D.
RESOURCE ANALYSIS AND LONG-RANGE PLANNING. RAND Corp., Santa Monica, Calif. Rept. no. RM3658PR. Jun 1963. 22p.
(Contract AF 49(638)700) DDC AD-406 844.

Program budgeting, cost effectiveness, and cost analysis are terms used with increasing frequency in our military establishment. This memorandum discusses each of the terms, with emphasis on cost analysis, and shows how the concepts that they represent are important for Air Force long-range planning. Since this memorandum is intended primarily for persons who must provide inputs to as well as use the results of, cost analyses, examples are given of the kind of detailed information required.

57. Novick, D.
SYSTEM AND TOTAL FORCE COST ANALYSIS. RAND Corp., Santa Monica, Calif. Research memo. no. RM2695PR. Apr 1961. 136p.
(Contract AF 49(638)700) DDC AD-408 623.

This memorandum describes the aims, concepts, and methods of military cost analysis as developed by the Cost Analysis Department of the RAND Corporation. Like the 1956 report on Weapon-System Cost Methodology, which it replaces, the present memorandum is concerned basically with the estimation of costs for proposed military activities so that informed choices can be made among them. It extends the earlier report by considering in more detail the underlying principles of cost analysis (Chapter I), and by describing methods for analyzing the costs of total force structures as well as individual systems (Chapter III). In Chapter II, the earlier cost categories

are refined, particularly by the provision of categories for research and development activities which now constitute an increasing share of system costs. By generalizing methods and examples, the scope of analysis is extended to support and control systems as well as weapon systems. In Chapter IV, the usefulness of cost sensitivity analysis is explained and illustrated by examples. The appendix describes detailed methods of estimating system manpower requirements.

58. Novick, D.
TECHNOLOGICAL CHANGE AND LOCAL ECONOMY. Rand rept. no. P-2568. Mar 1962. 21p.

A discussion of some of the technological changes that have already occurred as reflected in the national defense budget in an attempt to determine what these changes may mean to the economy and to forecast what must be done if future challenges are to be met successfully. The nuclear age has brought changes in system requirements that have resulted in shifts in the composition of labor-force demands, in facilities requirements, and in the make-up of the industry. These changes have forced reorganizations both in government and industry to improve the management of new programs. Still other changes will be necessary as space-age requirements are more clearly defined. Presented before the Economic Development Institute of Arizona at Tucson, Arizona, March 23, 1962.

59. Pardee, F. S.
ECONOMIC PLANNING AND THE MILITARY ELECTRONICS INDUSTRY. Rand rept. no. P-2006. 24 Jun 1960. 22p.

A discussion of the role of the economist (1) in making over-all evaluations of national economic conditions and corporate long-range planning activities, and (2) in using cost-sensitivity-analysis techniques to estimate the economic impact of alternative engineering designs, concepts of maintenance, logistics, training, and other operational deployment considerations. A decided challenge faces the engineer in evaluating the relative resource impact of alternative designs and the cost savings to be gained from improvements. The various disciplines must work together to realize sound system design and appropriate operational concept. Presented before the Institute of Radio Engineers, Professional Group on Military Electronics, at Los Angeles, California, November 23 and 24, 1959.

60. Pardee, F. S.
GUIDELINES IN ACCUMULATING FINANCIAL DATA ON FUTURE WEAPONS. Rand rept. no. RM-2583-ARPA. 27 May 1960. 51p.

Guidelines for collecting the financial data requisite to weapon-system evaluation. Part I discusses costing concepts, the handling of uncertainty, and the necessity of ensuring that the financial information is appropriate to the end use for which it is intended. Part II indicates the overwhelming importance of descriptive data for each of the alternative hardware designs, operational concepts, or test and deployment schedules being investigated. In Part III, two basic forms are furnished that show the major cost elements that should be estimated to determine the economic impact of the future weapon system. The forms suggest the financial input needed in cost-effectiveness evaluation of alternative possible decisions on weapon-system development, procurement, and operation.

61. Payne, B.
PLANNING FOR COMPANY GROWTH, THE EXECUTIVE'S GUIDE TO EFFECTIVE LONG-RANGE PLANNING. N. Y., McGraw-Hill, 1963.

The author, a management planning consultant, presents an integrated discussion of the entire scope of long-range planning. He cites six reasons why LRP has not been more widely practiced. (1) The chief executive who must carry out the plan frequently has not really been sold on LRP in the first place, and merely gives it lip service. (2) Corporate objectives are too superficially defined; (3) There has been inadequate factual background for the plan. (4) There is a tendency to set growth and profit goals below the capacities of the company to produce. (5) When immediate answers are not forthcoming, impatience with the entire project results. (6) Companies fail to make provisions for regular review and updating of the plan.

62. Perkins, C. D.
Man's utility in military space missions.
In 2ND MANNED SPACE FLIGHT MEETING. New York, American Institute of Aeronautics and Astronautics, 1963. p.254–259.

General considerations of the expansion of manned space activities in terms of man in military space systems. It is seen that, although many possible military missions in

space have been identified by many studies, only reconnaissance/surveillance has achieved any real recognition and is being developed seriously. It is suggested that the rationale for man in military space is usually based on doctrinal or other inadequate arguments. Possible uses of man in military weapons systems are in the role of operator of varied sensors in a sophisticated large space station for total surveillance and as an important subsystem in advanced intercept or inspection missions.

63. Pincus, J. A.
U.S. PRODUCTIVE CAPACITY AVAILABLE FOR INCREASING DEFENSE AND FOREIGN AID PROCUREMENT. Rand rept. no. RM-2843-PR. Sep 1961. 71p.

An attempt to determine, if during the next decade the United States should spend more than it does now on defense and foreign military and economic aid, how much of the increase could come from fuller use of the then-existing capacity, rather than from lower consumption expenditure. This question is considered for the national economy, for manufacturing as a whole, and for individual industries. Some answers in the form of estimates are summarized, and directions for possible further study are given.

64. Platt, W. J. and N. R. Maines
Pretest your long-range plans. HARVARD BUSINESS REVIEW 37:119–127, Jan/Feb 1959.

There are no all-inclusive models in operations research that can be relied upon to evaluate overall long-range planning. However, management can pretest its planning via computer experimentation, business games, and ecological models which yield valuable test reports than can direct management toward better long-range plans.

65. Quade, E. S.
MILITARY SYSTEMS ANALYSIS.
Rand rept. no. RM-3452-PR. Jan 1963. 34p.
DDC AD-292026.

A discussion of systems analysis as an approach to complex problems of choice under uncertainty by systematically examining the costs, effectiveness, and risks of the various alternatives. This memorandum attempts to survey the problems and procedures of such analysis when applied in a military context. To be incorporated in Military Operations Research, a book to be published by the Operations Research Society of America in its series, Publications in Operations Research.

66. Quinn, J. B.
Long range-planning of industrial research.
HARVARD BUSINESS REVIEW 39:88–102,
Jul/Aug 1961.

For truly effective research planning top management must (1) Establish meaningful objectives as guides to research; (2) See that both research people and operating management are attuned to the company's long-range technological needs and capacities; (3) fit research into the company's overall business strategy; (4) make sure that project rankings and program balance reflect appropriate business judgments; (5) organize research and operations for maximum transfer of research technology to operations.

67. Rapoport, L. A. and W. P. Drews
Mathematical approach to long-range planning;
how can corporate management apply linear
programming to investment planning and operations
scheduling? HARVARD BUSINESS REVIEW
40:75–87, May/Jun 1962.

Mathematical programming can be used to (1) evaluate planning factors and alternatives as they arise, rather than to prescribe courses of action, (2) provide systematic means of analysis, and (3) help management explore policies and objectives in greater depth, but not introduce a substitute for decision making.

68. Rauner, R. M. and W. A. Steger
SIMULATION AND LONG-RANGE PLANNING
FOR RESOURCE ALLOCATION. Rand rept.
no. P-2223-1. 15 Mar 1961. 33p.

Part of a broader investigation concerned with the development of a method of large-scale, manned simulation and with its application to some allocation problems faced by long-range planners in Air Force logistics organizations. This paper describes one of the major simulations RAND has conducted and suggests ways in which this research technique might bear upon allocation theory and practice. It is concluded that manned simulations appear promising to those planners who must choose between alternative resource allocations as they design complex systems in which man plays some kind of managerial role. Published in The Quarterly Journal of Economics, May 1962.

69. Raymond, R. C.
Betting on new technologies. In TECHNOLOGICAL PLANNING AT THE CORPORATE LEVEL. J. R. Bright, ed., Boston, Harvard Business School, 1962. p. 12-39.

Author is Manager, Technical Military Planning Operation (TEMPO), General Electric Co., Santa Barbara, Calif. He describes two research tools used by TEMPO, the broad-scale environmental study and the comparison of customer choices, in such areas, for example, as predicting future USAF requirements.

70. Richardson, R. C.
Long-range planning and technology as related to military expenditures and concepts. In PROCEEDINGS OF THE ASILOMAR NATIONAL STRATEGY SEMINAR, MONTEREY, CALIF., APRIL 25-30, 1960. Course material prepared by Stanford Research Institute.

General Richardson presents his analysis of the evolution of cost, concepts, and weapons in time; the relationship that exists between these basic elements of any defense effort; and how change or lack of change in these areas affects the national security posture.

71. Rothrock, Addison, M.
LONG RANGE PLANNING IN THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. National Aeronautics and Space Administration, Washington, D. C. 1962. 28p. Presented at the Long Range Planning Res. Seminar, Calif. U., Los Angeles, 13-14, Sep. 1962. NASA X63-12704. NOTICE: Available to U. S. Government Agencies and U. S. Government Contractors only.

Long range planning in the National Aeronautics and Space Administration is discussed. The major responsibilities of NASA are: development and operation spacecraft,

exploration and investigation in space, application of the results of space investigation, and contribution to the general advance of science. The NASA program to obtain these objectives is divided into five major segments: space sciences, space applications, manned space flight, flight system research and technology, and tracking and data acquisition.

72. Root, L. E. and G. A. Steiner
The Lockheed Aircraft Corporation Master Plan.
In LONG-RANGE PLANNING FOR MANAGEMENT.
Ewing, D. W., ed., N. U., Harper & Bros, 1958.
p. 136–156.

The origins, basic objectives, principal methods used, and the underlying philosophy of the Lockheed Master Plan are described.

73. Ross, R. J.
For long range planning; rotating planners and doers (rotating organization structure). HARVARD BUSINESS REVIEW 40:105–115, Jan 1962.

Author offers a new non-conventional approach to LRP, namely a rotating organization structure, with managers moving back and forth between operations and planning, first taking responsibility for the one, then the other. Rotation can be based on product cycles, changes in methods or processes, arbitrary calendar events, or any period significant to the conduct of the company's business.

74. Schaidt, Leander
The magic in program management. In PROC. 1963 NAT. WINTER CONVENTION ON MILITARY ELECTRONICS, IEEE. 17–24 Nov 1963. v. 2.

Every company has a particular approach or combination of techniques to solve management problems. Each method has its own merits and at least in part could be adopted by others to improve their system of management. At Martin Company's Orlando Division, certain concepts and systems of management and project control have proved eminently successful in the five-year history of the division. Martin Orlando is a division of Martin Company. Martin Company, in turn, is the aerospace division of Martin Marietta Corporation. While Martin is a fifty-year veteran of the aircraft and aerospace

industry with a history of solid management and achievement, constantly changing technology and requirements have led to innovations in management to keep abreast of the times. Program management techniques, or management tools, described in this paper merit consideration. They are not touted as the ultimate but have been effective in organizing, planning, and controlling the division operation in meeting overall corporate objectives.

Divisional objectives and long range goals are defined in a long-range plan which is established in conjunction with corporate headquarters. It is the job of corporate management to coordinate, resolve and define areas of business interest and to prevent competition with sister divisions with regard to types of work and proposed programs. A typical long-range plan covers a span of five years and defines in broad terms programs and business areas intended to be pursued. The long-range plan includes existing firm programs, a realistic estimate of what can be expected in the way of carry-on business, and a projection of potential business. Such future business is the subject of heavy concentration in order to maintain or expand division activities. The long-range plan is updated every six months to include not only a projection of programs and items of work, but to indicate an estimate of dollar potential, manpower requirements, and space and facility requirements.

75. Schilling, W. R., et al.
STRATEGY, POLITICS, AND DEFENSE BUDGETS.
N. Y., Columbia U. Press, 1962.

Three separate studies are included illustrating how the political process in the U. S. operates to define national security policy. (1) The politics of national defense: Fiscal 1950, by W. R. Schilling, (2) NSC-68; Prologue to Rearmament, by P. Y. Hammond, and (3) The "New Look" of 1953, by G. H. Snyder.

76. Schueller, C. F.
SPACE ACTIVITY IN 1972. Paper presented at
the IAS/CASI Meeting, Toronto, Canada. Oct 1962.
NASA document no. X63-12667.

Spacecraft that are expected to be in operation in the next decade or so are discussed. Gemini is expected to meet a 1964–1965 schedule. Manned lunar landing and return is forecast for 1972. Manned lunar base, manned space station, manned MARS mission, and orbiting astronomical observatory are also discussed.

77. Seitz, C. W., Jr.
LONG RANGE PLANNING PRACTICES IN MAJOR MILITARY ELECTRONICS COMPANIES. (M.B.A. thesis) Graduate School of Business Administration, Pasadena, University of Southern California, Jun 1961.

78. Smallman-Tew, R.
Aerospace technology in 1972 – airframe materials and structures. CANADIAN AERONAUTICS AND SPACE JOURNAL 9:151–158, May 1963.

Review of the materials, such as the high-temperature alloys, which are likely to constitute the airframe structures of research, interceptor, and transport aircraft at the end of the next decade. Discussed are some of the problems which need to be resolved in the employment and fashioning of these materials to make them suitable for their intended purpose. Canada's role in this development work is assessed.

79. Stauffer, Robert A. and John L. Ham
Space materials for the future. In 2nd MANNED SPACE FLIGHT MEETING. New York, American Institute of Aeronautics and Astronautics, 1963. p. 260–273.

Review of the materials problems of the national space program, in order to outline the general approach necessary to solve them. Some of the major material requirements are tabulated, showing the type of device, the materials application, and their requirements. Recent investigations of cohesive properties of materials at low temperatures are described, and possible methods of overcoming cold-welding problems are discussed. Recent developments in superconductors are reviewed and applications for these materials in space vehicles are considered. A superconducting solenoid which should make attainment of fields of 100 kilogauss practical is described.

80. Steger, W. A.
PROBLEMS OF SUPPORT PLANNING.
Rand rept. no. P-2574. Apr 1962. 13p.

An attempt to assist the operations researcher make his work more helpful for the support planner by discussing the problem areas that reduce the effectiveness of interaction between the two groups. The support planner should be more explicit about the lead time required to make major decisions and about reappraising his findings in the light of unfolding data. The operations researcher must find better ways to adapt his techniques to the uncertainties, complexities, and adaptive nature of the support planner's decision process. Presented before the Military Operations Research Symposium at Newport News, Virginia, April 24–26, 1962.

81. Steiner, G. A.
How to forecast defense expenditures. In
PLANNING AND FORECASTING IN THE DEFENSE INDUSTRIES. Stockfish, J. A., ed., Belmont, Calif., Wadsworth Publishing Co., Inc. 1962. p. 243–268.

Author is Director, Division of Research, Graduate School of Business Administration, UCLA. Chapter explores the basic reasons why forecasts of defense expenditures are of great value; the range of difficulties involved; some of the methods by which a forecast can be made, including a preferred method; and what management ought and ought not to expect from such forecasts.

82. Steiner, G. A.
MANAGERIAL LONG-RANGE PLANNING.
N. Y., McGraw-Hill, 1963. 334p.

Directors of long-range planning for 17 major American corporations and large Federal agencies describe in detail how their organizations make plans. The book contains a comprehensive discussion of the basic principles needed to secure successful strategic planning. Selected papers are individually abstracted within this bibliography.

83. Steiner, C A.
National security expenditures 1960-1970.
In PLANNING AND FORECASTING IN THE DEFENSE INDUSTRIES. Stockfisch, J. A., ed., Belmont, Calif., Wadsworth Publishing Co., Inc., 1962. p. 269-290.

Forecasts are presented from several sources, six by staff members of the following companies and a seventh by the author: Boeing, Douglas, Hughes, Northrop, Lockheed, and North American Aviation. (Except for the author, specific companies are not identified with individual forecasts.)

84. Stewart, R. F. and J. E. Lipp
Development planning at Lockheed Aircraft Corp.
In MANAGERIAL LONG RANGE PLANNING. Steiner, G. A., ed. N. Y., McGraw-Hill, 1963. p. 258-273.

The majority of Lockheed's Corporate Development Planning workload is divided into 3 categories: (1) background studies of sectors of the product/market spectrum; (2) diversification, and (3) master planning. Each category is briefly described.

85. Stockfisch, J. A.
PLANNING AND FORECASTING IN THE DEFENSE INDUSTRIES. Belmont, Calif., Wadsworth Publishing Co., Inc., 1962.

Book contains papers presented at a UCLA Seminar on the title subject held on 4-5 May 1960. Selected papers are abstracted individually in this bibliography.

86. Stoller, Morton J.
NASA LOOKS AHEAD – A REVIEW OF AMERICA'S PLANS FOR EXTENDING SPACE RESEARCH AND TECHNOLOGY OVER THE NEXT TEN YEARS. National Aeronautics and Space Administration, Washington, D. C. Rept. of the abridged text of a lecture given before the British Interplanetary Soc., London. 1 Oct 1960. p. 70–77. NASA N63-17656.

The objectives for extending NASA space research and technology over the next ten years are discussed. These are: (1) to investigate the energy transfer relations between the sun and earth, and to study other solar-terrestial relations; (2) to probe the origin and fundamental workings of the solar system and the universe; and (3) to search for the origin and distribution of life within our solar system. That portion of the space program which will be accomplished by sounding rockets, near-earth probes, and artificial satellites is then discussed in detail. The Explorer satellite system is described, as are the solar satellite, the Ranger and Mariner projects, a mobile lunar surface probe, satellite meteorology, plans for man-in-space, and communications systems in space.

87. Stone, John W.
Future of large launch vehicles. In 2ND MANNED SPACE FLIGHT MEETING. New York, American Institute of Aeronautics and Astronautics, 1963. p. 39–43.

Brief consideration of launch vehicles currently under development or study, emphasizing NOVA concepts. The potential missions which could utilize a NOVA class vehicle, and the NOVA study program, are outlined. The growth in payloads which future large launch vehicles will provide is shown graphically for single-launch weight-lifting capabilities to Earth orbit, showing the Saturn I, IB, V, and the NOVA. Operating cost trends for the future programs are highlighted, and advanced vehicle configuration concepts are discussed. Artist sketches of various NOVA configurations are presented. NOVA launch facilities are briefly considered.

88. Technical Military Planning Operationa, General Electric Company, Santa Barbara, Calif.
FUTURE NAVY SYSTEMS, VOLUME I. INTRODUCTION TO POLITICAL-MILITARY ENVIRONMENT OF WARFARE. Rept. no. RM-61-TMP-95. 31 Dec 1961. 83p.
DDC AD-401 346.

The TEMPO Future Navy Systems study is an across-the-board examination of sea warfare missions and seaborne weapon systems. Military missions and naval weapon systems have been studied in the context of the contribution of each system to the various missions, the competition between systems, and the impact of budgetary and other constraints. The results of the work are published in two volumes. This first volume examines the broad political, military, and geographic background of war, in order to obtain an overview of the global environment that leads to military missions and military force requirements. Volume II applies the perspectives gained by the study to each of the major combatant elements of the Navy.

89. Teller, E.
The next hundred years. In TECHNOLOGICAL PLANNING AT THE CORPORATE LEVEL. Bright, J. R., ed. Boston, Harvard Business School, 1962. p. 148-166.

Predictions of the future by the noted physicist, Professor of Physics-at-large, Lawrence Radiation Lab., University of California, Berkeley.

90. Thompson, S.
HOW COMPANIES PLAN. N. Y., American Management Association, 1962. 215p.

AMA publication intended to give timely information on how companies are planning for the future – especially for the longer range. The report is the product of a three-year study with information on various company policies gathered by visits to large number of companies. (AMA Research Study No. 54)

91. Tombach, Harold
The contribution of systems research to long-range planning in the defense industry.
MANAGEMENT TECHNOLOGY 3:78-91, May 1963.

Industrial long-range planning requires forecasts of market requirements, business environments and corporate (or divisional) capabilities. This article concerns itself with the problem of forecasting weapon markets. The needs for such forecasts are discussed and it is shown that mere reliance on official military plans, programs, statements, and "requirements" is a poor guide for long-range planning in the defense industry. It is further shown how system research studies can improve the forecasts sought. The proper conduct of such long-range-planning-oriented studies is outlined in some detail.

92. Warren, E. K.
Where long-range planning goes wrong.
MANAGEMENT REVIEW 51:4-15, May 1962.

Author separates LRP into four vasic types of activities (1) Forecasting activities (2) Budget and financial accounting activities (3) Setting goals and designing action programs (4) Direction, supervision, and coordination of planning activities. A clearer understanding of these for key elements is required by management before more meaningful and effective LRP is achieved.

93. White, David C.
Research needs for energy conversion systems.
In 2ND MANNED SPACE FLIGHT MEETING.
N. Y., A.I.A.A., 1963. p. 308-328.

The ability of man to travel in and explore outer space is determined by his having power sources that can meet minimum requirements for communication and mobility in any given space venture. Manned space missions that are currently in operational or developmental phases are Mercu , Gemi , and Apollo. The power requirements for these missions have been determined, and energy conversion systems to satisfy the mission requirements are under development. The establishment of research needs for energy conversion systems to carry out manned space exploration, should not come from space programs in the operational phase, but should come from projections of planned space programs for the future. These goals, coupled with programs designed to gain further knowledge of physical processes, regardless of their ultimate utilization, will yield the most effective energy conversion research program.

94. Wrapp, H. E., et al.
The line executive and long-range planning in a new economy. In MANAGING AMERICA'S ECONOMIC EXPLOSION. Fenn, D. H., ed. N. Y., McGraw-Hill, 1961. p. 110-130.

Authors list six distinct steps in long-range planning: (1) Setting broad company goals (2) Collecting data and forecasting (3) Development of alternatives (4) Selection of an alternative (5) Implementation of the plans (6) Up-dating of long-range plans.

95. Yale, J. P.
Elements in long-range planning. ADVANCED MANAGEMENT 26:16-19, May 1961.

The author stresses the importance of taking account of cycles peculiar to a given industry - plus being flexible - in making long-range plans.

96. Young, D. A. and J. H. Morse, Jr.
Long-range planning at Aerojet-General Corporation. In MANAGERIAL LONG-RANGE PLANNING. Steiner, G. A., ed. N. Y., McGraw-Hill, 1963. p. 80-97.

Aerojet's Corporate LRP Division is located at Monterey, a site equidistant from the two major centers of company activity, thereby compromising the conflicting factors of the need for close communication with senior executives and the danger of involvement in current crash programs. Included is the Division's charter, its principal problems, and formats used to summarize plans which are published in an integrated corporate plan.

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