

CONTRACTOR RELATIONSHIPS AND INTER-ORGANIZATIONAL
STRATEGIES IN NASA'S R&D ACQUISITION PROCESS

Dr. Joseph P. Guiltinan-NASA/HQ

SUMMARY

This report presents an approach for developing acquisition strategies which can be tailored to the needs of specific R&D systems.

An acquisition strategy is a management plan which is designed to achieve particular acquisition goals by employing appropriate business and program practices in a coordinated manner. In NASA, the acquisition process typically includes a variety of activities (project plans, RFP's, SEB's, negotiation, contract administration), over an extended period of time, and involving a variety of headquarters and field center decision-making and reviewing authorities. In addition, the process is inter-organizational in that both NASA and the contractor have an active role in the process. Consequently, an acquisition strategy must consider the goals and activities of the contractor if an effective working relationship is to be achieved and if goals are to be met. However, since contractors vary in terms of their goals and management styles, and projects vary in terms of their requirements and uncertainties, no single acquisition strategy can be identified for all situations.

The approach to developing a strategy which is advocated in this report incorporates five basic elements:

1. Definition of project goals and priorities;
2. Analysis of the contractor's motives, environment, and constraints;
3. Analysis of the NASA-contractor inter-organizational relationship;
4. Selection of a set of strategies and practices for planning and control;
5. Modification of strategies or practices as necessary due to changes in contractor strategies or due to unforeseen contingencies.

In addition, in order to provide some basis for implementing this approach the report provides some discussion of key factors which should be considered in developing a specific strategy. These factors include the following:

- * What are some useful criteria for setting operational project goals and priorities?
- * What are the various contractor motives for doing business with NASA?
- * How are contractor motives and strategies influenced by: the contractor's financial structure; organizational structure and style; other business; method of interacting with NASA personnel; NASA-administered and regulatory contractual limitations?
- * What information about the contractor is useful in identifying ways to motivate him to achieve NASA goals?
- * What are the factors governing the inter-organizational relationship which determine the relative power of NASA and the contractor or which lead to conflict between them?
- * Under what conditions can various strategies (e.g. economic incentives such as award fees, formal cost/schedule control systems, tight specifications) be useful in achieving acquisition goals through improved communications, control, or contractor motivations.

PREFACE

The author expresses appreciation to Frank Hoban, Low Cost Systems Office, NASA-Headquarters, and Herb Broman, Procurement Office, NASA-Headquarters for their assistance in developing this report.

Some of the issues discussed in this paper were also derived from the experiences of individuals involved in the development of topics and cases for the Project Management Shared Experience Program. Among these unwitting contributors were Don Fordyce, Robert Lindley, and Dr. Michael Vaccaro of Goddard Space Flight Center; Angelo Guastaferrero and Frank Moore of Langley Research Center; W. E. Giberson of the Jet Propulsion Laboratory; Henry P. Yschek of Johnson Space Center. Additional points were also obtained from J. B. Alldredge and Steve Armstrong of Johnson Space Center and George Muinch, NASA-Headquarters.

CONTENTS

Introduction.....	1
NASA Goals and Constraints.....	4
Contractor Objectives and Motives.....	8
Contractor Environment and Constraints.....	9
Inter-organizational Analysis.....	19
Inter-organizational Strategies.....	30
Conclusion.....	44
References.....	45
Appendices:	
A - The Acquisition Life Cycle in NASA.....	48
B - The Contractor Decision Process.....	54

INTRODUCTION

The purposes of this paper are to improve the understanding of the process by which contractor strategies are developed and to provide an improved framework for evaluating appropriate management strategies for the acquisition of large-scale systems through the application of inter-organizational analysis. While this paper develops such strategies in the context of the NASA-Contractor relationship, many of the strategies appear applicable to other government agency acquisitions.

Inter-organizational processes have been studied in a variety of situations (Benson, Stern, Warren, Litwak and Holton). However, the studies seldom deal with the acquisition of large scale systems involving R&D activity and significant technological, performance, and/or cost uncertainties, over a lengthy time frame. Such acquisitions are of paramount importance to agencies such as NASA, HUD, DOD, DOT, to government and private industry construction programs and to other industries acquiring high technology equipment.

Sayles and Chandler provide some inputs on these processes in a NASA-oriented 1971 publication. Drucker et. al. and Hunt and Rubin have studied the inter-organizational relationship in terms of interactions of technical personnel and project management personnel.

Some discussion of informal influence processes, conflicts, and relationships among contractors, project personnel, Congress, and upper-level military and civilian management is also available in some of the more comprehensive studies. (Scherer, Logistic Management Institute; Fox, Hunt).

In particular, the dynamic, life cycle aspect of this process merits special attention. NASA's acquisition process for major projects consists of a set of interrelated stages involving several different policy, decision-making, advisory and management groups (Program Office, Field Center, Project Manager, Contracting Officer, Contract Administration, Procurement, Legal, etc.)

On the other hand, contractors are often able to consolidate decision-making and implementation effort to develop initial strategies (including tactics for bids, negotiations, and contract management) and to revise these as necessary.

Fragmented study of the acquisition process ignores the changing environment and influence flows within and between the buying organization and the contractors. Consequently, a dynamic, integrative analysis of the acquisition process is needed to fully understand contractor strategy and to develop effective strategies and policies within NASA.

Contractor Relationships

In developing a conceptual approach to the description and analysis of the NASA-Contractor decision process, three fundamental elements of this process were considered.

The first of these elements is the life cycle aspect of the acquisition process for R&D systems. The contractor environment and the nature of the Contractor-NASA relationship change as the process moves from stage to stage. The stages identified for this purpose are:

1. Project Conceptualization and Definition - Science and data acquisition requirements, engineering requirements and technical specifications, and estimated costs are all defined.
2. Procurement Plan Development - Method of competition, type of contract (fixed price vs. cost-plus), fee provisions, (incentive vs. award fees) and amount of government furnished equipment are identified. Management approval is obtained.
3. Source Evaluation and Award - Source evaluation board defines criteria for evaluation, releases Request for Proposal (RFP) to industry, develops specific evaluation criteria, evaluates competitors' written and oral proposals, recommends a source. Top field center or Headquarters management selects source.
4. Negotiation Between NASA and Contractor - Negotiations define specific contractual plans for obtaining incentive and award fees, define target costs, contractor financial reporting requirements, methods for progress payments and for processing changes to technical plan.
5. Contract Implementation - Contractor completes work on the system, manages subcontractor work, NASA negotiates changes, monitors performance, audits costs, and makes cost and fee payments.

The second major element is the basic management approach to strategic decision-making. Generally speaking, a strategy is a plan of activities designed to achieve one or more objectives, based on an analysis of environmental opportunities and

constraints. Consequently, our analysis incorporates (within each stage) contractor objectives, environmental factors, and strategic activities available to contractors. Normative models of decision-making suggest that strategic activities should be selected after analysis of environmental factors and to attain one or more objectives.

The final element is the fact that the NASA-contractor relationship is inter-organizational. That is, neither party makes decisions in a vacuum. Rather, the parties are involved in exchanges of resources, products, and information during the process, and each party attempts to influence the technical and business decisions of the other. The appendices specify inter-organizational flows and decision processes at each stage.

Inter-organizational Strategy

Because this relationship is inter-organizational, the process of selecting an appropriate strategy must consider the anticipated response of the other party.

The concept of "contingency management" appears to have great applicability for selecting strategies in such turbulent acquisition environments (Murphy et. al.).

This concept suggests that organizations need to make decisions which consider not merely the current environment (of contractors, technology, costs, etc.) but also the impact of such decisions in terms of their influence on the future state of the environment so that maximum flexibility for coping with future conditions and new contractor strategies can be maintained.

In order to achieve a full understanding of this inter-organizational process, this paper addresses the following issues:

1. What are NASA's goals and constraints?
2. What are contractor motives and how are they shaped by the contractor environment?
3. What are the elements of the inter-organizational relationship which influence each party's ability to achieve desired results from the relationship?
4. What strategy options are available for influencing relationships in order to increase either party's ability to control results?

Development of the frameworks presented in this paper incorporates prior studies of contracting behavior in NASA and the Department of Defense, books and monographs published by consultants to

aerospace and defense contractors, general literature on inter-organizational strategy, and interviews with NASA project and Headquarters personnel pursuant to developing case studies and other materials for an agency-wide Project Management Shared Experience Program.

NASA GOALS AND CONSTRAINTS

NASA objectives include the accomplishment of technical mission performance, on schedule, within the scope of funding constraints. Assurance of timely and reliable performance at a reasonable cost is essential to meet the expectations of external organizations (such as Congress, OMB, the Science community, agencies and corporations which buy NASA services, and the general public).

The Apollo era in NASA was dominated by an agency perspective which focused on achieving specific mission achievements in a defined time frame (especially in manned programs) and on extending the state-of-the-art of technology.

While the current program dominating NASA (the Space Shuttle) also requires a tremendous devotion to technical achievements, the agency is no longer free to place secondary emphasis on costs. In order to maintain a balanced set of programs without strangling Shuttle funding, all projects must be seriously concerned with cost goals. Further, the successful implementation of Shuttle will require development of a cost-effective system which keeps user costs competitive with other existing or potential launch vehicles - especially as NASA-funded launches are reduced in proportion to reimbursables.

It is this changing thrust toward acquiring systems at low cost which has dramatically increased the complexity of acquisition management. Both NASA and contractor technical personnel prefer to build advanced systems with maximum capability and reliability and typically have little interest in reducing costs.

Perrow points out that historically, organizations engaged in non-routine technologies have focused on goals of quality, innovation, and reliability. Such situations are consistent with the technology development interests of project team members and contractors.

Goals and Priorities

Agency goals as such probably have not changed as the result of budgetary pressures. What has changed at the top level is the set of agency constraints. In essence, the agency is still committed to science, applications, and technology development. Mission success is still paramount. However, agency-wide

productivity to achieve these goals has become an administrative objective at the top level in the agency.

Operational goals for specific projects are conditioned by agency goals, administrative objectives at the Headquarters levels, and the goals of centers, experimenters, users, and project team members. Administrative objectives thus form project constraints, within which other goals must be realized. Additionally, a given project may be confronted by other possible constraints which cannot be controlled to a great degree such as critical launch schedules, visibility of the project to external agencies and publics, and state-of-the-art of technology.

Key elements in goal setting must include the following (of which items 4, 5, and 6 are the most controversial):

1. Spacecraft performance goals;
2. Science data, collection and transmission goals;
3. Schedule goals;
4. Acceptable levels of risk and reliability;
5. Technology development goals;
6. Cost goals.

Inherent in item 4, is the issue of defining risk. While statistical estimates of confidence levels for various components can be developed through reliability testing and through the use of redundant systems, the overall concept of risk is a more subjective one and a dynamic one. Most project managers appear to develop their own perceptions of risk which change over the life cycle as problems and solutions occur. Accordingly, it is probably impossible to obtain a single "risk" goal. However, prioritizing the elements of a mission in terms of their importance to project success, defining minimum standards for success, and defining acceptable levels of cost for testing, redundancy, etc., to achieve such standards is possible.

In terms of goal development sequence and priority, technology development should follow items 1 - 4. That is, on most acquisitions, spacecraft and instrument performance have primacy, and technology development should be restricted to those areas in which development is required to achieve the science objective. Establishing the balance between science objectives and technology development objectives is thus a primary issue.

Defining target cost goals for a project traditionally involves the application of statistical cost models which relate the technical requirements of the proposed acquisition to historical costs of similar R&D systems. The resulting estimates (adjusted for inflation) will simply reflect the expected cost of the system, assuming no excessive optimism on problems with new technology and assuming no significant changes in acquisition procedures (such as use of standard components, changes in testing requirements, etc.). Achieving performance within target cost will not be "low cost" performance if the target was based on a high cost analog. Appropriate low cost goals are those established to achieve necessary performance goals using acquisition procedures that minimize cost within "acceptable" levels of risk, yet which avoid "buy-in" optimism.

The critical element regarding goals is the issue of developing consensus. Effective commitment to a set of goals requires that all parties believe in the general appropriateness and feasibility of such goals.

Appropriateness requires that the specific goals be consistent with the values and goals of individual members and units. Feasibility suggests that goals are perceived as:

- achievable in technical terms;
- amenable to the management control systems available;
- reasonably consistent over the life of the project;
- amenable to unambiguous evaluation;
- open to review and modification at predetermined intervals in response to possible contingencies identified in advance.

The primary impediment to developing goal consensus and to achieving a consistent acquisition strategy may be the involvement of multiple organizational units each of which has varying concerns (as illustrated in the following table).

TABLE I

<u>Organizational Component</u>	<u>Some Primary Concerns</u>
Center Administration	Use of manpower and development of technical reputation
Center Technical Functional Offices	Advance technology
Project Office at Lead Center	Meet schedule, and assure performance of hardware
Center Procurement Office	Maximize competition and minimize protests
Source Evaluation Board	Contractor responsiveness and capability
Contracting Officer	Appearance of reasonable cost/performance outcome
HQ Program Office	Achieve mission goals, satisfy user needs, and obtain adequate funds
HQ Budget Office	Assure adequacy of target cost estimates
Science Steering/Advisory Groups and Users in Other Agencies	Maximize science/data return per dollar
HQ Top Management	Positive cost and performance visibility to outside
HQ Low Cost Systems Office	Maintain cost-effective reliability standards

CONTRACTOR OBJECTIVES AND MOTIVES

In their investigation of the NASA acquisition process, Hunt, Rubin, and Perry attempted to determine contractors views on what should be accomplished by the contract.

A summarization of contractor importance ratings yielded the following rank order:

1. Foster quality performance;
2. Reduce contractor risk;
3. Safeguard proprietary interests;
4. Offer operational flexibility;
5. Stimulate government-contractor communications and work relationships;
6. Motivate cost control;
7. Yield a high profit;
8. Reduce government technical direction or surveillance;
9. Foster program discipline on methods and procedures.

While a few firms showed significant deviations, this pattern tended to hold across large and small contractors.

Such results and the results of other studies have led to attempts to inventory contractor motivations at a more general level (Hunt, Scherer, Chisholm).

Basic motivations which have been suggested include:

- Organizational survival;
- Organizational growth and development;
- Maintaining present and future sales volume;
- Minimize working capital requirements;
- Protection of corporate reputation with Government Agencies;
- Maintaining and developing personnel and technical capabilities;

- Advancing the level of the organization's technology;
- Coverage of Independent R&D;
- Obtaining commercial spin-offs.

These have been summarized as motives which reflect the desire for effective control or "mastery" of contractor operations and environments. This mastery is comprised of two basic elements: (Hunt)

- Avoidance of risk and uncertainty;
- Maintaining the ability of the organization to control its own fate and facilitate expression of the technical interests of its personnel.

Actually, Hunt's "mastery" concept is hardly novel except perhaps in the specific context of aerospace contractors. It is, in essence, merely a restatement of the now classic observation by Cyert and March (p. 119) that:

"Organizations avoid uncertainty.... They avoid the requirement that they anticipate future negotiations of other parts of their environment by arranging a negotiated environment. They impose plans, standard operating procedures, industry tradition, and uncertainty absorbing contracts on the environment."

However, the results of the Hunt studies combined with earlier works by Scherer have resulted in increased visibility for the concept of extra-contractual motivations. Essentially, this concept suggests that contractor managers and personnel are motivated by factors other than profit. Further, the rate of profit obtained on a given contract is viewed as subservient to other motives as long as the economic viability of the firm is maintained. Finally, the concept suggests that when confronted with the option of achieving profit from either higher technical performance or lower cost, the former path will be selected.

While adequate evidence for extra-contractual incentives exists, there is a danger in assuming that financial motives will be of secondary importance to all contractors or to a given contractor at all times and on all projects. In addition, other environmental constraints will exist which impinge upon achievement of contractor motivations and thus influence strategy.

CONTRACTOR ENVIRONMENT AND CONSTRAINTS

The contractor's motives must be viewed in the context of a particular R&D acquisition if they are to be useful in selecting a strategy. That is, a given contractor program manager must

operate within a particular environment. The availability of strategies for achieving one or more contract objectives will be influenced not only by these underlying motives, but also by the environmental constraints surrounding the project. These constraints include:

- Contractor's Financial Environment;
- Contractor Personnel, Organization, and Management;
- "Other Business" Constraints;
- Constraints on Interaction with NASA;
- Project Specific Constraints.

Contractor's Financial Environment

Analysis of contractor's financial soundness is a formal part of the contractor selection review process in the Source Evaluation Board. NASA Management Instructions with regard to this process suggest that the latest balance sheet and profit and loss statement will be utilized in evaluating financial position of the company, and that consideration will be made for:

- "rates and ratios";
- working capital as measured by (current assets - current liabilities);
- financial trends in net worth, sales, and profits;
- methods of financing the contract, including an assessment of the availability of outside funding if necessary;
- necessity of government financial aid.

However, in addition to analyzing the financial environment to consider financial stability of a contractor, such analyses are useful in understanding contractor motivations and strategy.

At any point in time, a contractor has some set of financial goals and constraints which will exert some influence on strategy. These may include the following:

- A contractor needs to generate increased return-on-investment (Net Profit ÷ Net Equity) in order to obtain capital funds in outside money markets;
- A contractor needs to generate increased cash flow in order to meet upcoming debt maturities;

- A contractor operating below capacity needs increased sales to more fully utilize personnel and equipment and in order to cover fixed costs.

An understanding of such constraints is essential if all facets of contractor strategy are to be considered. That is, contractors may behave differently in terms of their reaction to incentives depending upon the particular financial constraints they face. Specific considerations which warrant attention in this regard are presented below:

1. Return-on-investment - The current "Profit '76" studies in the Defense Department are based on the presumption that aerospace industry investment needs to be stimulated to improve efficiency. Current government procedures for procurement provide for establishing target fees on a percentage of cost basis and then tying overhead rates to direct labor hours, reducing industry incentives to invest in labor saving equipment. To the extent that a contractor has a need for improved return-on-investment, then incentives which facilitate such improvements may be effective.
2. Financial Reporting - One of the limitations of return-on-investment analysis in the aerospace industry is the fact that contractors typically represent only one division of large, often diversified corporations. Such divisions typically do not report information beyond total sales and net profit to net sales ratios - if that, although return on capital employed may be estimated at the contract or at the divisional levels. (See Goodhue and Lampert). Further, corporate financial strategy may incorporate separate objectives for each division. That is, a corporation may rely on one division for cash flow, and another for a high profit to sales ratio to support a third division which is capital intensive.
3. Leverage - The size of a return on equity may not present a full picture of a corporation's financial position. As Martinelli has demonstrated, leverage (the ratio of long term debt to net worth) among contractors has risen sharply in the past decade. Contractors with high return-on-investment ratios may be in serious trouble if such ratios reflect very high leveraging using debt which is about to mature.

To illustrate these points, 1974 preliminary data on several major contractors is provided below: (Moody's, Standard & Poors)

<u>Company</u>	<u>Net Profit</u> <u>Net Worth</u>	<u>Net Profit</u> <u>Net Sales</u>	<u>Net Worth</u> <u>Long Term Debt</u>	<u>*Aerospace Sales</u> <u>Corp. Sales</u>
Boeing	7.5%	1.9%	6.4	16.6%
General Dynamics	11.7%	2.9%	4.1	5.8%
Grumman	26.4%	3.0%	0.8	93.0%
Thiokol	16.4%	5.8%	15.7	54.5%
Martin Marietta	12.8%	6.6%	2.2	44.1%
McDonnell-Douglas	13.9%	3.5%	7.4	14.0%
Rockwell	11.8%	2.9%	1.8	26.5%
TRW	14.0%	4.0%	1.4	10.0%

* Definition of "Aerospace" varied among companies to include all aerospace (Grumman, Martin, and Rockwell) down to specific "space" and "spacecraft/missiles" or "spacecraft and propulsion" (TRW) divisions.

4. Divisional Goals - The smaller the contract, the less likely it will even be amenable to return-on-investment analysis, as facilities will increasingly be shared with other contracts. In short, this concept - while important to the corporation is unlikely to be established as a specific contract goal. However, awareness of the financial leverage constraints and other fixed costs, of cash flow needs, or of net profit needs may improve awareness of specific contract goals to the extent that a given contract is expected to contribute to such needs.

5. Net Profit Goals - Hunt, Rubin, and Perry (pp. 267-268) found that large contractors tended to have lower percentage profit goals - probably due to better cash flow and to larger value of contracts (and thus higher absolute profits). For large contractors, minimum acceptable profit ranged from 3% - 7%, while the range for small contractors was 5% - 8%.

Where "reasonable" profits are expected to be achieved, there is a tendency to have a declining marginal utility of profit. That is, contractors who will clearly reach profit goals are likely to be less motivated to pursue cost savings investments, will avoid layoffs of key personnel, and will focus on assuring reliability through increased confidence testing.

6. Contribution to Fixed Costs - Primary sources of fixed costs facing the contractor are debt payments, general and administrative expense, depreciation and maintenance, and some indirect labor (assuming that the bulk of engineering, supervisory, and technical personnel will be retained even at excess capacity). A contractor operating well below capacity is likely to consider the financial attractiveness of a contract not merely in terms of accounting profit but in terms of the expected net contribution to fixed overhead. If a contract covers all variable costs and a portion of truly fixed overhead, such a contractor will be better off than he would be by not having the contract even if an accounting loss is incurred on the contract, since total divisional loss is still reduced. Similarly, overruns which reduce profit may still yield improved divisional performance if the incentive share lost per dollar of overrun is less than the contribution to fixed overhead gained from the government reimbursed share.

(For instance, a 20% - 80% share ratio saves a contractor \$.20 in profit on each cost dollar saved. Failure to save the dollar gives net revenue of \$.80 [\$1.00 in sales - \$.20 contractor share]. If over \$.20 of the \$.80 represents fixed cost to a contractor below capacity, the net contribution to divisional fixed overhead and profit will be greater with the overrun dollar being spent.)

7. Cash Flow - Increasing the contribution to fixed overhead, even at an (accounting) loss leads to greater availability of cash for purposes of meeting current obligations (payroll, debt, materials purchases) to assure continuity of business. Since certain fixed costs (e.g. depreciation) are only paper costs and others (e.g. G&A) can be delayed in payment, increasing fixed costs charged to a project will also lead to improved cash flow where a firm is below capacity. While cash flow problems can frequently be assessed by analysis of the ratio of current assets to current liabilities, it should be recognized that the "inventory" portion of current assets claimed by aerospace contractors may be considerably less liquid than for other types of businesses due to the limited market for items such as airframes, spacecraft components, etc. Further, corporate levels of current assets and liabilities may not reflect the proportionate breakdown for the aerospace division under review. Depending on the profit center organization of the corporation, such measures of working capital may or

may not indicate the level of cash flow pressures on the aerospace division.

Contractor Organization, Personnel, Management

The contractor's organizational structure will impact the acquisition effort to the extent it enhances or restricts the contractor program manager authority.

Where the contractor is organized along strong functional lines, a program manager has little authority over the personnel and financial resources allocated to his project. This may restrict his ability to:

- alter work rates to change schedules;
- develop cost-performance trade-offs;
- influence overhead charged to his program;
- stimulate technical personnel to respond to incentives;
- modify policies.

Under such conditions, the ability to respond to changes in mission needs is more limited than in a more dedicated program organization where all workers are responsible to the program manager.

Additionally, contractors generally need to maintain a viable labor mix and bidding capability simultaneously. Consequently, top design engineers may be removed from projects once a contract is signed. Thus the contractor may be constrained by the technical qualifications of his personnel.

Due to these constraints, it can be expected that evaluations of the contractor program manager operating in a strong functional organization will be more a function of technical performance and total revenue than of profit percentage. However, financial criteria will probably increase in importance for dedicated organizations attached to very large programs.

Also of concern is the constraint of disutilities (Scherer). These are organizational concerns regarding manpower utilization policies. That is, contractors operating below capacity tend to avoid layoffs which could reduce costs due to consideration of the skills needed for future program and bidding needs (as well as due to empire - building in functional divisions).

"Other Business" Constraints

Opportunity costs reflect the costs of lost profit and overhead contribution opportunities incurred because a contractor approaching full capacity foregoes an alternative contract. Consequently, if larger, more profitable or more technically important projects are competing for contractor resources, the contractor program manager may be constrained in responding to the needs of a given project due to the absence of resources and the lack of top management attention.

The existence of other business may pose constraints for other reasons as well. If the "other business" is primarily commercial, the government project may be a low priority set-aside for a manpower pool. Further, the requirements of other, larger contracts may restrict the availability of high quality manpower for managing sub-contractors - thus reducing the contractor's ability to control a major amount of the contract outcome.

Constraints On Interactions

Certain factors reflect those aspects peculiar to the relationship between two organizations which constrain the ability to maintain effective relationships between NASA and contractor managers.

In reviewing a series of studies on NASA-contractor relationships, Cirone suggested that government personnel tend to believe that rigid structuring devices improve contract performance while contractor personnel believe that inter-organizational processes, communications, and interpersonal relationships are most effective.

However, recent project manager workshops appear to indicate that NASA project managers are now more attuned to the need for inter-organizational communication because formal contractor reporting systems do not provide real-time visibility, may be misleading, and fail to cover technical progress to an adequate degree and because financial priorities of contractors may be unclear.

Key questions which should be investigated in order to understand potential problems regarding such interaction include the following:

1. Marketing Activities - Does the company have a sufficient, well-experienced, well-known marketing staff to help you sell changes in your program? Does its staff have the ability to keep company management abreast of the present government activities in the overall aspect of your program?

2. Contractor Involvement - Is your contract of significant value or importance that the company feels identified with the product? Does the company even know how important the contract is in the mission of the project?
3. Patterns of Interaction, Coordination with NASA Project Managers - Is the company used to working in the NASA environment? Will they help the project along by providing required inputs on a timely basis? Have they been known to help plan or just take direction? Are they willing to seek technical advice when needed?
4. Role Compatibility and Communications - Does the contractor program manager have a single NASA counterpart or rather overlapping contracts with a number of personnel thus reducing the effectiveness of inter-organizational communications.

In addition, interaction is impeded to the extent that: (Drucker, et. al.)

- NASA and contractor motives are divergent;
- Contractor's major problems are detailed design and manufacturing, while NASA major problems are technical evaluation, schedule, funding, and change control;
- Contractor delegates more authority (including a chief engineer) while NASA project manager tends to delegate less and often acts as chief engineer;
- Contractor program manager must also act as middle man with subcontractors in many cases so he has more outside interfaces.

Project Specific Constraints

Earlier, we suggested that contractors have both financial and extra-contractual motivations. However, the contractor's ability to achieve these goals and simultaneously satisfy NASA objectives will be limited by project - specific constraints over which the contractor has limited control.

These constraints include:

- reasonableness of NASA budget estimates;
- clarity and precision of performance objectives;

- magnitude of required technological advances;
- contract type and structure of incentives;
- limitations on cost accrual rates and funding constraints;
- use and limitations on use of parallel design efforts or on reliability testing levels;
- restrictions on technical changes.

Such constraints pose limitations to the contractor in terms of restricting the options he may select in meeting financial goals and in terms of restricting his "mastery" over his operations. However, while contractors may modify goals in line with these constraints, the non-NASA portion of the contractor environment will not necessarily change. Consequently, contractor strategies must evolve to deal with these goals and environmental constraints.

INTER-ORGANIZATIONAL ANALYSIS

An inter-organizational analysis of the NASA-Contractor relationship views the network as a social system in which economic, political, sociological, and psychological forces are operating (Benson). Inter-organizational analysis concepts have been developed to describe and explain network-relationships in a manner which incorporates relevant aspects of all these disciplines. In fact, inter-organizational analysis has been applied not only to business-related networks, but also to the analysis of networks of political units and educational-government networks. These concepts can be applied to the NASA-Contractor relationship to describe and explain the nature and dynamics of this relationship in the acquisition process, and to evaluate alternative approaches that NASA can implement to better manage this inter-organizational relationship.

While a comprehensive inter-organizational theory does not yet exist, a number of concepts have been used to describe and analyze inter-organizational relationships of various kinds. However, observation of the NASA-Contractor decision process and prior analytical studies of the NASA and DOD acquisition process (Scherer, Hunt, Fox, Logistics Management Institute) enable us to identify the most applicable concepts.

Concepts for Describing Network Linkages

This set of concepts incorporates those inter-organizational dimensions which describe the basic setting, purpose, and procedures of the network relationship, including: [See Benson, Evan, Warren, J. Thompson]

1. Organizational Set/Network Set
2. Goals and Goal Congruence
3. Domains and Domain Consensus
4. Leadership and Authority Structure
5. Work Coordination
6. Technical-Ideological Consensus
7. Dynamic Nature of the Relationship

Organizational Set is defined as the set of organizations which constitutes a given organization environment, including members of the network and other organizations which influence the availability of resources or decision making patterns in the network [Evan]. In the case of the NASA-Contractor relationship, the organizational set includes scientific and engineering groups and societies, Congress, OMB, GAO, users (such as COMSAT, the Weather Bureau), and other contractors and subcontractors. The significance of the extra-network organizational set is that it is the source of all resources available for aerospace contracting and can control the exchange process through setting priorities,

program review and funding control. The definition of the organizational set provides a basis for identifying all possible sources of inter-organizational activity, interaction, and influence that impact on the NASA-Contractor network relationship. Some categorizations of the major dimensions of such interactions are provided by Benson, and by Evans of which the following appear significant in describing the NASA-Contractor relationship:

- a. Resource Concentration - NASA resources come primarily from Congress. Utilization of these resources is subject to close scrutiny by OMB. Consequently, these organizations are most dominant in the NASA-Contractor organizational environment.
- b. Network Autonomy Over Joint Activities - This tends to exist only in low-cost, less visible projects and where external "users" are not involved.
- c. Environmental Control Mechanisms - Regarding selection, definition, and funding of projects exist in terms of: science community pressure for various types of projects; congressional pressure regarding project selection and funding; OMB funding controls; GAO review of program management and contracts, user specifications.
- d. Overlapping Functions - Technology diffusion to contractors and users is leading to the creation of potential competition for NASA on certain types of applications missions.
- e. Overlapping Goals, Values, Professional Membership Among Personnel - Communication and pattern of interactions that may lead to selection of priorities for scientific and technological advancements and approaches occur among government, industry, universities, user scientists and engineer.
- f. Potential Coalition Formation - Due to economic, political, or professional objectives exists. Although probably less pronounced than in DOD, coalitions between key congressional leaders and contractors or scientists may develop leading to pressures on NASA program policies.

Goals and Goal Congruence - Goal congruence refers to the level of agreement among members as to the inclusive goals to be achieved [Stern]. NASA goals include the accomplishment of technical mission performance, on schedule, within the scope of

funding constraints. Contractor goals include the development of reliable systems to meet missions needs while achieving certain financial goals. In NASA, contracts are the basic mechanisms set up to achieve both technical and business goal consensus. The adequacy of the contract in making joint goals consistent with each unit's goal is a fundamental dimension influencing the NASA-Contractor relationship.

Domain is a concept reflecting the boundaries claimed by an organization regarding the scope of its activities [J. Thompson]. Domain consensus reflects the level of agreement among network members on the appropriate division of work activities and areas of responsibility appropriate to the achievement of network goals. As a practical matter, while contractors are primarily responsible for performance and NASA is responsible for project definition and supervision, there is a significant overlap in domains due to formal and informal interactions. Contractors frequently participate in definition of technical approaches and specifications, and may even assist in selling the project to Congress and external agencies. NASA may insist on the adoption of technical methods, testing levels, or use of government specified or government furnished equipment, and may interfere in the management of subcontractors. Accordingly, a good deal of overlap in domains may occur.

The problem of domain consensus is complicated by two fundamental organizational motivations. Contractor motivations are heavily weighted toward maintaining a "mastery" [Hunt] or control over their organizations' activities and destiny. NASA is motivated to assure timely and quality performance in order to meet the expectations of external organizations. These forces are likely to impede domain consensus to the extent that joint goals can be achieved without a perfect division of labor and responsibility. In effect, duplication or supplementary efforts may result.

Structure of Leadership and Authority Within Networks - Sayles and Chandler have suggested that R&D networks are more egalitarian than hierarchical due to science and professional values which stress equal status for equal technical competence. Additionally, the NASA-Contractor relationship is marked by significant distinctions in business requirements. Private industry is constrained by the fiscal need to achieve target levels of sales, profit and return on investments while NASA (as a government agency) desires to minimize the financial outlays necessary to achieve a goal. The basis for cooperation, then is primarily technical achievement in these networks, while in others (such as manufacturer-retailer distribution systems), joint profit motivations are operative. It is possible that hierarchical networks are more likely to surface where network members possess more similar fiscal management requirements such that coordination of financial resource generation processes is possible. As a

consequence, in R&D networks, authority is primarily centered at the organization level and network leadership is limited to definition of program objectives. The ability to effect further control over network relationships is (as we shall see below) a function of other bases for power.

Work Coordination refers to the degree of effectiveness and efficiency in coordination and collaborations within the network [Benson]. NASA's extraordinarily high level of project success in terms of attaining mission objectives seems to testify to a high level of achieved effectiveness. Analysis of cost overruns, however, leads to a more varied record of success measured in terms of efficiency. This may reflect lack of domain consensus [leading to duplication of effort] as well as other factors to be discussed below.

Ideological/Technical Consensus refers to the level of agreement in the nature of a task and/or on appropriate approaches to accomplishing tasks [Benson]. The selection of technological approaches, specification levels, documentation and confidence testing practices, and use of standard and/or government furnished equipment are among the issues where consensus may be lacking. While technical consensus is promoted by informal interaction between NASA and contractor technical personnel throughout the acquisition process, the imposition of business requirements by NASA may impact the ability to achieve consensus. That is, technical consensus is more readily (but not necessarily) achieved where technical/cost trade-offs are minimal.

Dynamic Nature - Changes in the nature of network linkages occur as the acquisition process moves from project conceptualization through implementation due to:

- o Changes in extra-network constraints on the scope and funding of projects;
- o Changes in inter-organizational management strategy, as the specific environment and objectives of each organization change for each stage of life cycle;
- o Changes in inter-organizational decision points and in key interfacing, personnel (particularly in NASA).

In particular, as Sayles and Chandler note, the relative importance of business and technical goals tends to oscillate over the life cycle.

Concepts for Analyzing Network Outcomes

Stern et. al. have suggested four variables as being highly meaningful as a basis for conceptualizing the connections or structure of inter-organizational relations:

1. Power - The capability an organization possesses for effecting the outcome of another organization.
2. Comparison Level - The standard against which the member evaluates the "attractiveness" of the relationship. Each member has a standard set of goals to be achieved in a relationship and this concept indicates what these are (for purposes of reference).
3. Comparison Level of Alternatives - The "opportunity cost" of foregoing one relationship in order to engage in another. This reflects the lowest level of anticipated outcomes a member will accept given the current environment.
4. Intensity - The degree of involvement in the relationship. This is primarily a function of two factors which express the energy level of the relationship: frequency of interaction and size of resources investment. (Marrett)

For purposes of studying NASA-Contractor relationship outcomes, several component factors of these variables are considered.

Intensity - The NASA-Contractor relationship is one of reciprocal interdependence in that both members employ some degree of mutual adjustment in order to achieve coordination (J. Thompson). The perceived degree of interdependence reflects the relative perception of members as to the extent to which each is dependent upon the other (Stern).

In general it appears that a relatively high level of interdependence exists. As we have suggested above, the two units are generally autonomous and have disparate business goals. Consequently, work coordination and development of technology and domain consensus are the basic points which demand interaction and mutual adjustment. Where projects are highly defined and specified in the early stages, interaction is much lower than for projects where uncertain technological achievements are required. However, interdependence increases over time - particularly after the contract award - as work coordination and funding flows become more dominant, leading to increased frequency of contacts. Further, the amount of resources (funds, manpower, technology) devoted to the relationship increases over the life cycle.

Consequently, in large-scale R&D contracts, the level of uncertainty, frequency of contact, and large amount of resources involved lead to a relationship of high intensity.

In addition, Jacob's concept of essentiality appears appropriate here. The provision of resources and programs by agencies such as NASA are essential to the aerospace industry contractor in order to develop hardware items. Similarly, the existence of aerospace contractors with technology and manpower to develop systems is essential to the functioning of NASA programs. Consequently, each party has resources vital to the other, such that the degree of involvement of both parties is generally high.

Permanency of the Relationship and Availability of Alternatives -
Permanency of the relationship refers to the perception as to the length of time the units will continue to act as a network (Stern). Increased perception of permanency will lead to greater cooperative effects as general rule. (This assumes also that both members perceive the relationship as beneficial). The perception of a more permanent relationship will increase to the extent that: NASA is unwilling to drop a contractor after an award is made; the project is complex and long-term in scope; expectation of related follow-on work is high; the contractor has unique capabilities in the specific type of work or technology such that future contracts will be awarded. Also, contractors who have a larger percentage of this business allocated to NASA activity are more likely to perceive a more permanent relationship.

Counterbalancing such forces is the notion that each party may view the current project as a unique relationship. Future awards are not certain in NASA (since production contracts are rare and past performance is seldom the major criterion in source selection), and even where the expectation of receiving future awards is high, project and program managers for both members are likely to change. In general, then, perceived permanency is likely to be most closely measured by the expected time frame for the current contract.

Motivational Investment - The greater the stake of one member in continuing a relationship and the greater the commitment to the performance of the joint activity, the higher the motivational investment of that member (Emerson). Both parties will have some motivational investment in the relationship in terms of the technical accomplishment of the tasks. This is uniquely important in networks which are based on a technical/professional relationship. NASA's investment, however, is likely to be stronger due to the impact of a failure to achieve technical goals on the organization's relationship with its extra-network organizational set (users, Congress, cognizant agencies and the public). Failure to complete highly visible projects has a particularly high threat potential for losing resource inputs and for the application of external controls on the work process.

Comparison Levels - Prior to the award of a contract, NASA generally has the option of interacting with a number of prospective bidders, so several alternative sources exist. Similarly, each contractor can evaluate the opportunity costs (if any) of foregoing one contract to bid aggressively on a second contract and to determine if a given contract opportunity is sufficiently attractive to enter into a relationship. Particularly in a period of time where contractors are operating below capacity levels, however, it would appear that contractors are relatively dependent on NASA during the pre-award stages.

Subsequent to the award, however, NASA's reluctance to reopen competition or terminate a project suggests the lack of substitutability of contractors. This suggests a need to maintain the attractiveness of the relationship to contractors and to maintain contractor motivational investment in the relationship to assure continuity of the relationship through completion. (Note that even in the event of a termination, contractors receive payment for all authorized work completed.)

Dependence on Extra-network Forces - As suggested in an earlier section, financial resources flow into the network from environmental agencies. Further, these agencies have a certain degree of control over operating relationships within the network.

NASA is constrained by budgetary and program approval processes of federal agencies and by the limitations of scientific community and public support. Additionally, reimbursable programs funded wholly or in part by other "users" influence NASA decisions. Maintenance of technical and schedule performance thus becomes a major priority for NASA management on approved programs, while demonstration of cost-effective impact is the major priority for projects in the pre-approval stages.

This process may result in over-optimistic initial cost estimates followed by descoping, schedule slippages, redefinition and/or increased reliability testing at later stages. Cost overruns and budgetary re-allocation often result.

Contractors are influenced by public approbation, demands of "other business", the ability to gain access to money markets, and the ability to use technical gains to obtain future work. Consequently, maintaining capability, good technical performance, and obtaining some minimal contribution to overhead and profit are primary considerations.

Additionally, external organizations impose restrictions on the timing of budgetary flows, methods for competition, acceptability of costs, and other factors governing the relationship.

Asymmetry in Risks and Rewards

Asymmetry in network relationships reflects the degree to which the relative risks and rewards allocated to the network members are perceived as unbalanced such that joint cooperative action benefits one party more than the other (Stern). The difficulty in dividing balanced risks and rewards is largely a function of the level of uncertainty in a project in terms of: unforeseen costs, unknown technical problems, changes in contractor environment and capacity, or uncertainty over NASA's potential use of options to buy in multiple units (where applicable).

In addition to the inherent uncertainty in developing large-scale systems, constraints in both organizations result in a significant tendency by both parties to minimize risk in the network. In NASA, it has been traditional for project and program managers to primarily focus on system technical performance in risk minimization, with schedule performance also being significant in projects with critical "launch windows" (such as inter-planetary projects). Cost and budget risk have historically been secondary concerns.

Contractors attempt to minimize risks in two areas, financial and technical. Poor system performance damages the contractor's credibility with NASA, with other possible clients, and with the general public and investment community. Consequently, high reliability is a major objective. Similarly, the contractor manager responsible for a project will normally attempt to avoid any loss, as this may be interpreted as a failure of management capability within the organization.

Interaction of the risk avoidance motives of both parties frequently leads to the following:

- NASA is willing to raise target cost and accept or initiate changes for higher reliability;
- Both sides are reluctant to control reliability and confidence testing;
- NASA is unwilling to invoke cost ceilings and will apply additional funding on overruns (which is known by contractors);

In sum, interactions regarding risk and reward trade-offs between members tend to lead to increased emphasis on technical performance outcomes.

Relative Visibility of Goals and Activities

Visibility represents the degree to which each party can obtain timely knowledge of the goals, activities, processes, constraints, or accomplishments of the other member of the network.

In general, contractors have a decided advantage in visibility due to close inter-organizational ties to NASA personnel and to agencies (such as OMB) which monitor NASA activities. In addition, much of the information desired about any government agency must be open due to public record requirements. More specifically:

- NASA project priorities are made visible in the RFP;
- NASA technicians interact with industry counterparts in developing technical plans;
- NASA budget information becomes known, enabling contractors to adjust price estimates to the NASA cost target;
- Contractors can (and must) tie work to funding schedules.

NASA visibility, on the other hand, is impeded by:

- Need to assess priorities of many contractors in preaward stage (while contractors need only analyze one organization);
- Reliance on contractor past performance or preliminary studies by contractors for many cost estimates;
- Inconsistency in accounting systems across contractors and across projects (especially in indirect and overhead costs);
- Reliance on outside agencies (DCAS) for auditing at contractor site;
- Time-lag on reports from contractor;
- Uncertainty about contractor's motivations to trade-off incentive profit for manpower or capacity utilization, or to trade-off incentive or award fees on one dimension (e.g. cost) for fees on other dimensions (schedule, performance).

Strategic Position

To the extent that one member of the network performs an activity which is critical to network performance, that member possesses power since that activity will determine (at least in part) the network outcome. Strategic position is a reflection of the domains mapped out by each party. As suggested earlier, the basic domain of NASA concerns project definition and performance evaluation, while contractors are primarily responsible for implementation.

However, these boundaries are not always clear cut. Where technical and performance specification and cost targets are clear, precise, and thoroughly developed, then NASA's strategic positional power is enhanced. However, to the extent that initial specifications are influenced by contractors, call for new technology or are overly optimistic about performance, then contractors will have greater power, in that performance outcomes will be largely a function of contract implementation since original specifications become meaningless.

In general, the greater the uncertainties involved in a project, the greater the positional power which derives from implementation as opposed to specification and evaluation activity.

Two additional points should be noted. First, the matter of who performs a function is relevant primarily because of a disparity in goals. If both parties are concerned solely with technical performance, outcomes are likely to be minimally affected by a shift in domains. Second, an overlap in domains (such as specifications, direction of subcontractors, or contractor initiated changes) may or may not lower system performance directly, but may contribute to conflict.

Dominance and Conflict

This section has identified two sets of inter-organization factors useful in understanding the acquisition process in NASA. The first set described the general linkages that exist in the NASA-Contractor relationship. The second set reveals the dimensions which must be analyzed to determine the nature of a specific inter-organizational relationship. That is, when the general linkages are combined with the specific NASA environment, contractor environment, and project uncertainties, it should be possible to evaluate the specific NASA-Contractor relationship for a given acquisition along these eight analytical dimensions.

These eight dimensions, in turn, provide inferences as to:

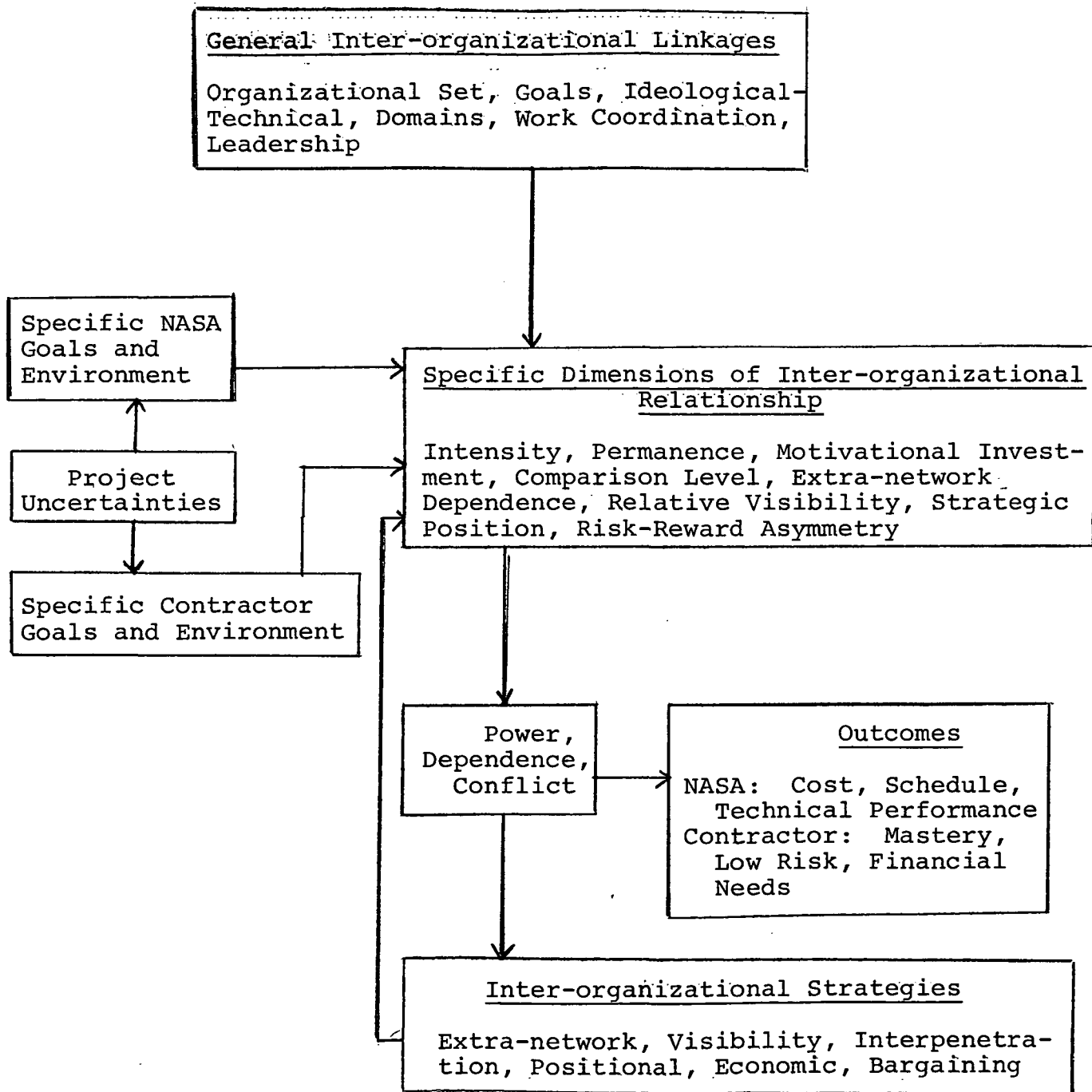
- the relative power of each party to influence the outcomes of the relationship (in terms of each party's achievement of its goals);
- the amount of inter-organizational conflict that will result if either party perceives a serious threat to its ability to achieve its goals.

This second set of dimensions, therefore, represent those elements of the relationship toward which inter-organizational strategy will be directed.

Figure I portrays the relationships among these dimensions.

FIGURE I

Relationship of Inter-organizational Concepts



INTER-ORGANIZATIONAL STRATEGY

Inter-organizational strategy is the development of inter-organizational activities and decisions designed to improve the relative dominance of a given network member and/or reduce network conflict.

Six basic strategy approaches are presented:

1. Extra-network power strategies
2. Strategic network positioning strategies
3. Visibility strategies
4. Interpenetration strategies
5. Economic power strategies
6. Bargaining-negotiation strategies

It should be noted that such strategies may not be mutually exclusive. They may be used in tandem, or, owing to the life cycle nature of many inter-organizational relationships, they may be used sequentially.

Further, it should be noted, that the term "strategy" is used in a relatively broad sense. Sayles and Chandler (p. 70) distinguished "contextual designs" for achieving managerial control from "strategies" for stimulating desired responses or performances. The former involve factors (such as dependency) reflecting the context or setting of a relationship. The use of such designs involves activities influencing orientation, commitment, and responsiveness of the other organization. Strategy (in their view) is an attempt to pre-program actual decisions via some specified stimulus.

The term strategy, as used in the present study, incorporates both of the foregoing concepts on the assumption that both represent some managerial action design to achieve an objective. That is, strategy will incorporate activities which are designed to modify the overall context of the relationship (e.g., by influencing intensity or relative visibility) as well as those activities designed to evoke specific responses (such as establishing cost incentive fees).

1. Extra-Network Power Strategies

Strategies for minimizing dependence and increasing power may be focused on the organization sets of the network members. Specific alternatives within this set of strategies include the following:

a) Seek prestige - Organizational prestige (as conferred by organizations of publics in the environment) may provide at least a partial basis for power (J. Thompson). Contractors may obtain prestige through professional citations or public approbation regarding technical expertise, performance and capability. Similarly, NASA obtains prestige, through public acceptance of and interest in its programs, through professional support of the science and engineering communities, and (historically) through Congressional and White House support.

b) Seek new resource bases - Broadening the resource base by finding new uses and users will reduce reliance on existing members of the organizational set. This may involve: finding new sponsors for space experiments; finding users for existing programs or hardware who can be brought into the programs at variable costs; finding support for developing technology with potential commercial applications.

c) Manipulative strategies - Organizations may attempt to influence agencies or publics in the organizational set of the other network member in order to place pressure on a given member and thus gain power (Benson). While NASA has quite limited options in this area, contractors may attempt to influence resource generating or resource monitoring agencies (Congress, OMB, GAO, Users) to force changes in program priorities, commitments, or funding in NASA, or to force review of NASA decisions regarding contract awards, cost reimbursement, or domain activities. The mere threat of such actions may be sufficient to prompt reconsideration of NASA policies or decisions.

d) Authoritative strategies - One option available (in theory) to NASA is to obtain the formal support of an environmental organization regarding a given policy (Benson). For instance, obtaining Congressional, GAO, or OMB support for policies regarding low-cost practices, reporting requirements, types of contracts to be used, auditing practices, allowable costs, etc. may facilitate the ability to implement a given policy, thus increasing power by formalizing and/or re-organizing the structure of inter-organizational relations.

2. Strategies for strategic network positioning

This group of strategies is designed to minimize dependence through extending the organization's dominance over the inter-organizational linkages in the network. More specifically, this group includes the following strategies:

a) Precise specifications of project requirements - Improved project definition at an early stage in the relationship will increase the dependency of the contractor and reduce the uncertainty on the technical approaches and bases for performance evaluation. Early definition of tight technical specifications, cost effective testing requirements, and specified cost, technical and schedule performance requirements decrease dependence on contractors. Further the development of realistic cost estimates and related funding ceilings reduces contractor options on work coordination strategies. Excessive optimism in NASA's in-house cost estimates (to "sell" a project), and reliance on past contractor cost performance (without regard to efficiency evaluation) increase NASA dependency in cost definition. One argument against tight specifications is that they reduce innovation by contractors. The use of design to cost policies is one method for balancing cost and innovation goals.

b) Domain strategies - Domain strategies involve either the takeover of more network functions or the exercise of greater discretion in contrasting functions. Dependence is minimized to the extent that the domain incorporates all activities except those which (Sayles & Chandler):

- have only a short-run impact
- do not inhibit future competition
- do not make NASA technically dependent
- are too costly for in-house resources
- individually have a small impact on the system
- are not core functions essential to the organization

Contractors with excess capacity and manpower may expand their domain in order to achieve control over operations. NASA policy is generally oriented to minimizing in-house activity to the extent that performance will not be impaired either in the short-run or long-run. As a consequence, contractor domain strategies are expansive in general while NASA's are protectionist. Activities which appear to be in the discretionary zone for NASA include those where matching responsibility issues are significant. Systems integration, subsystem testing, direction of sub-contractors, mandating of government furnished and standard equipment, and retention of approval over subcontracting arrangements are activities which, if pursued by NASA, result in reduced contractor responsibility. However, decreased NASA dependence due to employing domain strategies may be offset by a decrease in contractor motivational investment or by the adoption of other contractor power strategies of an extra-network or economic nature.

3. Visibility strategies

NASA's dependency can be decreased by increasing visibility over work coordination activities, thus helping to maintain adherence to performance standards. Standardization of work breakdown structures, reports, indirect cost allocation methods, and overhead charges, improving the speed and accuracy of audits, and increasing the frequency of key contractor reports are vehicles for improving visibility and thus at least partially creating the "self-operating system of control" suggested by Sayles and Chandler.

Additionally, improved analysis of and awareness of contractor motivations and strategies facilitates the ability to identify anticipated contractor activities regarding work and performance priorities. Periodic evaluations of all performance dimensions would provide additional visibility useful in minimizing dependence. (This is a supplemental advantage of award fee contracts which are discussed later).

With regard to formal financial reporting systems for monitoring cost and schedule progress, several kinds of problems have been experienced.

- Such reports may overload the system (especially on large projects where PERT is being used) with an unmanageable volume of information.
- Required reporting formats may be incompatible with contractors' internal systems, thus adding to the cost of reports and perhaps reducing their accuracy..
- In complex systems acquisitions, such reports may be prepared two or three levels away from the working level, resulting in a large time lag.
- Such reports do not reflect technical problems currently being encountered which, if unsolved, will lead to cost and schedule problems later.

As a consequence, frequent face-to-face reviews at the management and technical working level are often required to identify technical problems at an early point in time. Such reviews often lead to technical intervention and direction from NASA, a condition which may conflict with the contractor's desire to maintain a "mastery" over his technical operations.

4. Interpenetration strategies

This class of inter-organizational strategies includes activities designed to increase intensity and motivational investment in the network relationship by reducing uncertainty, increasing interaction, or increasing consensus on network goals and tasks.

Three types of interpenetration strategy can be identified.

a) Informal boundary spanning activities - Boundary spanning personnel are individuals involved in informal or formal relationships with personnel in other network organizations. Informal activities of these personnel include contractor marketing activities, informal negotiation of disputes, and shared decision-making on contract implementation procedures. Such personal communications activities (which are educational or propagandizing in nature) may assist in developing inter-organizational awareness of joint problems and lead to increased motivational investment (Stern). Further, boundary activities of technical personnel may lead to the substitution of professional group pressures for formal standards of performance (Sayles & Chandler). Obtaining insight into the needs and styles of the other organization and increasing inter-organizational identification are direct consequences of informal boundary activities and facilitate decision-making and coordination at the project definition and implementation stages (Hunt & Rubin, pp. 304-306).

b) Coopting strategies - Cooptation is the process of absorbing elements from one organization into the decision-making structure of another organization, to increase the likelihood of future support and thus reduce uncertainty (Thompson). NASA may attempt to coopt contractors by involving them in the design of RFP's and technical specifications, definition of incentive systems and control systems, and designation of cost-effective practices. A related inter-organizational adaptation that may occur is the absorption of leadership by expertise. That is, in the contract implementation phase, on project manager may become the "de facto" manager of both organizations due to special skills, experience, or knowledge of the technical tasks to be performed. In effect this ability to control or guide task performance generates a shift in power - often toward the contractor - as a result of task interactions (Hunt & Rubin, p. 300).

The acquisition of such leadership is generally not one of organizational policy, but derives from the need for task guidance and from interactions between project managers. This interpenetration thus facilitates either the contractor's ability to use the government project personnel in "selling" changes or NASA's ability to control technical/cost trade-offs.

c) Coalescing - involves the development of an unusually close relationship similar to the creation of a joint venture (Thompson). This requires the development of high goal consensus with agreement and commitment to future joint decision-making where the impact of the achievement will result in strong approbation of extra-network forces. Typically, this means submersion of all goals, save the one major joint objective, and will rarely be effective. However, when available it assures a high degree of intensity and motivational investment.

5. Economic Power strategies

Economic power strategies are designed to minimize dependence through the application of economic forces (such as maintaining competitive pressures, applying cost and funding controls, and utilization of incentives and performance evaluations) which maintain control over risk and reward structures in the network. In particular, the objective of such strategies is to assure that each party accepts an appropriate level of economic risk commensurate with performance. The achievement of economic power, therefore, would mean that the member with relative power has the dominant ability to control the flow of resources and allocation of risks.

In the NASA-contractor relationship, this means that NASA must seek economic power through its ability to award contracts, its control over the funding available to distribute to contractors, and its ability to control performance through selection of type of contract. Contractors must seek economic power by attempting to influence NASA's selection of a contractor and of a type of contract, and by the way in which it structures its performance to earn revenue, and to take advantage of funding controls and incentive and award fees.

Further, strategies for economic power are dynamic in that they involve interrelated activities and decisions at various stages of the life cycle. Additionally, the selection of strategies must also consider the full range of motives and priorities of both parties in a given network as well as the degree of uncertainty involved.

a) Competitive strategies - involve the degree to which NASA can obtain economic power through using the pressure of competition among contractors to achieve motivation for excellent technical, schedule, and cost performance. Contractor strategies will be designed to maximize NASA dependence by maximizing the firm's differential competitive advantage.

Among the options available to NASA in this class of strategies are:

- promoting parallel efforts to extend competition through more than one stage of technical development;
- use of recompetition on multiple buys of "standard" equipment;
- reducing transfusion of information among contractors and especially from the government through shorter acquisition cycles and better orals techniques (Management Study of NASA Acquisition Process);
- develop budget and cost estimates which are realistic rather than optimistic to obtain more competitive price competition (Drake suggests that FPI contracts often lead to estimates which are not correct, leading to buy-ins and lack of price competition);
- be willing (and demonstrate willingness) to invoke limitation of funds clause, and the threat of re-opening competition to avert buy-ins (Fox);
- place heavy emphasis on prior performance in contractor selection process (Scherer, Hunt).

Contractor may attempt to avoid competitive pressure through:

- influencing technical specifications which match company capability;
- marketing efforts designed to generate more advantageous evaluations of technical and management capability;
- obtain technical advantages to improve chances for obtaining sole source or follow-on contracts, and maintaining such advantages through control of technical transfusion for re-competition;
- competitive optimism (Scherer, Fox) on bidding and anticipation of upward revision of NASA cost targets and funding ceilings, of change orders which increase costs, and the unwillingness of NASA to re-open competition;
- maintain low visibility of cost growth in early stages of a project to make the re-opening of competition more difficult when cost growth becomes apparent to NASA.

b) Automatic economic incentive strategies - The concept of economic incentives generally reflects contractual incentives which permit the contractor to earn profit on some performance

basis (Scherer). Such incentives may be of two basic types. Automatic contractual incentives (incentive fees) correlate the amount and/or rate of profit with contractor performance on a pre-arranged formula. After-the-fact incentives (award fees) provide a rate or amount of profit based on formal evaluation of contractor performance after the work (or portions of the work) have been completed.

Additionally, a variety of contractor motivations will be operating on contractors. Certain motivations for good performance tend to exist even in the absence of contract incentives. Accordingly, the design of an economic power strategy should consider the relationship between contractual incentive structures and existing motivations.

In particular, selection of an automatic incentive approach by NASA should incorporate explicit consideration of the following factors:

1) Contractors emphasize quality and schedule performance because they believe that poor performance on these dimensions will lead to loss of future awards (user costs) and because of the concern of technical personnel with technology advancement and high reliability (Scherer, Hunt). User costs are probably less significant in NASA business due to fewer production contracts, less formal performance evaluation in the SEB smaller sales potential, and less likelihood of program termination for poor performance due to greater criticality of schedules. User costs may also be significant if the loss of skilled personnel is feared. Consequences of these factors are:

- probable redundancy of incentives on technical performance and schedule performance;
- the tendency to maximize use of manpower by avoiding subcontracting and by maximizing the number of technical tasks;
- emphasis on reliability testing.

Some substantiation of this argument is provided by Parker and Belden. In a comprehensive study of Air Force contracts, they conclude that:

- contractors tend to earn performance incentives regardless of contract cost outcomes;
- underruns tend to be associated with early product delivery and overruns tend to be associated with late product delivery.

Further, Hunt, Rubin, and Perry (pp. 256-257) found that knowledge of contract incentives seldom extends below top management and, even then, is typically restricted to awareness of performance and schedule incentives.

2) Diminishing marginal utility of profit - Contractor managers are more likely to be rewarded for factors other than contract profit once losses are avoided and minimal acceptable profit levels are attained. Consequently, increased profit may not offset user costs, disutilities, or the political and customer repercussions of large profit percentages.

The Parker and Belden finding the CPIF contracts actually averaged larger overruns than CPFF contracts may lend further support to the argument that profit maximization is not a paramount contractor goal in the short run.

3) Wide cost incentive ranges - around target costs mean that incremental rewards for each dollar of cost savings are perceived as low. However, if cost ranges are too narrow where target costs are unrealistic, the number of cost levels with no incentive (both above and below target) is increased. Multi-dimensional incentives tend to have limited cost ranges, increasing the need for tight cost estimates (Scherer). CPIF contracts typically have cost ranges of approximately plus or minus 25% of target cost.

Clearly, the ability to effectively utilize such contract types to achieve an effective incentive range will be closely tied to the accuracy of the target cost estimate. Yet the rationale for cost-plus contracts assumes that such estimates are bound to be risky.

4) Cash flow - Where a contractor has severe cash flow needs, use of delivery incentives may lead to excessive responsiveness. Contractors may shorten test cycles, apply overtime, or risk performance against the attainment of such incentives.

5) Contractor cost share above target cost - The percentage cost share faced by a contractor may not be an incentive to hold down costs.

- If cash flow needs are great, the contractor cost share represents cheap interest for quick cash. (A 15% cost share may approximate a contractor's cost of capital - and the principle need not be repaid);

- If the percentage of the overrun which goes to fixed costs and reduced tax burdens exceeds the contractor share, the net contribution to overhead and profit is enhanced by overrunning.

Implication for the use of incentive fees by NASA include the following:

- Design multiple incentives only where incentive ceilings that avoid contractor control over performance direction can be achieved,
- Design incentives which minimize desirability of trade-offs of incentive profits for overhead coverage,
- Design incentives which stimulate cost saving investments (Logistics Management Institute, Fox),
- Control the re-investment of any underrun dollars by program offices and avoid cost targets with an underrun bias so cost savings are not illusory.

c) After the fact reward strategies - Since contractors have user costs and disutilities which may limit the effectiveness of cost incentives, they may have the motivation to bargain for incentive structures which reduce the risk of losses and which support technical and schedule performance. Correlating profit with contractor performance on a prearranged formula, however, assumes that shortrun profit is the primary contractor motivation. If this is not the case, incentives may not lead to the acquisition of economic power. In fact, if contractors are successful in bargaining for risk-averse share ratios and cost ceilings and for desirable and attainable performance and schedule incentives, economic power flows away from NASA -- particularly where cost estimates are poor, change orders are probable, and the likelihood of maintaining cost targets and ceilings through termination threats are small (Scherer, Pace, Hunt).

Alternatively, Scherer, Hunt and Fox have argued for FP contracts where cost estimates are tight or for after-the-fact performance evaluation systems. The award fee concept, in which NASA will unilaterally evaluate performance against the RFP requirements and priorities (at milestones and at project completion) is an economic power strategy which is consistent with the after-the-fact evaluation argument.

While award fees do not provide complete control over contractor performance they may provide greater incentive on the cost dimension while reducing the contractor's ability to manipulate incentive structures, since profit will be more a function of

performance than of bargaining and costing. Further, they permit re-direction of performance objectives where NASA requirements shift over time. Key problems in implementing such awards are (Scherer, Pace):

- the ability to clearly define relative priority of objectives; and to employ only a few dimensions;
- subjectivity and consistency in applying awards;
- administrative costs;
- if contractors must accept more risk in terms of performance rewards they will bargain for more flexibility and fewer controls (Sayles, Chandler, p. 283).

In addition, successful use of award fees may be enhanced if:

- the relative basis for fees (among cost, schedule, technical dimensions) is varied over time in response to performance; and is related to the contractor's own plans;
- performance periods are differentially weighted such that early periods receive heavier emphasis, since these periods are critical in establishing performance patterns; (with a significant bonus for final performance);
- contractor motivation is maintained in spite of early sub-par performance by preserving "lost" award fees for potential "catch-up" performance later;
- award fees are paid at the end of each performance period thus enhancing the contractor's ability to increase cash flow through good performance;
- contractor top management is kept informed about award fee evaluations. The award fee is frequently used as a "report card" on the contractor program manager, so a cut in award fees may generate greater attention to a problem.

d) Disruptive strategies - When a power imbalance in an existing relationship is significant and permits the party with dominant power to ignore internal conflict, one organization may invoke a disruptive strategy consisting of activities designed to threaten the resource generating capacity of the target organization through domain violation, fund diversion, or program circumvention (Benson).

The ability to invoke such a strategy requires the availability of alternative exchange channels and a minimal motivational investment in the inter-organizational relationship. Due to the risks (to NASA) involved in program termination or attempts to re-open competition, the utility of such strategies will likely be confined to contractors - and then, only in cases where visibility control systems are poor and expectations of future contract award losses are small.

However, under conditions of severe conflict, poor controls, and inadequate economic incentives, it is possible that a contractor might allow schedule slippages, incur excessive testing, manpower, or overhead costs or engage in slipshod management of subcontractors to either deliberately embarrass NASA managers, to attempt to recoup perceived imbalances in risk/reward trade-offs by the generation of greater total revenues and work, or to force a revision in contractual terms.

6. Bargaining and negotiation strategies

Bargaining and negotiation primarily occur in the fourth and fifth stages of the acquisition life cycle and are heavily intertwined with other stages for two reasons. First, bargaining is the mechanism by which certain economic strategies or visibility strategies are implemented. Negotiations of price and contract terms, change procedures, acceptability of reports, prices, acceptance of changes, and bases for fees are illustrative of this interconnection. Secondly, the range of bargaining strategies available is restricted by the implementation of prior strategies, and the selection of strategies is restricted by the results of prior bargaining (especially in stage four). For instance, the effectiveness of contractor strategies to control incentive fees, to earn supplemental revenue from changes, and to delay reports or documentation will be limited by the bargaining outcomes of stage four of the life cycle.

The use of the term bargaining strategy, therefore, focuses on the approaches used to gain power, reduce dependency, or increase the intensity of the relationship through the negotiation of procedures for implementing other strategy components (i.e., for implementing a visibility strategy, an incentive strategy, etc.).

The ability to implement a negotiation strategy is determined by three major factors: (Contract Management Institute)

1. Organizational structure and informal bargaining power,

2. Institutional forces and economic bargaining power,
3. Decision-making patterns of negotiators.

In the case of NASA, these might be illustrated as follows:

Informal power accrues to the contractor for organizational reasons when:

1. NASA negotiators don't have full support of NASA top management;
2. NASA negotiating team has disagreement on priorities;
3. The contractor negotiator is more experienced and of higher status;
4. The contractor has extensive supporting cost data;
5. NASA cost model is not fully accepted by NASA negotiating team;
6. Close ties exist between contractor and project personnel on NASA negotiating team.

Institutional forces influence bargaining power to the extent that:

1. The contractor has significant need for the contract;
2. The contractor has other contracts available;
3. NASA has alternate contractors available;
4. The contract is highly profitable;
5. Cost targets are tight, (i.e. reasonably certain);
6. The threat of contract cancellation is small;
7. The contractor size is very large or very small;
8. The program is designated as urgent by NASA.

Decision-making patterns are significant factors to the extent that:

1. NASA knows contractor motives from past contracts;
2. The contractor knows primary areas of expertise of negotiating team;
3. Negotiators have heavy workloads and wish to speed contract negotiations;
4. NASA contracting officer perceives a need for low overhead dollars and low profit percentage;
5. Either party perceives cost targets as risky.

(See Pace, p. 540; Bond; Fox 348-357; Logistics Management Institute for elaboration).

The total impact of these forces will indicate the relative bargaining power of each party. Consequently, changes in economic dependence or in within-organization factors can influence bargaining.

Relative bargaining power, in turn, will reflect the range of options available to either party. In general, the options selected will be designed to minimize risk (Scherer, Hunt) by both parties.

In NASA, strategies to reduce risk will take the form of maximizing the contractors share of cost overruns, setting tight cost ceilings, reducing contractors' ability to make non-essential changes, minimizing the possibility of embarrassing overruns or underruns, and increasing the opportunity for intervention on subcontracting, overhead charges, and testing requirements.

Contractor strategies available include the following (Pace, Fox, [Ch. 15], and Incentives Analysis, Inc.):

1. Structure cost allocation to show low indirect cost rates that appeal to contracting offer.
2. Obtain incentives permitting flexibility in performance standards.
3. Attempt to tie funding to level of effort.
4. Obtain simplified control system by lowering the price of compliance.
5. Obtain disclaimers of responsibility for follow-on work.
6. Avoid cost saving investments.
7. Argue that due to high fixed costs, a small percentage of cost is controllable.
8. Obtain language emphasizing "goals" rather than "requirements".
9. Point out the risks involved in accepting mandatory requirements where contract is CPIF.
10. Build in contingencies that can be "sacrificed".
11. On incentive contracts:
 - if cost target has overrun bias, bargain for low share ratios, high ceilings;
 - if cost target has underrun bias, bargain for high share ratios, accept lower ceilings;
 - if cost targets are tight, bargain for loose change provisions.
12. Obtain change provisions focusing on "allowable" as opposed to "reasonable" costs.
13. Structure milestones and related progress payments schedules in order to speed cash flow.

CONCLUSION

This paper has portrayed the NASA-Contractor relationship in terms of an inter-organizational network. Neither party makes decisions in a vacuum. Rather, the organizations are involved in exchanges of resources, products, and information over time. Each attempts to influence the business and technical outcomes of the network through strategies of direct action and/or of indirect activities which attempt to influence key elements in the network's organizational environment.

Prior applications of inter-organizational strategy have focused on all-business networks (e.g. distribution channels) or all-government networks (e.g. health agencies). By extending these concepts to a business-government network, it may be inferred that inter-organizational strategy is broadly applicable to a variety of network and organizational situations.

While various strategy typologies are available, the six alternatives suggested in this paper demonstrate the range of strategic approaches that may be employed individually or in combinations over time. Further, by considering the variety of strategic options available in terms of their impacts on the goals of other network members, improved anticipation of reactive strategies is facilitated. Where network relationships are at least moderately durable and dynamic, such a contingency management approach appears essential to achieving desirable network outcomes for each network member.

It is not coincidental that these strategy alternatives also appear in the conflict resolution literature. This reflects the fact that in highly interdependent networks such as the NASA-Contractor network, strategy selection decisions must incorporate conflict management mechanisms if joint network goals are to be achieved.

Joseph P. Gaultinan
Low Cost Systems Office
NASA Headquarters
June 14, 1976

REFERENCES

1. L. Sayles and M. Chandler, Managing Large Systems: Organizations for the Future (New York: Harper and Row) 1971
2. J. Kenneth Benson, "The Inter-Organizational Network as a Political Economy" Administrative Science Quarterly Vol. 20, June 1975, pp. 229-249
3. William Evan, "The Organizational Set: Toward a Theory of Inter-organizational Relations" in J. D. Thompson (ed.) Approaches to Organizational Design (1966: Pittsburg: Univ. of Pittsburg Press) pp. 173-191
4. E. Litwak and L. F. Holton "Inter-organizational Analysis: A Hypothesis on Coordinating Agencies" Administrative Science Quarterly Vol. 6, Sept. 1962
5. R. L. Warren, "The Inter-organizational Field as a Focus for Investigation," Administrative Science Quarterly Vol. 12, September 1967, pp. 397-419
6. J. D. Thompson, Organizations in Action (1967: New York: McGraw-Hill)
7. L. W. Stern, "Potential Conflict Management Mechanisms in Distribution Channels: An Inter-organizational Analysis" in D. N. Thompson (ed.) Contractual Marketing Systems (1971: Boston: D. C. Heath) pp. 111-146
8. D. F. Pace, Negotiation and Management of Defense Contracts (New York: Wiley-Interscience, 1970)
9. Contract Management Institute, Incentive Contracting in the Aerospace Industry (Washington 1966)
10. F. M. Scherer, The Weapons Acquisition Process: Economic Incentives (Boston: Harvard Univ., Div. of Research GSBA 1964)
11. Logistics Management Institute, The DOD-Contractor Relationship - (Preliminary Review, March 1970)
12. Incentives Analysis, Inc., Incentives in Government Contracts (Manhattan Beach Cal.: Incentives Analysis, 1962)
13. Tom Bond, Price and Cost Proposals (No. Hollywood, Cal.: Western Periodicals Co., 1968)

14. J. R. Fox, Arming America: How the U.S. Buys Weapons (Boston: Harvard Univ. Div. of Research, GSBA, 1974)
15. NASA, Management Study of NASA Acquisition Process, Report of Steering Group for Study of NASA Acquisition Process, June 1971
16. R. Hunt, I. Rubin, and F. Perry "Federal Procurement: A Study of Some Pertinent Properties, Policies, and Practices of a Group of Business Organizations" National Contract Management Journal Vol. 4, Fall 1970, pp. 245-299
17. R. Hunt and I. Rubin "Approaches to Managerial Control In Interpenetrating Systems: The Case of Government Industry Relations" Academy of Management Journal, Vol. 16, June 1973, pp. 296-311
18. Hudson B. Drake, "Major DOD Procurements at War With Reality" Harvard Business Review, Jan.-Feb. 1970, pp. 119-140
19. Raymond G. Hunt, A Study of Incentives in R&D Contracting (Dec. 1971) and Extracontractual Incentives in Government Contracting (March 1971) NASA Grant NGR 33-015-061
20. P. A. Martinelli, "Financial Leverage and Its use in the Defense Industry" National Contract Management Journal Vol. 5, Fall 1971, pp. 79-89
21. A. Cirone, "Extra-Contractual Influences in Government Contracting," National Contract Management Journal, Vol. 5, Fall 1971, pp. 53-66
22. J. Parker and D. Belden "An Examination of Army, Navy and Air Force Incentive Contract Outcomes" National Contract Management Journal, Vol. 6, Spring 1972, pp. 59-74
23. D. Baron, "Incentive Contracts and Competitive Bidding", American Economic Review, Vol. 62, June 1972, pp. 384-394
24. D. Murphy, B. Baker, and D. Fisher, Determinants of Project Success, NGR 22-003-028, 1974
25. C. Perrow, "A Framework for the Comparative Analysis of Organizations," American Sociological Review, 1967, Vol. 32, pp. 194-208
26. C. Marrett, "On the Specification of Inter-organizational Dimensions," Sociology and Social Research, 1971, Vol. 56, pp. 83-99

27. L. Stern, R. Bagozzi, and R. Dholakia, "Mediational Mechanisms in the Management of Inter-organizational Conflict," Working Paper, Northwestern University, August 1975
28. D. Jacobs, "Dependency and Vulnerability: An Exchange Approach to the Control of Organizations," Administrative Science Quarterly, 1974, Vol. 19, pp. 45-49
29. E. Drucker, et. al., Project Management in the Apollo Program: An Interdisciplinary Study, NASA Grant NGL-33-002-090, January 1972 (NASA CR-126941).
30. R. Cyert and J. March, A Behavioral Theory of the Firm, (Englewood Cliffs, NJ: Prentice-Hall, 1963)
31. R. Emerson, "Power Dependence Relations," American Sociological Review, 1962, Vol. 27, pp. 31-41
32. NASA, Cost Plus Award Fee Contracting Guide, NHB 5104.4
33. NASA-DOD, Incentive Contracting Guide, NHB 5104.3A
34. W. Chisholm, "Return on Assets Considerations for Contract Administrators", National Contract Management Journal
35. L. Goodhue, "Fair Profits From Defense Business" Harvard Business Review, March-April, 1972, pp. 97-107.
36. L. Lampert "Defense Industry Profits: Contractor Capital Employed" National Contract Management Journal, Fall 1973, pp. 93-114.

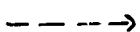
APPENDIX A

The Acquisition Life Cycle in NASA

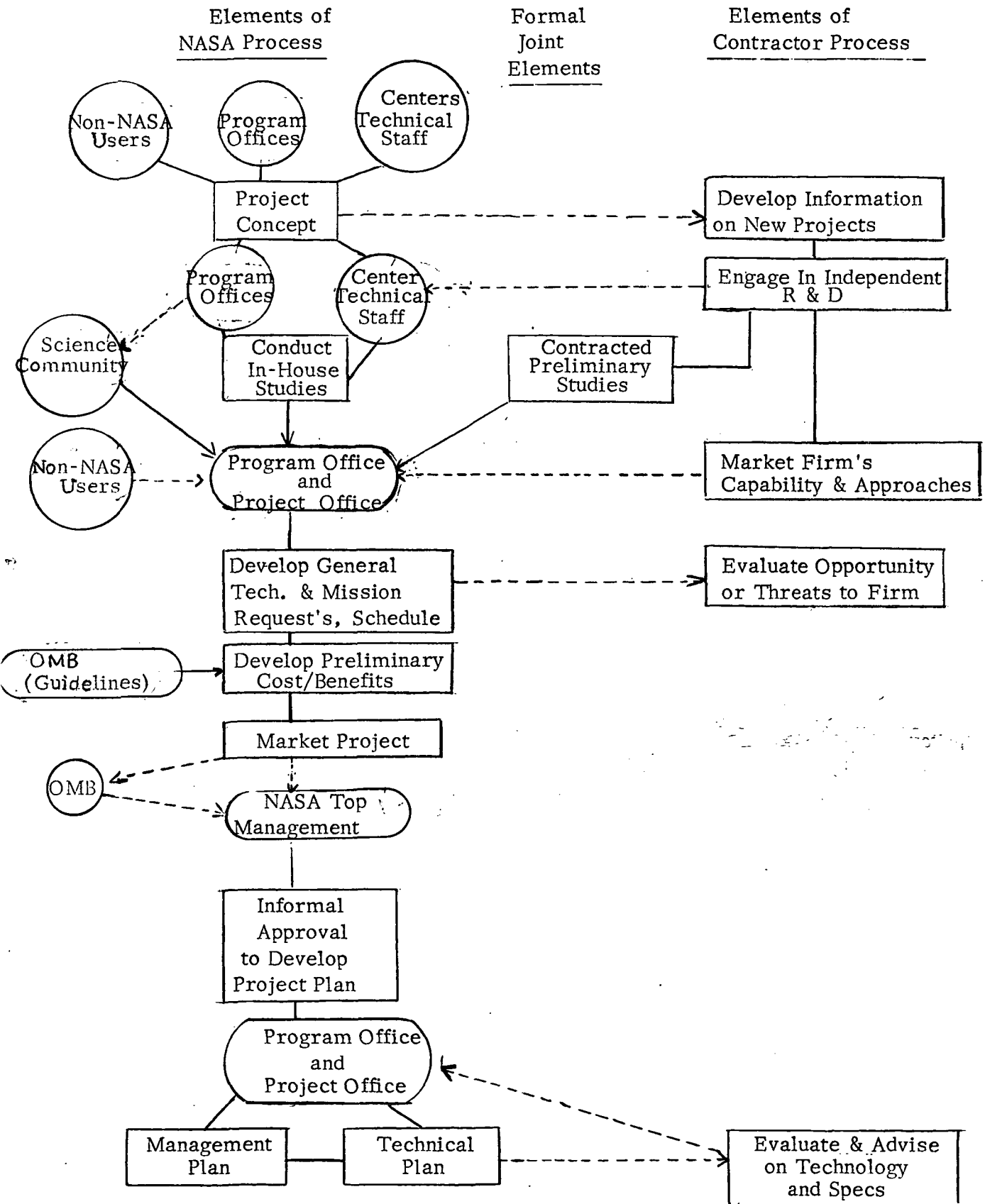
The following flow charts summarize each stage of the acquisition life cycle in terms of:

- o Key elements in NASA decision process
- o Key elements in contractor decision process
- o Formal joint interaction elements
- o Formal communication flows
- o Informal communication and influence

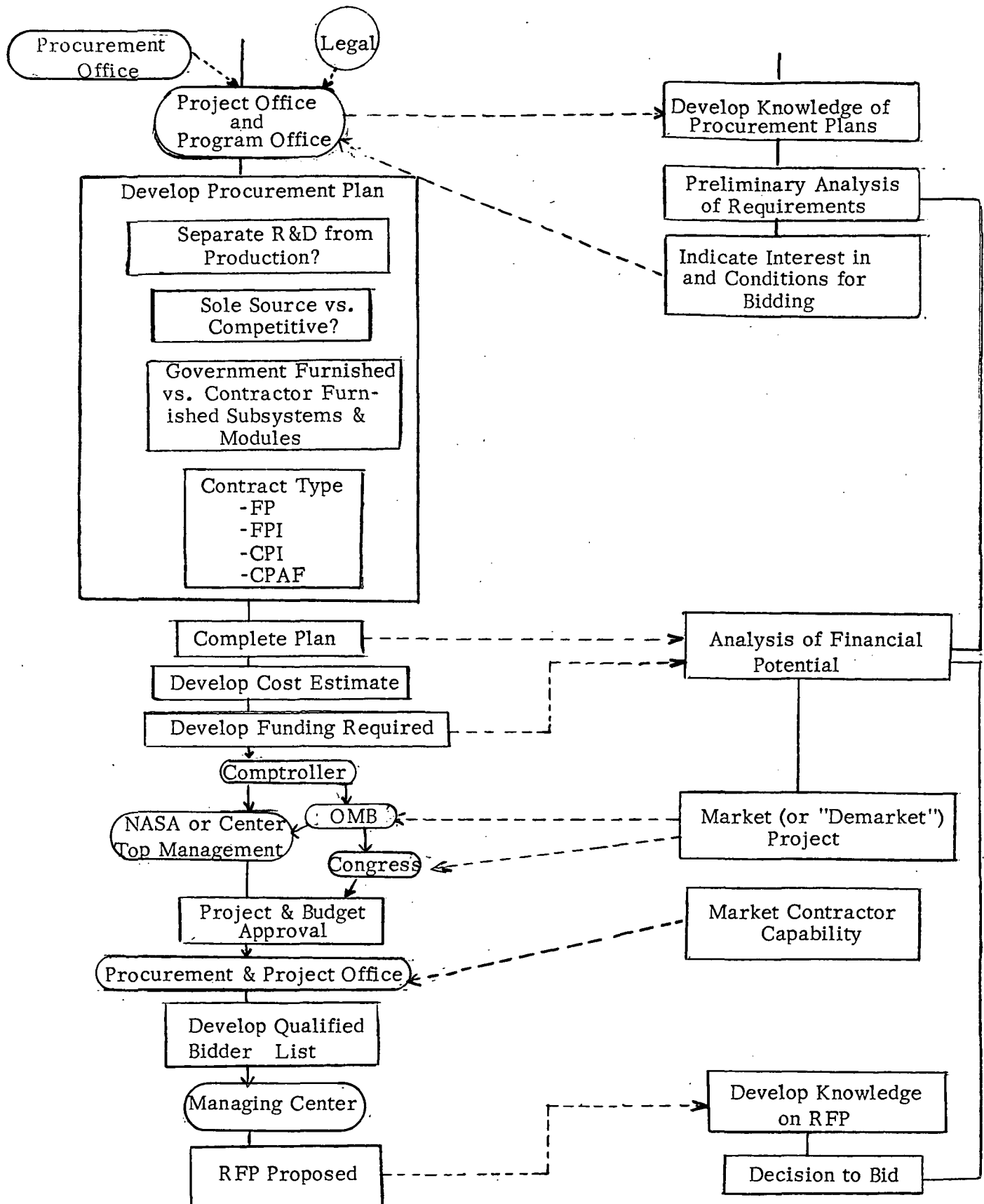
Symbols:

-  - Activities and decisions
-  - NASA cognizant management and within-NASA, outside influencers
-  - Indicate relationship among activities and decisions
-  - Indicate formal communications
-  - Indicate informal influences and communications flow

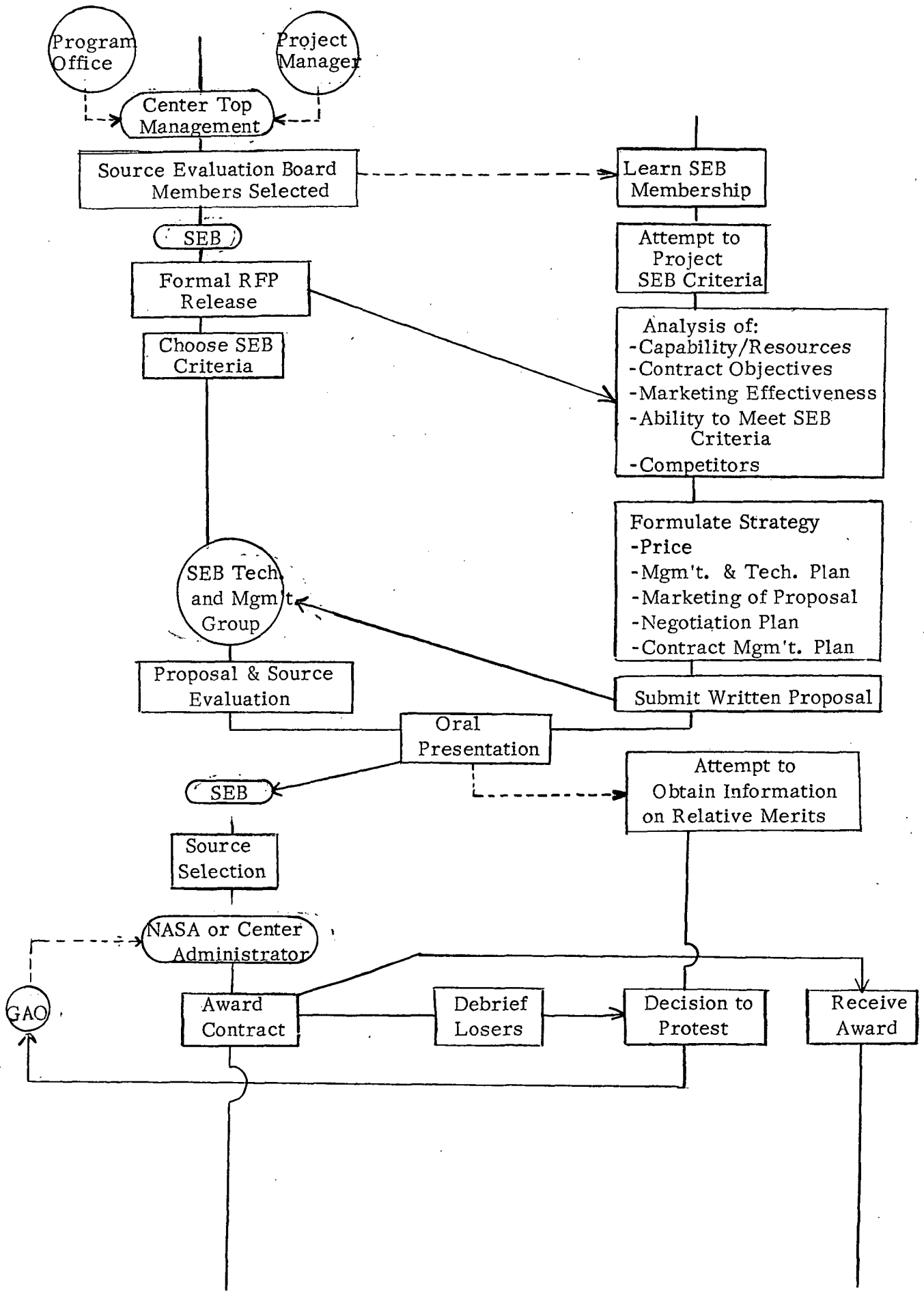
I. Project Conceptualization and Definition



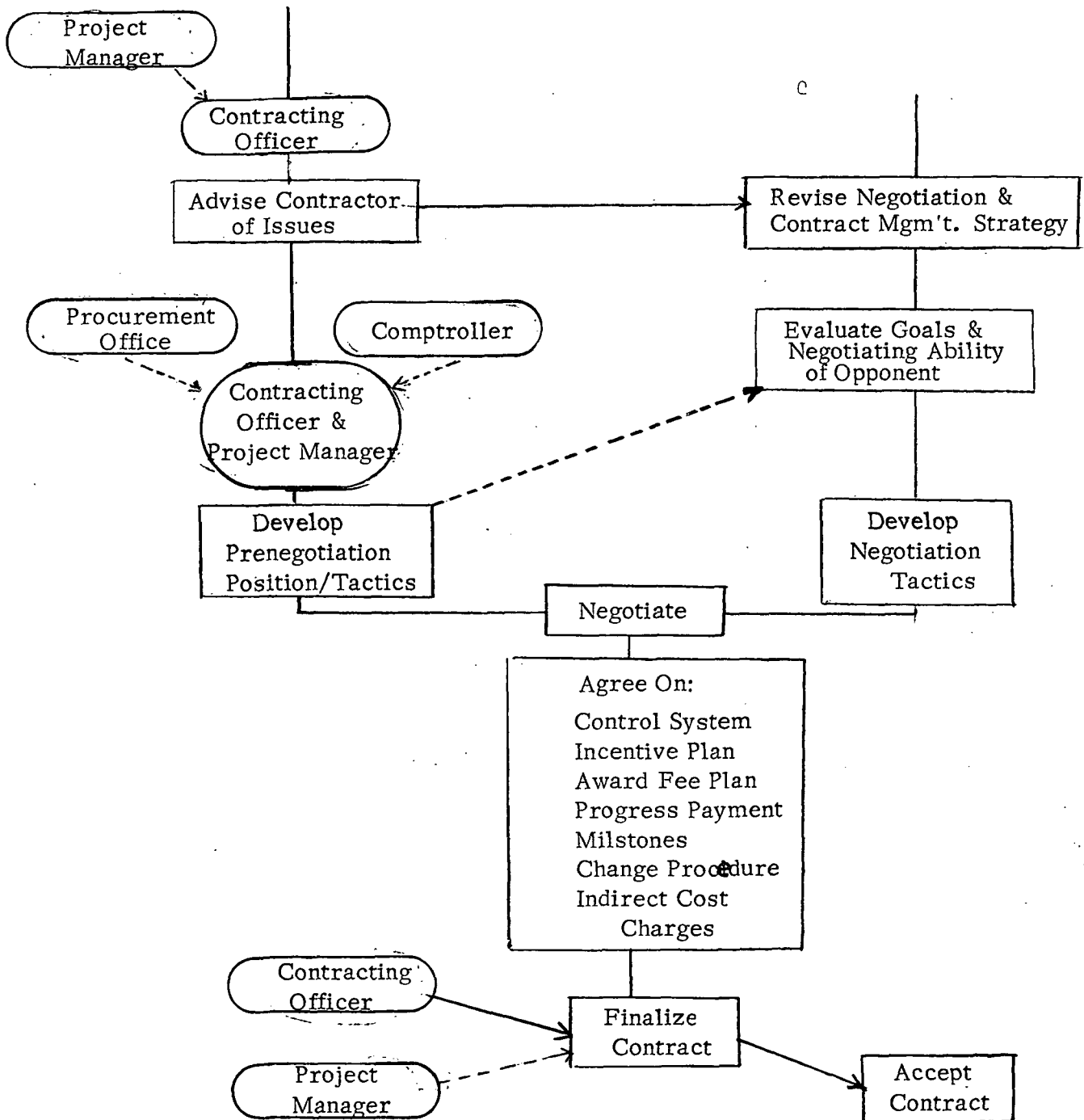
II. Procurement Plan and Request for Proposal (RFP) Development



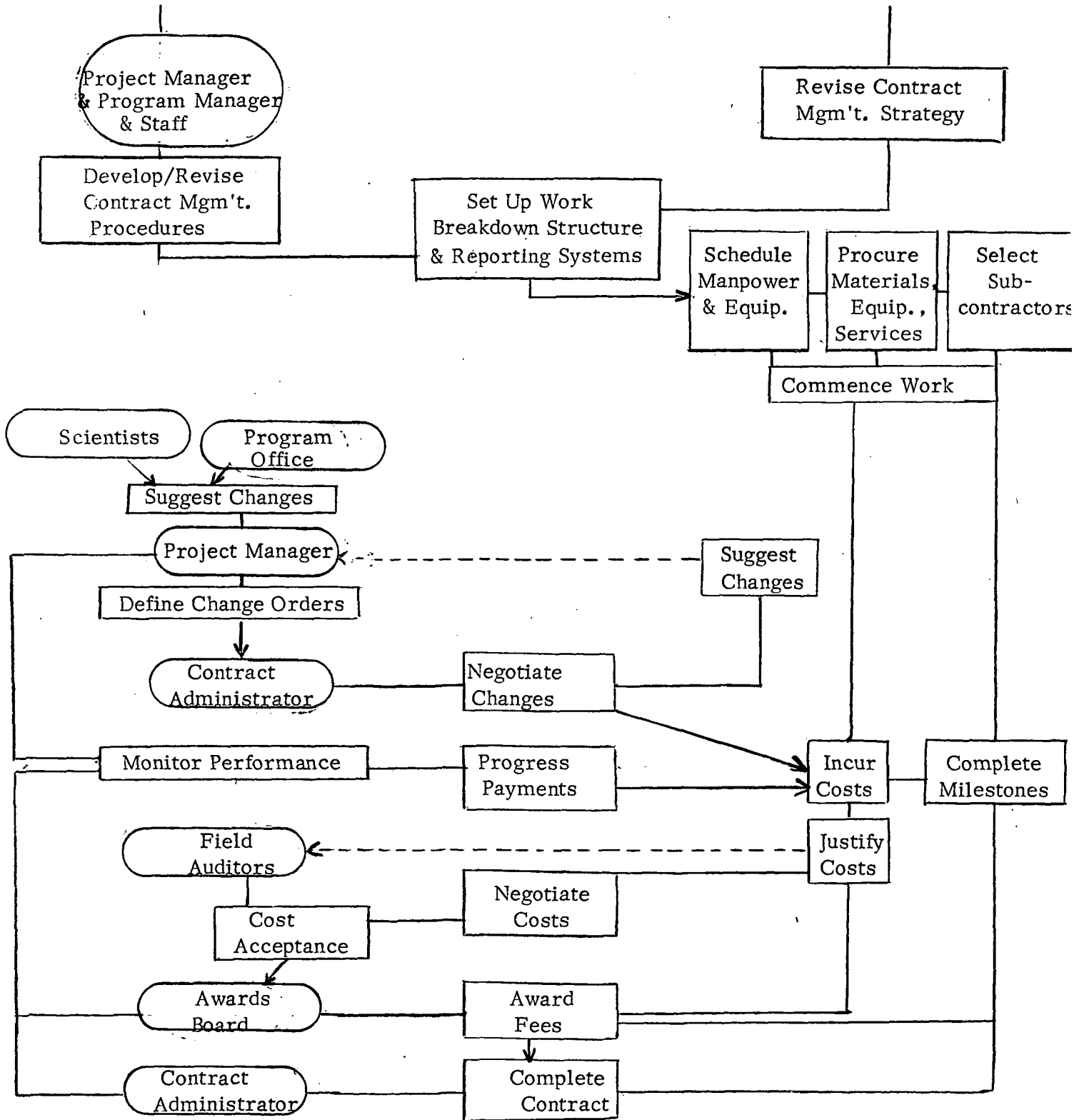
III. Source Evaluation and Award



IV. Negotiation



V. Contract Implementation



APPENDIX B

THE NASA/CONTRACTOR DECISION PROCESS'

Stage I Project conceptualization and definition

A) NASA

Influences

1. NASA Objectives
2. NASA Resources
3. NASA Environment
 - Science Community
 - OMB
 - Congress
 - General Public
4. State of Technology
5. Program Office Needs/Goals
6. User Requirements
7. Centers Manpower Availability
8. Technical Interests and Activities
of Centers Technical Staff

Objectives

1. Contribute to NASA Mission
2. Meet User needs to get resources
3. Advance state of the art
4. Utilize center manpower
5. Facilitate cost estimation,
contractor selection & negotiation

Cognizant Management

1. Center's Technical staff
2. Program Office
3. Science Principal Investigators
4. User Managers
5. Project Manager and Staff

Major Activities and Decisions

1. Level of in-house development
2. Use of Contractors for preliminary studies
3. Relative emphasis on payload instrumentation
vs vehicle hardware
4. Relative use of existing technology and
equipment vs advanced technology/equipment
5. Precision of technical specifications and
performance specifications
6. Degree to which contractor technical
suggestions are incorporated

B) Contractor

Environmental Analysis

1. Effects of a NASA proposed concept or development
on sales of contractor-developed or contractor
researched concepts/items/systems
2. Relative advantage possessed by competing con-
tractors in developing the proposed concept
due to technology, capacity, size, prior in-
dependent research and development (IR&D) or
preliminary, NASA-funded studies.

3. Relative profitability of competing,
alternative concepts that might be advanced.

Objectives

1. Develop understanding of proposed concept
and related technology.
2. Influence development of specifications to
fit contractor ability to compete.
3. Influence NASA evaluation of contractor's
technical understanding and capability.

Influence development of specifications to
fit contractor ability to compete.

Strategies

1. Develop informal relationships with cognizant
technical and management personnel
2. Market technical approaches
3. Market suggested cost/performance priorities
4. Gather information on NASA's proposed
technical approaches and project goals
5. Gather information on competitors' activities
and suggested technical approaches

Stage 2 Procurement Plan & RFP Development

A)

NASA

Influences:

1. Degree of Definition in Project
- ☐ Objectives and Technical Specification
2. Required level of technological advance
3. Schedule criticality
4. Cost objectives and priority of NASA
5. NASA Procurement goals/policy
6. Legal constraints
7. Number of capable contractors
8. Availability of funding
9. Number of units required and timing
of requirements
10. Systems/Subsystems/Modules/Items/Services
Involved.

Objectives

1. Sell program to Congress
and OMB
2. Meet schedule needs
3. Maximize competition
4. Provide equitable price for contractor
risk/responsibility

Cognizant NASA Management

1. Project Manager and Staff
2. Managing center functional offices
3. Program office
4. Procurement (Hq/Center)
5. Hq-Legal
6. Hq-Comptroller
7. Hq-Top Management

Major Activities and Decisions

1. Use of sole source vs competition
2. On contracts for multiple buys:
 - separate R&D from production
 - firm orders vs options
 - plans for recompetition
 - separate R&D competition
(phased project planning)
 - separate R&D performance from prototype testing
3. Acquisition of subsystems/modules:
 - NASA directed subs vs contractor
furnished equipment vs GFE
 - In-house systems integration vs
contracted systems integration
 - changes from unit-to-unit
4. Contract Price types:
 - FP:
 - where target cost accuracy high
 - where efficiency options lacking
 - where no changes expected
 - base for escalation precisely defined

-FPI:

- where target cost estimate fairly accurate
- where negotiation and price administration experience good
- where ability to specify efficiency options is good and NASA objectives clear

-CPIF: ~~price~~

- target cost estimate is moderately accurate
- contractor has ability to control incentive areas
- willingness to invoke limit of funds clause
- control of direction of contractor action in multiple incentives can be maintained

-CPAF:

- performance criteria difficult to quantify in advance
- scope of work difficult to determine in advance
- multiple performance criteria required

5. Develop cost estimate, Work breakdown Structure

Cost Estimation

- historical costs
- cost as f_c (related costs)
- cost as f_p (performance specs)
- item analogy
- expert opinion

6. Develop funding schedule
7. Open vs Qualified Bidder advertising
8. Select control System
9. Final project/budget approval
10. Draft RFP

B) Contractor Analysis

Environmental Analysis

1. NASA expectations and priorities regarding contractor proposals
2. Contractor capacity available
3. Availability of engineering talent
4. Availability of management talent
5. Contractor level of technology development
6. Potential sales volume (including follow-ups)
7. NASA managers' responses to marketing activities on technical suggestions
8. Level of understanding of NASA requirements
9. Analyze cost of proposal development

Objectives

1. Influence technical specifications to fit capability
2. Influence perception of appropriateness of contractor as sole source
3. Influence funding level
4. Influence NASA choice of pricing strategy to maximize sales, minimize risk

Strategies

1. Market technical approaches
2. Market contractor technical and management capability
3. "Threaten" to non-compete under certain conditions (e.g., Fixed Price)
4. Avoid committing funding for proposal if competitors are more capable
5. Support funding if contract perceived as good opportunity
6. Determine whether to commit proposal development resources to project:
 - as prime contractor
 - as subsystem contractor
 - as prime and subsystem contractor

Stage 3 Source Evaluation and Award

A) NASA

Influences

1. Project objectives and priorities
2. Funding limitations
3. Contractor responsiveness/proposals
4. Contractor past performance
5. Perceptions of contractor capability
6. Prime/Subcontractor relationship
7. Degree of project definition
8. Scope and type of expected changes

9. SEB membership
10. Legal requirements

Objectives

1. Select contractor most capable of meeting project objectives
2. Avoid "buy-ins"

Cognizant NASA Management

1. Center top management
2. Source Evaluation Board (SEB)
3. Legal
4. NASA Administrator
5. Procurement Office
6. Program Office

Major Activities/Decisions

1. Selection of SEB members
2. Develop SEB criteria/priorities
 - technical criteria
 - business criteria
3. Release RFP
4. Evaluation of proposals
 - business analysis
 - price analysis
 - technical analysis
5. Select major contenders
6. Conduct oral questioning

7. SEB recommendation
8. Center/Program Office Reactions
9. Source selection
10. Debriefing of losers

B) Contractors

Environmental Analysis

1. Competitive Analysis
 - competitive bid histories
 - competitors' capacity
 - competitors' technical positioning for project
 - expected NASA evaluation of competitors' prior performance
2. Customer Analysis
 - expected decision criteria priorities based on RFP, marketing, and informal interactions
 - degree of project definition
 - perceived effectiveness of contractor marketing efforts in influencing evaluation
 - analysis of SEB members' skills and priorities
3. Financial Analysis
 - direct cost requirements
 - indirect cost requirements
 - opportunity costs of foregoing alternative contracts (if at full capacity)
 - inflation estimates
 - cash flow requirements

- investment requirements
- anticipated G&A and profit from subcontracting
- anticipated cost/profit gain from change order
- potential discounted value of follow-on orders if contract is received
- overhead allocation
- current financial leverage

4. Risk Analysis

- technical uncertainty and performance risk
- schedule risk and penalties
- uncertainty of cost estimates for fixed price contracts
- ability to control subcontractor cost, schedule, technical performance
- probability estimate of obtaining award at various competitive bid prices

5. Organizational Factors

- corporate profit center structure
- internal basis for divisional, project, or profit center evaluation
- dollar net profit
- net profit as a percent of sales
- profit return as a percent of incremental investment
- profit return on allocated burden
- total dollar contribution to overhead and profit

6. Analysis of long-term technical gains
 - ability to obtain related NASA/DOD business
 - commercial applications
 - development of engineering staff skills

Objectives

1. Sales volume (for stability of employment, facility utilization)
2. Overhead contribution
3. Develop technical base
4. Position for future sales
5. Return on investment
6. Avoid loss
7. Attain satisfactory after-tax profit goals
8. Minimize cash flow requirements

Strategies

1. Cost based pricing strategies
 - accept overly-sophisticated or poorly defined specifications
 - incorporate costly testing requirements
 - recommend "gold-plated" specifications
 - buy-ins which cover marginal cost plus some overhead
 - pessimistic escalator clause indices
 - cost modeling with heavy allocation to direct costs on which escalators will apply
2. Revenue-based pricing strategies
 - orient bid toward funding limit
 - propose incentives as alternatives to mandatory performance requirements
 - buy-in on R&D segment based on expected contribution from production segment of contract
3. Proposal selling strategies
 - orient proposal toward RFP/SEB criteria
 - sell company capability based on past performance
 - emphasize quality staffing
 - sell contractor's willingness to assume high cost risk by emphasizing high fixed costs
 - show special achievements required and contractor's capability to attain them

4. Supplemental financial strategies

- reduce investment by use of Government Furnished Equipment (GFE) and Progress Payments
- buy-in with expectation of change orders
- expand use of subcontractors to earn subcontracting G&A and profit
- make allowance to permit reduced subcontracting if excess capacity is large
- request options for later takeover of CFE from GFE on block buys with sequential production, either to get G&A from subs or to expand amount of contractor work volume

Stage 4 Negotiation

A-NASA

Influences

1. Degree of project definition
2. Type of contract
3. Confidence in NASA cost model
4. Project priorities
5. Responsiveness of original proposal
6. Funding limitations
7. Bargaining position
8. Variety of items to be negotiated
9. Type of control system
10. Contractor finances

Objectives

1. Maximize visibility and control of costs and performance to meet project objectives within funding limits

Cognizant Management

1. Contracting Officer
2. Project Manager
3. Center Functional Offices
4. Procurement Office

Major Activities and Decisions

1. Pre-negotiation plan
 - price target
 - desired control system/reports
 - testing requirements
2. Agreement on
 - progress payment plan
 - change procedures
 - award fee milestones
 - indirect and overhead cost rates
 - auditing procedure
 - subcontractor management
 - overhead allocation to R&D vs Production
 - incentive plan
 - target cost
 - ceiling price
 - share ratios
 - incentive range

-award fee criteria and payment plan

-government investment

B) Contractor

Environmental Analysis

1. Cost target analysis
 - tightness of estimates
 - existence of overrun bias
 - existence of underrun bias
2. Range of contract items to be negotiated
 - cost and type of reporting system
 - performance standard
 - R&QA standards
 - progress payment schedules
 - contract change procedure
 - cost allowances/audits
 - basis for overhead charges
 - procedure for award fees
3. Analysis of incentive contracts (where applicable)
 - measureability of performance targets
 - definition of upper technical limits
 - cost incentive range
 - trade-off opportunities on multidimensional incentives
 - contractor ability to control performance outcomes

4. Decision-making patterns in NASA
 - project office priorities
 - user/program office priorities
 - contracting officer priorities
 - avoid large underruns
 - maximize contractor risk
 - avoid cost padding and obtain low indirect, overhead costs
 - degree of consensus among NASA negotiating team members
5. NASA bargaining position
 - availability of other contractors
 - credibility of NASA cost model
 - profitability of contract
 - top management support of negotiator
 - potential threat of reopening competition
 - long lead time available
6. Contractor bargaining position
 - availability of other business
 - knowledge of NASA funding limits
 - knowledge of own technical superiority over competitors
 - lack of project definition
 - program urgency

- relative experience and status of negotiators
- knowledge of opposing negotiator priorities
- unified position of negotiation team members

Objectives

1. Maintain project control
 - control systems with low visibility
 - open change procedures
 - control on technical and manpower specifications
 - avoid NASA direction of subcontractors
2. Clarify responsibility
 - technical performance standards
 - statement of GFE responsibility
3. Maintain relationship with contracting officer/customers
4. Recoup buy-in losses
5. Minimize contractor investment
6. Maximize cash flow
7. Position for follow-ons
8. Minimize risk of loss

Strategies

1. Structure cost allocation to show low indirect cost rates that appeal to contracting officer
2. Obtain incentives permitting flexibility in performance standards
3. Attempt to tie funding to level of effort

4. Obtain simplified control systems by lowering price of compliance
5. Obtain disclaimers of responsibility for follow-on work
6. Avoid cost saving investments
7. Argue that due to high fixed costs, small percentage of cost is controllable
8. Obtain language of "goals" rather than "requirements"
9. Point out risks involved in accepting mandatory requirements where contract is CPIF
10. Build in contingencies can be "sacrificed"
11. Identify with project manager
12. Gamesmanship approaches
13. On incentive contracts:
 - if cost target has overrun bias, bargain for low share ratios, high ceilings
 - if cost target has underrun bias, bargain for high share ratios, accept lower ceilings
 - if cost targets are tight, bargain for loose change provisions

Stage 5 Contract Management

A) NASA

Influences

1. Project objectives/requirements and change in them
2. Contractor progress/performance/responsiveness
3. Control systems/reports and visibility
4. Contractor initiated changes
5. Technical problems
6. Funding limit and schedule
7. Cost growth
8. User/scientific investigator needs

Objectives

1. Meet performance requirements
2. Meet schedule requirements
3. Obtain necessary funding
4. Meet target cost

NASA Decision-Makers/Management

1. Project Manager & Staff
2. Center functional offices
3. Program Office
4. Contract Administrator

Major Activities/Decisions

1. Revise work schedules to meet requirements
and constraints
2. Negotiate changes
3. Make progress payments
4. Make awards
5. Negotiate overhead costs
6. Generate additional funding for overruns
7. Invoke limitation of funds clause
8. Negotiate revised target costs and/or
share ratios
9. Complete documentation

B) Contractor

Environmental Analysis

1. NASA project manager priorities
2. Change orders from NASA
3. Contractor change opportunities
4. Cash flow
5. Technical problems
6. Inflation
7. Budgetary constraints
8. Personnel changes in NASA management
9. Change in capacity due to completion or
receipt of other contracts
10. Type of contract in related contracts and in
main contract

11. Type of reporting system
12. Fee structure
13. Change order procedure
14. Program office authority within-NASA
15. Effectiveness of DCAA audits
16. Probability of contract termination due
to cost overrun
17. Schedule slippages initiated by NASA
18. Profit opportunities anticipated
from awards fees
19. Loss of excess fees by Renegotiation
Board action

Objectives

1. Maintain project control
2. Maximize work effort
3. Minimize layoffs
4. Facilitate technical advancement and high
reliability goals of technical staff
5. Maintain customer relations by avoiding large
profit percentage, large underruns, large over-
runs (where loss can be avoided) and by quality
technical performance
6. Meet minimum profit and contribution goals
acceptable to contractor top management

Strategies

1. Where minimum organizational profits are assured:
 - consider trade-off of after-tax value of cost incentive profits vs fixed overhead contribution lost per dollar of cost reduction
 - trade cost incentives for manpower utilization where excess capacity exists
 - trade cost incentives for increased assurance of reliability to meet quality goals of technical personnel
2. Where related contracts are in progress, shift the allocation of fixed costs:
 - from FP to FPI, CPI contracts
 - from CPI to CPAF contracts
 - from high share ratio to low share ratio incentive contracts
3. Add costs to avoid:
 - excess profits
 - annual budget underruns
 - large cost underruns
4. Begin work on changes before negotiation to obtain "allowable" rather than "reasonable" cost

5. Delay documentation requirements used for competition on follow-on work
6. Reduce subcontracting if total sales drop
7. Load manpower early to speed progress payments
8. Load manpower rather than equipment for tasks if overhead rate tied to direct labor hours
9. Schedule work to meet funding availability rather than costs
10. Negotiate cost targets upward through changes
11. On multiple incentive contracts, structure performance/cost/schedule tradeoffs in work scheduling to maximize incentives - restructure over time toward attainable incentives