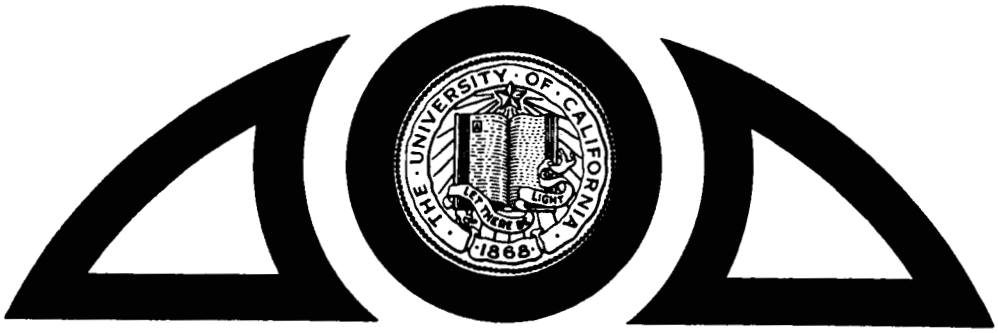
N67-13880



NASA RESEARCH PROJECT

Graduate School of Business Administration / Division of Research

UNIVERSITY OF CALIFORNIA, LOS ANGELES

NASA offices + Research Centers

A MANAGEMENT MODEL FOR SELECTING MAJOR SUBCONTRACTORS IN THE AEROSPACE INDUSTRY

By

Edmund R. Gray
Assistant Professor
College of Business Administration
Louisiana State University

NASA Research Paper No. 9

April, 1966

FOREWORD

Reliable estimates place the level of subcontracting at approximately fifty percent of aerospace industry sales. Moreover, because of the rapid proliferation of technology and the government's policy of encouraging and promoting subcontracting, there is every reason to believe that this level will not diminish in the near future. Subcontracting, therefore, plays a prominent role in aerospace industry management activities.

Despite the obvious importance of aerospace subcontracting management there is a dearth of literature on the subject. In A Management Model for Selecting Major Subcontractors in the Aerospace Industry, Gray attempts, partially, to fill this void. He describes the general process by which prime contractors select major subcontractors and sets forth a series of guides or principles which will enable prime contractors to improve their selection decisions.

The study is directed specifically toward an audience of aerospace executives involved in subcontractor selection decisions. Others, however, may find it of interest as an example of a model building technique for approaching complex recurring decision situations.

A Management Model for Selecting Major Subcontractors in the Aerospace Industry is one of a continuing series of studies on the management of research and development programs conducted under the Division of Research, Graduate School of Business Administration, University of California, Los Angeles. The study was supported largely by National Aeronautics and Space Administration (NASA) funds.

George A. Steiner
Director,
Division of Research

PREFACE

The purpose of this paper is to present a model of the management decision process for selecting major subcontractors in the aerospace industry. The model presents the principal conclusions of an empirical study which covered nearly two years.[1]

The author became aware of the need for such a study through discussions with knowledgeable aerospace executives. These executives generally agreed that they were having "problems" in selecting subcontractors and did not know what to do about it. Upon further investigation it quickly became apparent that no reliable guides were available for prime contractors to follow in selecting subcontractors. Furthermore, even an adequate description of the subcontractor selection process could not be found. Hence, the author decided to undertake a detailed study of the process in hopes of accurately describing it and finding ways of improving it.

During the past two years numerous people have aided the author in his research. Foremost among these is Professor George A. Steiner.[2] Without his support and guidance this report would have been impossible. Special acknowledgement must also be given to the Division of Research, Graduate School of Business Administration, University of California, Los Angeles, for making available National Aeronautics and Space Administration funds, which financed a large portion of the research.

---

[1] For the complete study see Edmund R. Gray, The Selection Process for Major Subcontractors in the Aerospace Industry (Ph.D. dissertation, the University of California, Los Angeles, 1966).

[2] Director of the Division of Research, Graduate School of Business Administration, University of California, Los Angeles.

Unfortunately, it is impossible to thank individually all those in the aerospace industry, the government, and the University of California, who assisted the author in this study. The author, however, particularly would like to single out Mr. L. G. Julliard of the Missile and Space Division, Douglas Aircraft Company, Inc., and Colonel William Ryan of the Division of Research, Graduate School of Business Administration, University of California, Los Angeles, for the time and effort they devoted to the research project.

The author finally wishes to thank Mrs. Martha Whitehead, Miss Marilyn McElroy and Miss Janell Delaune who shared the typing chores. Appreciation is also extended to Miss Mary McMurray who handled the administrative details associated with the publication of this paper.

Edmund R. Gray

TABLE OF CONTENTS

CHAPTER I

INTRODUCTION

A. Nature and Importance of Aerospace Subcontracting

Subcontracting may be defined as the process by which prime contractors purchase subsystems, components, equipment, material, and services from suppliers. This process plays a vital role in a crucial segment of the American economy--the aerospace industry. In the recent past aerospace industry sales to the United States Government have been running slightly less than three percent of Gross National Product (GNP)--about $21 billion in 1965. Approximately fifty percent of these sales are subcontracted. Hence, in terms of sheer economic magnitude the importance of subcontracting is clear. Subcontracting, moreover, plays a role in the nation's defense which cannot be adequately assessed in monetary terms. The reason for this fact is the high degree of interdependence among the various subsystems and components which constitute sophisticated weapon and space systems. If any one of these items is ineffective, the entire system may be non-operational. Since inappropriately placed subcontracts can lead directly to ineffective or delayed subsystems or components, the significance of subcontracting to the national defense is also evident.

B. Status of Subcontractor Selection Programs in the Aerospace Industry

Most large aerospace prime contractors have formal management

programs--consisting of policies,[1] procedures,[2] and rules,[3]--for selecting subcontractors for subsystems and large components[4] (major items). These management programs serve as planning frameworks within which major subcontractor selection decisions are made. There appears to be a tendency in the programs presently in use toward ineffectiveness and inefficiency.

They are ineffective to the extent that they result in the selection of less than the best possible subcontractors. There is little in the way of documented evidence indicating the degree to which inappropriate choices are made. Occasionally a subcontractor may default by failing to meet contract provisions. Moreover, there have been publicized cases in which the government has refused to accept the subcontractor chosen by the prime contractor--ostensibly because the prime contractor had not selected the optimal subcontractor. The above situations represent overt examples of inappropriate subcontractor selection decisions. All ineffective subcontractor selections, however, do not appear as defaulted contracts or

---

[1]A policy, as used here, is a general statement or understanding which guides or channels thinking in decision making. It delimits the area within which a decision is to be made.

[2]A procedure is defined as a guide to action which details the exact manner in which a certain activity must be accomplished. It requires that the activity be carried out in chronological sequence.

[3]A rule is a requirement that a specific and definite action be taken with respect to a specific situation. Policies, procedures, and rules are considered standing plans because they are designed to deal with recurring problems. Standing plans can be distinguished from single-use plans which are designed for a unique set of circumstances.

[4]Most aerospace prime contractors also have policies, procedures, and rules (a management program) pertaining to the selection of subcontractors for small off-the-shelf components, material, equipment and basic services. These management programs tend to be less complex than those used in selecting subsystem and component subcontractors and are not considered in this paper.

government rejections. Frequently, even though a subcontractor may be delinquent, overexpending, or not meeting specifications, the prime contractor may find that he is "stuck" with the subcontractor because of the critical time pressures inherent in many system procurement programs.

Evidence collected in the present study suggests that management programs for the selection of subcontractors also tend to be inefficient. In other words, even though a management program results in the selection of the optimal subcontractor a high percentage of the time, this may be accomplished at an excessive cost in terms of dollars and man-hours. Efficiency requires a program which assures, with a high degree of reliability, the selection of the best possible subcontractor at a minimum cost.

There appears to be two principal reasons why many of the management programs for selecting major subcontractors currently in use are ineffective and inefficient. One reason is that the several policies, procedures, and rules which constitute a management program may have evolved somewhat haphazardly over time. Thus, the individual standing plans were never viewed as part of an integrated system and, as a consequence, the likelihood of an inadequate overall program is increased. The other reason is that some prime contractors have patterned their management programs after the programs described in government procurement manuals. Unfortunately, these programs typically are not readily adaptable to industrial use. Moreover, the programs described in the manuals often are incomplete and inadequate even for government use. As a result the management programs patterned after these manuals tend to assume their inadequacies.

C. Benefits to be Gained Through Improving Selection Programs

Prime contractors stand to benefit in several ways through improving their management programs for selecting subcontractors. Four major benefits should be particularly noted.

First, a superior selection program will enable a prime contractor to achieve a competitive advantage in vying for government contracts. The reason for this is that a firm's make-or-buy program and procurement system are two factors considered by the government in evaluating prime contractors. In a close competition a superior rating in these categories could give a prime contractor the deciding edge over his competitors.

Second, an effective selection program may permit the prime contractor to earn a higher fee or profit on some contracts than he would otherwise. Thus, under a fixed-price contract, a management program which enables him to select the lowest price bidder who can meet technical performance and schedule standards will result in a higher profit. To a lesser degree the same will be true under incentive contracts. This factor, it should be noted, is becoming more important with the increased emphasis the government is placing on fixed-price contracts.

Third, a superior selection program will simplify the prime contractor's task of justifying his subcontractor selections to the government. This may result in a tangible saving of time and money as well as a reduction in the frustration level.

Finally, an improved selection program may result in cost savings in the decision process itself. Any cost saving made may directly benefit the prime contractor by allowing him to earn higher profits than he would otherwise. Alternatively, the prime contractor may pass along some or all

of these savings to the government in the form of lower overhead rates. When the latter is done the prime contractor may achieve a competitive advantage because he will be in a position to submit lower bids than he would otherwise.

CHAPTER II

DEVELOPMENT OF THE MODEL

A. Method

The data on which the model is based was collected, in the main, by two methods: 1) a detailed questionnaire, and 2) depth interviews.

The questionnaire contained seventy questions of both the structural (yes or no, multiple choice, etc.) and open-ended type. It was sent to twenty major aerospace prime contractors throughout the country and an eighty percent return was achieved. The purpose of the questionnaire was twofold. First, it provided a convenient means of gathering systematic data on current practices in the industry. It would have been many times more difficult to have obtained an equivalent breadth of coverage--both in terms of the number of prime contractors included and their geographical distribution--strictly by means of interviews. Second, it was an efficient technique for interrogating prime contractors on a large number of specific questions. Several separate interviews, embracing many hours, would have been needed to cover adequately all the questions included on the questionnaire. In other words, it would have been excessively costly if not impossible to have obtained the same data by interview.

The depth interviews were conducted with executives at ten major aerospace prime contractors in the Los Angeles-San Diego area. These

interviews provided an invaluable means of clarifying and amplifying the responses given on the questionnaire.

The information obtained by the questionnaire and interviews concerned mainly current practice in the industry although opinions on how the selection process could be improved also were encouraged. This information after being digested and analyzed provided the basis for the development of the model. The model itself represents, essentially, a synthesis of what was found to be good practice in the industry.

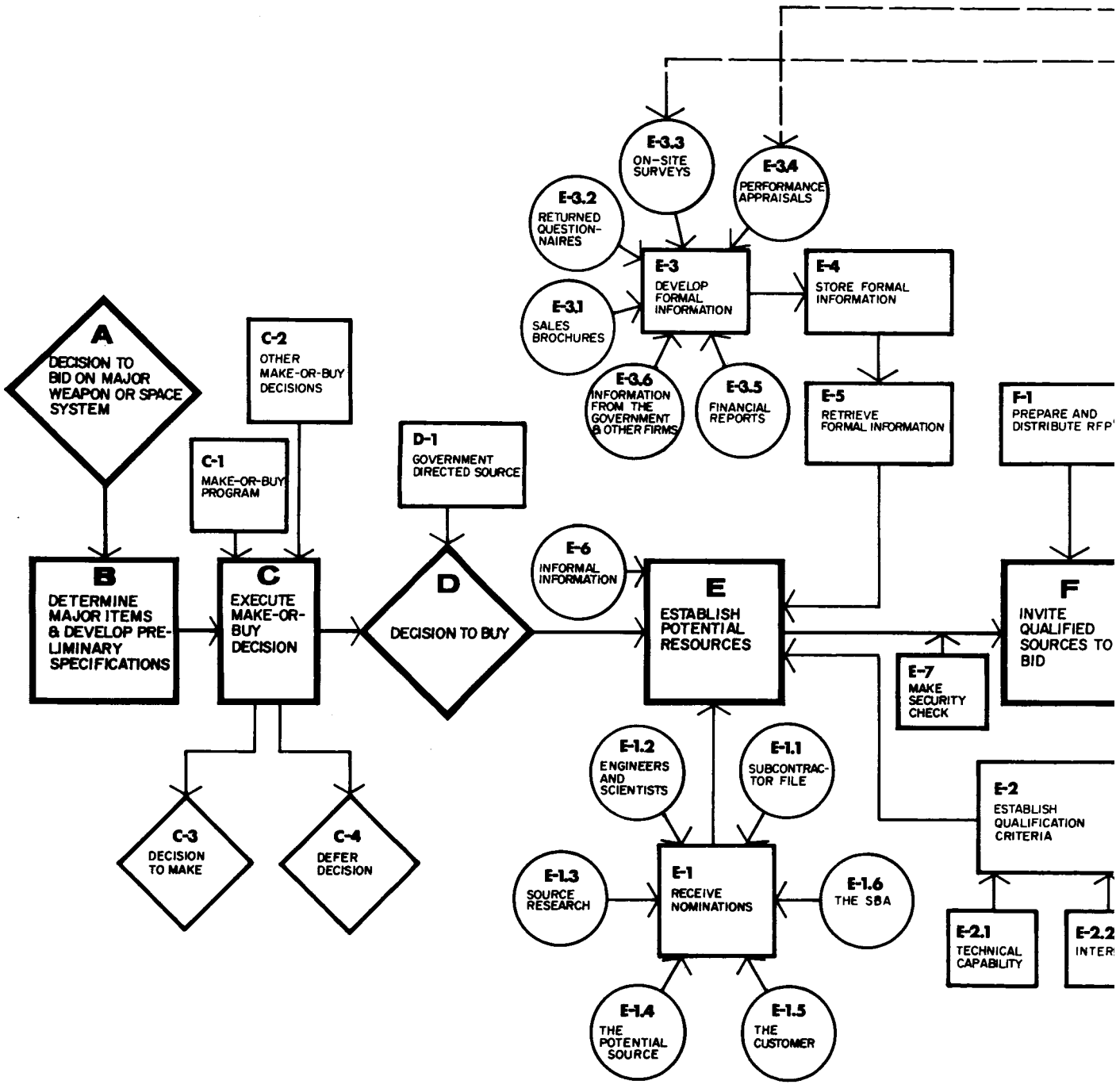
B. Nature of the Model

The model is qualitative in nature and is divided into two major sections. One section is descriptive and the other is normative (i.e., perscriptive). The descriptive section of the model is a flow diagram depicting the principal activities, decision milestones, and sources of information which constitute the process within which subcontractor selection decisions are made (see Exhibit 1). The normative section of the model consists of a series of thirty-six management principles which are keyed to the flow diagram. These principles provide a framework within which effective and efficient management programs for the selection of subcontractors can be constructed.

C. Purpose of the Model

The overall model is designed to accomplish three interrelated objectives. The first is to present a detailed and accurate description of the principal parts of the decision process for choosing subcontractors. This description is displayed in the flow diagram or first section of the model. To the author's knowledge no comparable description of the process

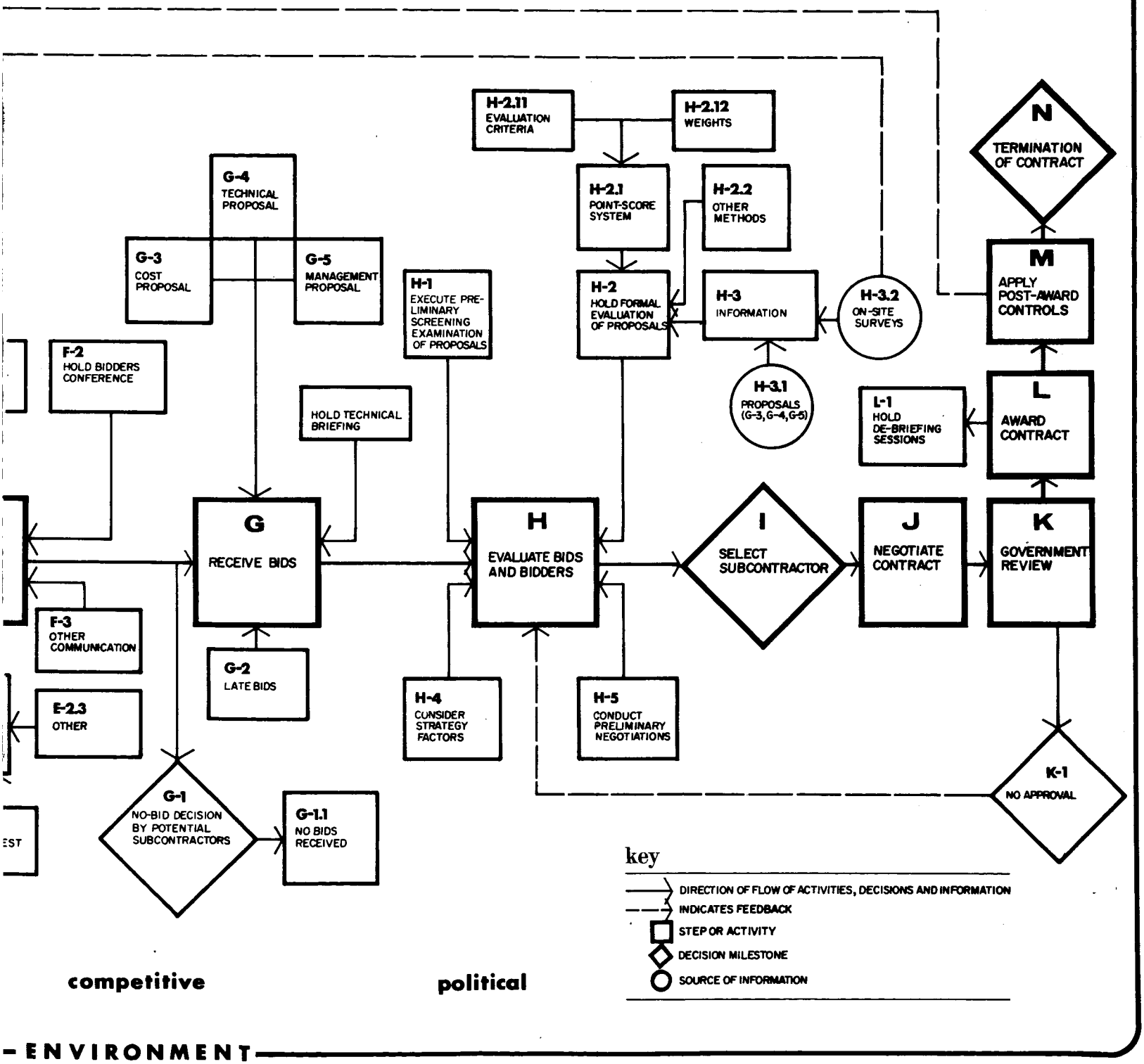
DESCRIPTIVE M
SELECTION PROCESS FOR M



legal

EHIBIT 1

ODEL OF SUBCONTRACTOR
IAJOR ITEMS AND ITS ENVIRONMENT



exists.

A second and corollary objective of the model (and especially the flow diagram) is to provide a useful device for orienting staffs on the parts and interrelationships involved in the subcontractor selection process. Important subcontractor selection decisions at most aerospace firms cut across departmental lines and involve numerous employees working on small pieces of the overall decision. Hence, few individuals comprehend the totality of the process. The application of the flow diagram as an orienting or pedagogical technique should have positive value, therefore, in helping an employee see how his duties interrelate with other employees' duties in the complex decision process. Such an overall orientation will provide the employee with a useful conceptual framework for coordinating his efforts with others working on other parts of the decision process. Furthermore, there is evidence suggesting that if an individual understands how his job fits in with the overall task he will have greater job satisfaction and, therefore, will work with greater enthusiasm.[5]

The third and most important objective of the model is to serve as a useful guide to prime contractors in their subcontractor selection decisions. To this end the normative section of the model was developed. This section, as noted earlier, is comprised of thirty-six management principles. A principle, as the term is used here, is a general proposition which is sufficiently applicable to the phenomena under study to provide a guide to action. The emphasis, here, is on the terms "general proposition" and "guide." In other words, these management principles

---

[5]H. G. Maule, "Work: Pleasure or Penance"? Occupational Psychology, XXX (Oct. 1956), 240.

are to be considered as flexible guides, not rigid and absolute rules from which there can be no deviation. They are generalizations which, when applied to the majority of situations, will lead to the desired results. Specifically, they are intended as guides in the establishment of the basic policies, procedures, and rules which constitute a prime contractor's management program for selecting subcontractors.

The management principles are keyed to the flow diagram but do not represent every part of it. Rather, they are selected to embrace those parts of the selection process which are considered critical or strategic. These are: 1) those parts where there are major differences in practice, 2) those parts where significant problems have developed, and 3) those parts (not already included in 1 and 2, above) which are considered absolutely essential to the effective selection of subcontractors.

In summary, the model presented here depicts the process within which subcontractors are chosen as an integrated whole and sets forth selected management principles which should be heeded in the establishment of basic policies, procedures, and rules at strategic points in the process. These basic standing plans, once formulated, provide a foundation around which other elements of a management program can be built. In other words, the selected management principles act as guides in the establishment of the strategic policies, procedures, and rules; these, in turn, form a skeleton around which a network of supporting standing plans can be then built.

CHAPTER III

APPLICATION AND LIMITATIONS OF THE MODEL

A. Application

Although the model presented here has yet to be applied in practice, it is strongly recommended that prime contractors test it against their present management programs for selecting subcontractors. This can be accomplished by a relatively simple and inexpensive procedure. First, the prime contractor should compare his present management program with the model. Next, he should make note of the differences between his program and the model. Finally, he should search for reasons for the differences noted. In searching for reasons he may find that he cannot justify the existence of some of his present standing plans. Furthermore, he will be in a position to make advantageous changes in his management program.

It is to the prime contractor's advantage to test the model in the above way because any improvement he makes in his method of choosing subcontractors will be profitable for him. The reasons for this were discussed earlier but deserve reiteration here. First, an improved selection program will afford the prime contractor a competitive advantage in the competition for prime contract awards. Second, it may allow him to earn a higher fee on certain types of government contracts than he would otherwise. Third, it should simplify the requirement of justifying his subcontractor selection decisions to the government. Finally, it may lead to decreased costs in the selection process.

B. Limitations

In addition to comprehending the uses and advantages of the model it is also essential that potential users understand its principal limitations. One limitation is that the model is designed to be used in the selection of subcontractors for large and important items. It prescribes, therefore, the construction of an elaborate management program whose purpose is to assure effective selection decisions with a high degree of reliability. Cost is a significant factor only after the reliability of the program is guaranteed. On smaller and less important subcontracts the prime contractor may be willing to sacrifice some degree of reliability in order to reduce the cost of the decision process. In other words, on small subcontracts, the marginal value of the extra reliability built into the model may be exceeded by the extra cost of employing such a complex management program in making the selection decision. Little guidance can be given to the prime contractor in determining at what point the intricate program encompassed by the model is no longer worth the cost except to suggest that by studying the model he will be able to estimate where and how he is sacrificing reliability in his selection decisions.

A second limitation on the use of the model concerns the formation of up-stream bidding coalitions. Contractors sometimes form bidding coalitions or teams, with one firm as prime contractor and the other firm (or firms) as subcontractor, for the purpose of competing for a prime contract award. Frequently these bidding coalitions are established during the definition phase of large weapon or space programs. They typically are considered joint-ventures by all parties concerned and are

suited better to informal negotiations between the parties than to the formal bidding arrangements envisioned by the model.

Another limitation pertains to situations where patents or proprietary information are involved. If it is known that only one firm, because of a patent or proprietary information, is capable of developing or producing an essential subsystem or component it would be foolish to hold a formal competition. Hence, the type management program required by the model would be inappropriate here, also.

Follow-on contracts represent the final limitation, to be noted here, on the use of the model. Follow-on contracts awarded on the basis of formal competition sometimes are desirable as a means of reducing cost or improving technical performance. Nevertheless, when time is critical and performance has been satisfactory it is usually most efficient to award the follow-on contract to the current subcontractor on a non-competitive basis. In such a situation the utilization of a management program patterned after the model, again, would not be applicable.

CHAPTER IV

THE FLOW DIAGRAM AND SELECTED MANAGEMENT PRINCIPLES

A. Flow Diagram

Exhibit 1 (the flow diagram) represents the descriptive half of the overall model. Each major step (activity or decision milestone) is identified by a capital letter (A, B, C, etc.). Each sub-activity is identified by a capital letter (to indicate the major step to which it is related) followed by a number (e.g., C-1). When further subdivision is required a second or third number is added (e.g.; G-3.2, H-2.12). Steps C--I represent the core of the subcontractor selection process. The other steps depicted place the subcontractor selection process in the larger perspective of the relevant sequence of events facing prime contractors. In addition, the flow diagram indicates that subcontractor selection decisions are affected by significant legal, political, and competitive factors in the environment.

B. Selected Management Principles

The following series of management principles constitute the normative half of the overall model. Each principle is keyed (the appropriate designation is shown in parentheses) to the pertinent part of the flow diagram and is followed by a brief explanation of the rationale for the principle. The principles are organized in sections according to the major steps to which they are related.

Make-or-Buy (C)

1. The make-or-buy program which is submitted to the customer as part of a prime contract proposal should be confined to the basic subsystems which constitute the overall system. Section 3-902.2 (C) of the ASPR provides a useful guide in determining which items should be included. (C).

Explanation. A situation in which the make-or-buy program is carried to a low technical level (i.e., includes many small subsystems and components) is conducive to ineffective subcontractor selection decisions. This is so because the performance specifications and design of the various items which compose a system are apt to change numerous times before the final design is "frozen." Thus, the earlier in a program a particular make-or-buy decision is made, the less accurate the information upon which to base that decision. When a make-or-buy program is carried to a low technical level a great many make-or-buy decisions are made early in the program and, hence, the chance of error in at least some of these decisions is large. Moreover, changing a make-or-buy decision, once it is written into the contract, under the "change to the make-or-buy program" clause of the ASPR, involves a bothersome and time-consuming procedure.

A recent change in the ASPR--section 3-902.2(C)--states that as a guideline contractors should not include items costing less than $500,000 or one percent of the contract price, whichever is less, in their make-or-buy programs. On the surface this appears to have resolved the aforementioned problem of carrying the make-or-buy program too far in the technical breakdown of a system. Empirical evidence gathered in the study indicates, nevertheless, that some prime contractors are still submitting make-or-buy programs which include lengthy lists of components. Moreover, the NASA PR does not contain a provision similar to the above mentioned ASPR section -- it simply states that contractors should confine their make-or-buy programs to important items.

2. A formal source selection competition should be used as a means

of making make-or-buy decisions on all items except those which are clearly in one category or the other. The prime contractor, however, must guarantee all competitors that they will be given fair and impartial treatment. (C).

Explanation. This practice allows make-or-buy decisions to be based on as complete information as there is available at a given time. When a make-or-buy decision is not made by means of a formal competition it normally is based on rather complete information on internal capability and considerably less information on external capabilities. The information on outside sources is typically in the form of some general indication of outside capabilities as a whole rather than detailed information on the most promising subcontractors. On the other hand, if a prime contractor holds a formal source selection competition he will receive not only competitive cost or price proposals from potential sources but in the case of development contracts also will receive proposals on alternative technical approaches upon which to make his choice.

In addition, the competition provided by outside competitors should supply incentive for more efficient operations in the prime contractor's divisions. Furthermore, this practice, if implemented by all prime contractors, should lead to greater efficiency in the utilization of the industrial capabilities in the aerospace industry.

For this type of make-or-buy decision to be effective, however, outside competitors must have assurance that partiality will not be shown toward the "in-house" bidder. If favoritism is suspected, subcontractors may refuse to bid in the future. Moreover, a formal competition should never be held when the item in question is obviously a "make" item.

Such a situation would tend to make a mockery of the competition.

Establishing Potential Sources (E)

3. Multiple sources of nominations should be maintained. These should include: a subcontractor file (E-1.1), engineers and scientists (E-1.2), source research (E-1.3), the customer (E-1.5), the SBA (E-1.6), and the potential source itself (E-1.4).

Explanation. Empirical evidence indicates that no single source for subcontractor nominations is adequate. Channels of communication, therefore, should be opened to multiple sources. The above mentioned sources have proved to be the most useful in practice. This does not mean, however, that all sources should necessarily be used on each procurement but merely that these channels should be utilized as needed.

4. An index to the subcontractor file should be established by technical category and kept up-to-date (E-1.1).

Explanation. The subcontractor file is normally the most valuable source for subcontractor nominations. However, only if it is supplemented by an up-to-date technical category index will it be a reliable and fast means of obtaining nominations. An up-to-date index is one in which both the technical categories used and the firms listed under these categories are kept current.

5. A thesaurus of technical terms should be established. These terms should be used in communicating requirements for complex items where possible (E-1.1).

Explanation. A major problem in using a technical category index to a subcontractor file is the difficulty of translating engineering design requirements (developed by the engineering department) in terms of the categories established in the index (usually maintained in the

purchasing department). This problem can be overcome to a large extent by using standard terms. The application of Principle 6, below, also will help in rectifying this problem.

6. The employees who maintain the subcontractor file should be well versed in engineering terminology (E-1.1).

Explanation. Another major problem in establishing a technical category index to a subcontractor file is that of translating subcontractors' capabilities (what they say they can do) in terms of the established categories. This problem can be overcome to a large degree if the employees who maintain the file have a working knowledge of engineering terminology. This can be accomplished through training or by hiring personnel with engineering experience.

7. At least three firms should be nominated and invited to bid on a subcontract except under special circumstances (E-1, F).

Explanation. A policy to this effect should assure adequate competition for the contract award. Three firms are indicated as a bare minimum. The actual number invited to bid should vary depending on circumstances.

Under special circumstances, however, sole source procurement may be justified. For example, it is sometimes more efficient to "go sole source" on follow-on contracts. When potential items or proprietary information are involved it is usually necessary to deal with a single subcontractor. Also, if the customer directs the use of a particular firm it would be foolish to hold a formal competition. Finally, the formation of up-stream bidding coalitions sometimes justifies the lack of competition in choosing a source.

8. The engineers who write the statement of work for a particular "buy" item should be required to submit in writing a list of suggested subcontractors along with the statement of work (E-1.2).

Explanation. This practice will insure the utilization of technical personnel as a source for nominations. Empirical evidence suggests that this frequently is the most valuable source on items which are "pushing" the state-of-the-art.

Qualification Criteria (E-2)

9. The qualification criteria employed in determining the subcontractors who will be invited to bid should always include technical capability (E-2.1) and interest (E-2.2).

Explanation. It is obviously inefficient to issue RFP's to firms which either do not have the technical capability to perform the required work or the interest in doing so. Hence, these factors should always be employed as qualification criteria. General technical capability normally can be quickly determined from the data in the subcontractor file. Interest will be discussed in Principle 10 below.

10. Potential subcontractors should be contacted to determine their interest in the subcontract prior to being issued RFP's when the cost of preparing and issuing an incremental RFP is high relative to the cost of sending out a brief description of the item (E-2.2, E-3).

Explanation. The cost of the subcontractor selection process will be reduced if some firms can be eliminated through this technique because the prime contractor will save the cost of preparing and distributing additional RFP's. Furthermore, he also may be able to save the cost of conducting additional on-site surveys. Of course, if the prime contractor

"knows" by means of other communications that a subcontractor is interested in a given contract, it is unnecessary to contact him for this specific purpose.

11. Qualification criteria (in terms of minimum standards), other than technical capability and interest, which can be readily determined, should be applied in establishing potential sources (E-2.3).

Explanation. The application of additional qualification criteria which can be quickly determined by the prime contractor will have the general effect of reducing cost and time in the subcontractor selection process because it will facilitate the "weeding out" of marginal firms prior to costly formal proposal evaluations and in some instance expensive on-site surveys.

12. Multiple sources should be utilized in developing information on potential subcontractors. These sources should include: sales brochures (E-3.1), returned questionnaires (E-3.2), on-site surveys (E-3.3), information from government agencies and other firms (E-3.6), financial reports (E-3.5), and past performance appraisals (E-3.4).

Explanation. Up-to-date information is essential both in determining which firms will be invited to bid and in making the final selection of a subcontractor. Multiple sources of information are necessary because they support and supplement each other. They support each other in that one source may verify information from another source. They supplement each other in that no single source is designed for the purpose of supplying all the required data. Furthermore, it is doubtful that such an all-purpose source of information could be discovered. The several sources mentioned above have been found to be the most useful in practice.

13. An on-site survey should be conducted at the facilities of every firm being seriously considered for a subcontract. Preferably, this survey should be conducted after the subcontractor has returned a proposal (E-3.3).

Explanation. It would be foolhardy to award a contract to a subcontractor without first visiting his facilities to substantiate his assertions and other information received pertaining to his facilities, organization, and personnel. On a strictly cost basis the ideal time to conduct this survey is immediately after the return of the proposals because it will be necessary to survey only those firms which have not been eliminated earlier in the selection process for not returning proposals or for other reasons. Time and other factors, however, may dictate conducting on-site surveys prior to the return of proposals. Also, if an on-site survey has been conducted at the facilities of a particular firm in the recent past, it may be unnecessary to re-survey this firm. It should also be noted that empirical evidence suggests that periodic surveys of subcontractors' facilities tend to increase the cost of the selection process unnecessarily.

14. The nomination (E-1)--information storage (E-4)--information retrieval (E-5) process should be automated where a cost-benefit analysis shows it to be of value.

Explanation. A prime contractor's nomination--information storage--information retrieval process may be expedited through the application of automation techniques (note that information on subcontractors and qualification criteria are inputs to the automated process). The decision on whether to install such a system at a particular firm should depend

on the projected cost of installing and operating the system compared with the projected benefits to be gained by its use.

15. The security status of each firm should be verified immediately prior to sending it an RFP containing classified information (E-7).

Explanation. A firm's security status may change from day to day. Therefore, it is essential that a subcontractor's clearance to receive classified information not be taken for granted.

Inviting Qualified Firms to Bid (F)

16. The employees responsible for preparing the statement of work portion of the RFP should be skilled in technical writing (F-1).

Explanation. The statement of work is the prime contractor's primary means of communication with prospective subcontractors. As such, it should accurately communicate the desired technical requirements. Poor statements of work tend to result in deficient proposals and these poor statements of work are often the result of ineffective writing. The prime contractor, therefore, should employ individuals skilled in technical writing as a means of improving the communication value of this instrument.

17. The actual preparation of the statement of work should commence as far in advance as knowledge of the requirements for the subsystem permits (F-1).

Explanation. Empirical evidence suggests that statements of work sometimes result in poor communication because they are hastily drafted at the last minute. To preclude this possibility the preparation of the statement of work should begin as far "up stream" as knowledge of the requirements for the subsystem allows.

18. A bidders' conference normally should be held as a means of supplementing the statement of work for a development subcontract (performance specifications are used) or whenever the prime contractor feel the statement of work requires additional explanation (F-1).

Explanation. Even when expert writers are employed and adequate time is taken to prepare the statement of work, it is difficult to communicate accurately performance specifications for a complex subsystem by means of the written word. Questions almost always arise in the minds of the bidders. These questions can be answered efficiently by means of bidders' conferences.

19. Bidders' conferences (when employed) normally should be held after the RFP's have been issued (F-2).

Explanation. If a bidder conference is employed after the RFP's have been distributed, the subcontractors will have time to study them and thus be in position to ask pertinent questions. If, on the other hand, the conference is held prior to or simultaneous with the distribution of the RFP's the subcontractors only will be able to ask very general questions. Occasionally, in order to compress time, it may be necessary to hold conferences prior to or simultaneous with the distribution of the RFP's.

20. As a means of promoting effective communication with subcontractors, prime contractors should hold individual conferences with each bidder as part of general bidders' conferences. These individual conferences should be carefully controlled to prevent any one firm from gaining a competitive advantage. If other considerations (such as time and cost) prevent holding individual conferences, a question and answer

session involving written anonymous questions from the bidders and oral replys from the prime contractor should be employed as an alternative method of encouraging effective communication (F-2).

Explanation. Research findings disclosed that subcontractors are sometimes afraid to ask pertinent questions at open bidders' conferences for fear of disclosing their intended technical approaches and thereby sacrificing a competitive advantage. There is evidence, moreover, indicating that some subcontractors have used bidders' conferences as a means of trying to confuse their competitors as to their intended technical approaches and, in doing so, have rendered these conferences ineffective. The ideal way to overcome these problems is through the use of individual conferences. If, however, the information disclosed to each bidder during individual conferences is not carefully controlled, the possibility will exist that one of the competing firms might gain a competitive advantage.

Since individual conferences are more time consuming and costly than general conferences, time and/or cost constraints may discourage their use. In such a case, the second best method of solving these problems is through the use of anonymous written questions and oral responses.

21. All communications between the prime contractor and the subcontractor should be channeled through a single responsible executive at each firm. Direct communication between technical personnel and others in the two firms should be allowed, however, provided the responsible executive gives his permission in advance and is advised of the results of the direct communication (F).

Explanation. Informal communication often takes place between

various individual employees of the prime and subcontractors. This practice may lead to a subcontractor getting information which will give him a competitive advantage or to a situation where a subcontractor may act on the basis of unauthorized information. The problem can be overcome by making a single executive at each firm responsible for all communication to and from the other firm.

Speed and accuracy of communication under this practice can be encouraged by permitting direct communication between various employees at the two firms, provided the responsible executives consent to the communication in advance and are informed of its outcome. This technique combines the advantages of using both a single channel and several direct channels of communication.

Receiving Bids (G)

22. A standing plan (policy or procedure) should be established for meeting situations in which none of the firms solicited return proposals. This plan should generally conform to the following steps: 1) determine the reasons for the "no-bid" responses, 2) rectify the problem if possible and rebid, and/or 3) seek out and consider new sources including the possibility of "making" the item (G-1.1).

Explanation. Research findings show that situations have arisen in which none of the firms solicited have returned proposals. Since time is often a critical factor in the development and production of a weapon or space system it is prudent for prime contractors to have a standing plan ready to meet such an emergency. A policy or procedure based on the above steps is an expeditious way of handling this type of situation.

23. As a matter of policy late bids should be rejected. (G-2).

Explanation. A policy to this effect will tend to discourage firms from returning late bids. This is an especially important consideration on contracts where lead-time is critical. Furthermore, if late bids are accepted those firms which return their proposals by the due-date will be penalized because they will have had less time to prepare their proposals.

Nevertheless, the rejection of the late bids should not be a hard and fast rule since there is a possibility that a prime contractor may deny himself the best subcontractor by rejecting a late bid. Careful consideration should be given, however, before accepting a late bid since this act may have a damaging effect on the prime contractor's relations with the other subcontractors.

24. Oral technical briefings by subcontractors as a supplement to their proposals should be required only when, in the opinion of the prime contractor, the technical proposals are so complicated they cannot be reduced adequately to writing. When the privilege of presenting an oral briefing is extended to one bidder it should be extended to all (G-6).

Explanation. Empirical evidence indicates that oral technical briefings tend to be time consuming and are typically turned into "sales pitches" by the bidders. Therefore, they should be used only when the prime contractor feels they are absolutely necessary to understand the bidders' technical proposals.

In order to maintain good relations with all bidders the opportunity to present an oral briefing should be offered equally to all the competing firms if it is offered to one of them.

Evaluating Bids and Bidders (H)

25. A preliminary screening evaluation of proposals should be held

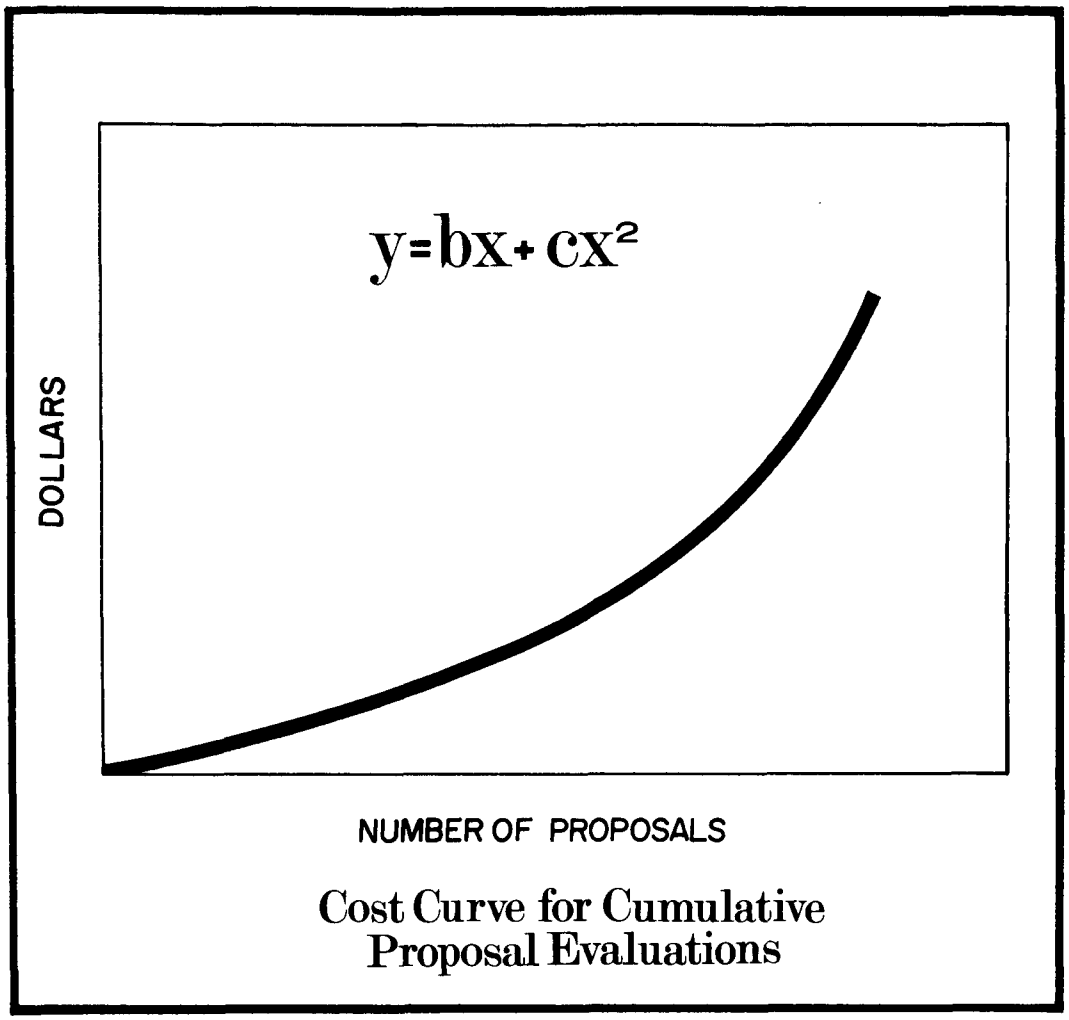
prior to the formal evaluation. During this screening the evaluator should eliminate those proposals which do not respond to the requirements set forth in the RFP or are clearly deficient in some other way (H-1).

Explanation. It is both expensive and time-consuming to evaluate a proposal formally. The research findings, moreover, suggest that the relationship between the number of proposals evaluated and the total cost of formally evaluating all proposals takes the form of a second degree equation (see Exhibit 2). The reason for this relationship is that proposals are evaluated by making comparisons between them -- hence, cost and also time tend to increase more than proportionally as additional proposals are evaluated. An effective preliminary screening of proposals provides an efficient means of eliminating, before the formal evaluation, those proposals which are obviously unacceptable -- thus, saving time and money.

26. A formal point-score system consisting of criteria (H-2.11) and weights (H-2.12) should be used for evaluating bids and bidders.

Explanation. The use of a formal point-score system forces the prime contractor to formulate clearly in advance the critical factors (criteria) in the evaluation of subcontractors and the relationship between these factors (weights). In any selection decision, the prime contractor will do this implicitly. The formal point-score system forces him to do this explicitly. Furthermore, the formal point-score system provides a convenient structure for specialization of effort in the evaluation of bidders. Also, such a system has the advantage of reducing the various criteria to a common unit of measure (numbers). Finally, it provides a convenient means of justifying the selection of a subcontractor to the government.

EXHIBIT 2



Cost Curve for Cumulative Proposal Evaluations

27. A unique point-score system (the structuring of criteria and weights), tailored to the particular subcontract, should be designed for each individual major item (H-2.1).

Explanation. Since the technical and administrative requirements tend to vary from subcontract to subcontract, the criteria and weights used should also vary to appropriately reflect the bidders' ability to perform the contract. It may be useful, nevertheless, to establish a general point-score format which can be used as a guide by those charged with designing a scoring system for a particular evaluation. Such a format may have the effect of promoting speed and insuring that nothing is overlooked. Care must be taken, however, to insure that this general format does not become inflexible.

28. On complicated items the evaluation criteria and weights should be established or recommended by a committee composed of specialists in various areas germane to the proposed subcontract (H-2.11, H-2.12).

Explanation. Research findings indicate that on a complex item no one executive has, typically, the overall knowledge to determine singlehandedly the criteria and weights which should be used in evaluating potential subcontractors. Therefore, a committee decision or recommendation is necessary. The exact composition of the committee should vary according to the complexity and peculiarities of the item in question.

29. Sub-criteria and sub-weights should be employed in the point-score systems used for evaluating firms bidding on complex items (H-2.11, H-2.12).

Explanation. Dividing a critical factor into its component parts and assigning relative weights to these parts, provides an excellent

technique for organizing one's thoughts on the evaluation of subcontractors. Of course, care should be taken not to dissect critical factors into meaningless parts which will result in misleading comparisons between firms. In other words, the sub-division of criteria can be carried too far.

30. Each criteria or sub-criteria should be accompanied by a narrative definition of exactly what is to be evaluated (H-2.11).

Explanation. This practice will inform the evaluator of exactly what he is expected to evaluate. It is also useful in helping those who establish the point-score system determine the exact boundaries between categories. In addition, it may be helpful to those who review the system and the scoring.

31. The same group (two or more) of competent specialists in the fields encompassed by a particular criterion or related group of criteria should score each subcontractor (H-2.1).

Explanation. There are three related practices here. First, the individual (or individuals) doing the scoring should be competent in the particular area in which he is rating the bidders. This is essential if the scoring is to be valid. Second, the same individual (or individuals) should score each bidder. Reliability of the scores cannot be assumed if different individuals score different firms. Finally, more than one evaluator should rate each firm in each category or group of categories. This practice will improve the reliability of the scoring because the averaging effect will tend to counterbalance flagrant inaccuracies or biases on the part of an individual evaluator. Moreover, group pressures may exert a modifying influence on biased scorers.

32. After the final scores have been awarded, both the scoring system and the actual scores received should be reviewed, and other factors not originally included in the point-score design should be considered. The final decision should rest on mature judgment rather than the mechanical totaling of points (H).

Explanation. Both the structure of point-scoring systems and the actual assignment of points are based on subjective judgment. Therefore, a scoring system should not be considered as a "mechanical decision maker." This is especially important to keep in mind in situations where the top subcontractors' final point totals are fairly close. Furthermore, it might be necessary to consider strategic political factors prior to awarding the subcontract. Also, bargaining discussions (see Principle 33 below) with subcontractors may influence the final decision.

33. Preliminary negotiations should be conducted with the firms which receive the highest point totals prior to announcing the winner of the competition. These sessions should not be used, however, to "play" one firm against another (H-5).

Explanation. A prime contractor by bargaining with the leading competitors prior to announcing the award of the subcontract may be able to secure more favorable contract arrangements than he would otherwise. Telling one firm what other firms have proposed as a method of achieving a more favorable contract agreement is considered unethical, however, and if practiced, will impair relations with subcontractors.

34. The final decision or a recommendation as to the final decision should be made by a committee (Source Selection Board) composed of mature executives with specialized experience and knowledge in the areas in

which the bidders are being rated (I).

Explanation. A committee selection decision is necessary because no single executive has the requisite breadth of knowledge and experience to assess properly the bidders in all areas. The committee should be composed of executives with specialized knowledge and experience in the critical areas in which the bidders are being evaluated. This allows the knowledge and experience of the specialist to be brought to bear in each area being evaluated and then integrated through group discussion and deliberation with the other specialized areas. These executives also should have the mature judgment to be able to consider the broad picture as well as their own specialized fields.

35. After the award of the subcontract individual debriefing sessions should be held for each of the unsuccessful bidders. These sessions should be kept short and be controlled so as to prevent the disclosure of strategic information (L-1).

Explanation. Debriefing sessions have two primary advantages. First, they tend to promote the goodwill of the unsuccessful bidders by explaining to them why their bids were not successful. They also tend to improve future proposals by providing subcontractors with accurate information on the shortcomings of their proposals.

Because of cost and time considerations these sessions should be kept short. The discussions should be confined to the evaluation of the firm being debriefed with reference to the other bidders in general rather than specific terms so as not to disclose strategic information which might give the firm being debriefed a future competitive advantage.

36. Employees who have a specific interest in any of the prospective

subcontractors should be disqualified from participating in selection process (C through L).

Explanation. Research findings suggest that conflict of interest policies help eliminate conscious bias in the selection process. Unfortunately, they do not completely obviate the problem of bias. A full solution to the problem can be realized only through constant vigilance by the prime contractors' management.