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The Air Force High Technology Ejection Seat (ACES II) acquisition program is analyzed to determine what factors were considered while this program was adapted to the leader/follower procurement technique. Two additional factors are identified.

Using the fourteen identified factors, a model is developed to determine if an acquisition program can be successfully adapted to the leader/follower procurement technique. The model is presented in four parts: a decision model to determine the adaptability of a system acquisition program; an economic decision model to determine the cost effectiveness of using the leader/follower procurement concept; an implementation decision model to be used during the solicitation and selection steps to ensure a successful application of the leader/follower technique; and a long term effects model to determine the effects of large scale applications of the leader/follower procurement technique on government and industry.

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LEADER/FOLLOWER: AN ANALYSIS OF A PROPOSED TECHNIQUE FOR INCREASING COMPETITION IN AIR FORCE WEAPON SYSTEM PROCUREMENTS

THESIS

Presented to the Faculty of the School of Engineering
of the Air Force Institute of Technology
Air University
In Partial Fulfillment of the
Requirements for the Degree of
Master of Science

by

Larry L. Soderquist
Captain USAF

Graduate Systems Management

September 1979

PREFACE

This research was performed to develop a model for applying the leader/follower procurement technique to improve the competitive posture of a system acquisition program. Although the model provides only a basic framework to aid the decision making process, hopefully it will be useful to program managers and contracting officers who consider the use of the leader/follower concept.

The analysis of the ACES II program was complicated by the fact that the program is active and a new contract was being negotiated while this research was being conducted. As a result, various data could not be released concerning the program. Thus, interpretation of the available data was often the result of my personal evaluation and perception, and I accept full responsibility for any errors made in the analysis.

I wish to express my gratitude to Mr. Al Goebel (ASD/PM) and Major Ray Fellows (BRC) for suggesting this study and providing research leads and contacts. Additionally, I would like to thank Mr. Claus Perry (ASD/AELK), Mr. James Schaeffer (ASD/PM) and Captain Bob Shipman (Hq USAF/RDC) for providing records and correspondence on the ACES II program and leader/follower procurement. Finally I wish to express my gratitude to my reader, Dr. Joe Cain, and my advisor, Lieutenant Colonel William Letzkus who supplied numerous constructive comments and encouragement throughout this research effort.

Larry L. Soderquist

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LEADER/FOLLOWER: AN ANALYSIS OF A PROPOSED TECHNIQUE FOR INCREASING COMPETITION IN AIR FORCE WEAPON SYSTEM PROCUREMENTS

I. INTRODUCTION

Philosophy of Competition

Social Desirability

In an unregulated market economy, such as exists in the United States, competition ensures adequate economic performance. Throughout the history of economic policy in this country, a continuing effort to encourage and preserve market competition and limit monopoly is reflected in antitrust laws, procurement statutes and regulations, and a variety of other public laws and policies (Ref 23:1). These laws and regulations indicate a general social desirability to maintain competition.

Lower Prices

In addition to being generally socially desirable, competition is particularly influential in yielding lower prices in defense procurement. In 1965 Secretary of Defense McNamara presented exhibits prepared by the General Accounting Office and Department of Defense agencies which indicated that the introduction of price competition into the procurement of a wide variety of military equipment had resulted in average price reductions of twenty-five percent or more (Ref 40:12-14).

In a later study Yuspeh has documented savings of fifty percent for selected items which were shifted from sole source to competitive procurement (Ref 42), while Carter has estimated a savings of forty-one percent using the same data (Ref 5:123). Other studies indicate consistent price reductions through the use of competition, with the average savings estimated from twenty-five to thirty-three percent (Ref 2).

Other Benefits

While social desirability and cost savings are generally considered as the primary benefits of competition, other less direct benefits are perceived to be gained by introducing competition into the system acquisition process. For example, Congress perceives greater technological achievement resulting in a better product and a "carry over effect" (Ref 36:2-3) when using competition. This "carry over effect" presumes that if competition is introduced at the start of the acquisition cycle, the benefits of competition will "carry over" into the other acquisition stages even if production is limited to a single source situation. Also, competition creates the appearance of fairness since the awarding of large, long-term contracts without competition appears to be unfair to the rest of the industry (Ref 36:3-4).

Difficulties in Obtaining Competition

However, various difficulties arise when the Department of Defense tries to obtain the benefits of competition in all procurements. Items which are purchased on the open market such as blankets, buildings, shoes and medical supplies can be purchased under competitive conditions and consequently reap the benefits of competition. On the other hand, certain goods such as weapon systems and other supplies designed specifically for the military mission are unique and can not be purchased in the open market place. In these instances, "substantial barriers to competition are encountered" (Ref 18:2). In fact, the more unique and technologically advanced an item or system is, the less likely it is that it will exhibit the homogeneous characteristics required for competition as described by economic theory. Unfortunately a large proportion of the items procured by the Department of Defense exhibit noncompetitive characteristics.

Magnitude of the Problem

In a study of defense procurement during the 1960's, almost sixty percent of the total procurement budget for weapon systems was found to be through negotiated sole source solicitations (Ref 29:12). In a similar review Carter found that almost seventy percent ($9.4 billion) of the 1973 budget for all weapon system procurements was contracted through a single source. Almost one-third of the total Department of Defense procurement budget of $30 billion was thus allocated to noncompetitive procurement of weapon systems (Ref 5:1-2). Assuming these percentages continue, approximately $7 billion of a projected weapon systems procurement budget of $10.1 billion for fiscal year 1980 (Ref 1:143) for the United

States Air Force will be procured by noncompetitive procurement methods.

However, this does not imply that the Air Force or the Department of Defense do not understand or ignore the advantages of price competition. In fact, the Defense Acquisition Regulation requires the use of competition whenever feasible. The regulation states "All procurements, whether by formal advertising or by negotiation, shall be made on a competitive basis to the maximum practicable extent" (Ref 11:Section 3,1-21).

The Production Phases

Initially almost all Air Force weapon system procurements begin the first stages of an acquisition program with competitive proposals from interested sources for the development of a weapon system (See Figure 1). The competition typically takes the form of prototype or paper design competition and is often referred to as design and technical rivalry (Ref 16: 5). The major problem with this strategy is that once the preferred design is selected, price competition is effectively impeded in production and follow-on production contracts. The selection of one contractor for the development of a weapon system gives the chosen contractor an advantage in pricing and general know-how for follow-on contracts. Thus contractors often view research and development contracts as a prelude to more lucrative manufacturing contracts (Ref 17:8).

Barriers to Competition

Three major barriers to competition restrict the entry of new firms into the production phases of the acquisition

Development Phases			Production Phases	
Conceptual Stage	Validation Stage	Full Scale Development Stage	Production Stage	Deployment Stage

Figure 1. The Stages of an Acquisition Program (Ref 21:6)

process for a weapon system. First, the start-up costs are often so high that potential producers are not interested in competing against a manufacturer who has already developed much of the tooling and know-how necessary through government research and development contracts (Ref 17:6).

Second, a legal barrier may exist concerning the possession of patent or proprietary rights to technical information developed by the original contractor. The ownership of these rights is often in doubt, especially in systems which require extensive creative engineering, technical innovations and advanced manufacturing techniques (Ref 28:1).

The third barrier to competition in the production phases is the difficulty of transferring technical data so that a contractor can produce exactly what is wanted (Ref 23:5). Although technical information can be transferred from one producer to another using data packages containing all necessary specifications, a data package, no matter how comprehensive, can not relay all of the know-how gained by the original developer (Ref 15:2). These three barriers that hamper the entry of new firms, in conjunction with the advantages enjoyed by the developing contractor, serve to restrict competition during the production phases of the weapon system acquisition process.

Background

Early Procurement History

The historical evolution of government contracting procedure has resulted in a gradual departure from formally advertised procurement as technology has become more complex (Ref 29:11). The first federal law requiring advertising for bids was enacted by Congress in 1809. This statute required all military purchases to be placed in the open market or through formal advertising (Ref 12:96). It was later modified in 1829 to state that advertising was the preferred method but open market purchases could be employed when public exigencies demand immediate performance of the contract (Ref 31:4). Since the first statute was enacted, the commitment to advertised competition has been continuously modified by exceptions which allow negotiated contracts (Ref 29:11). During the nineteenth century when weapon technology was slowly evolving, adequate specifications could be written to obtain competitive bids. However, as weapon technology progressed more rapidly, coupled with World War I and World War II, negotiated contracts became the rule rather than the exception (Ref 31:5-8).

Consolidation of Procurement Laws

In an effort to integrate the endless number of procurement laws which had evolved since 1809, Congress enacted the Armed Forces Procurement Act of 1947. Although this statute reaffirmed the preference for formal advertising, seventeen specific exceptions were listed in which negotiated contracts were acceptable. The rapidly advancing technology and time constraints imposed by the Cold War and the Space Race provided additional impetus for the use of negotiated procurement (Ref 31:8-10).

Procurement Strategies of the 1960's

As a result of criticism of cost overruns on major weapon systems during the 1950's, the Department of Defense initiated procurement methods to stimulate competition and reduce costs. These efforts focused on incentive contracts and procedures to remove the barriers to competition involved with negotiated contracts (Ref 26:12).

Three approaches were advanced by the government during the 1960's to remove barriers to competition when the weapon system acquisition process progresses from the development phases to the production phases. First, multi-year procurement has been used to help overcome the start-up cost barrier by ensuring the contractor a large volume of business (Ref 22:3). Second, standard military specifications for products have been established to aid a clear definition of the product (Ref 23:6). Finally, data packages which contain the developer's technical data have been purchased and then furnished to prospective contractors (Ref 17:7). Each of these techniques has been used in an effort to introduce competition into the system acquisition process. However, each technique has serious shortcomings.

Multi-Year Procurement. The concept of multi-year procurement is designed to encourage new sources to bid on contracts by awarding full production contracts which extend over a period of several years (Ref 26:15). Using this approach, contractors are ensured of longer and larger production runs on which to distribute start-up costs. This technique presumably increases competition by reducing the decisive advantage held by the developer by spreading the initial entry cost of a contractor over the larger and longer production run. However, this strategy does not solve the problem of the inherent uncertainty of forecasting future military purchases nor does it deal with the legal or technical barriers to competition.

Standard Military Specifications. The second technique, establishment of standard military specifications for products, focuses on the "procurement to performance or form-fit-and-function specifications rather than specific configuration or design specifications" (Ref 18:8). In this approach procurement can be obtained through formal advertising, which increases the competitive posture of the acquisition process. One limitation on the use of this technique is that the military may have to stock several different items which have the same purpose but different physical characteristics requiring different replacement parts and maintenance procedures. The result is higher logistics costs. Another limitation is that standard military specifications are not practicable for new high technology items that may have changing physical attributes (Ref 17:7). These two limitations can cause costs to exceed the benefits of this method to increase competition.

Technical Data Package. The final technique, acquiring the developer's technical data package, is an effort to develop competition for items of identical design by purchasing the developer's technical data and transferring it to prospective suppliers. These data packages usually consist mainly of engineering drawings and associated specifications (Ref 24:4). However, a major problem with data packages is that they are frequently inadequate and/or incomplete, and there are reasons to question the adequacy of engineering drawings and specifications as the only instrument of technology transfer (Ref 17:7-9). This procedure is generally inadequate for high technology items since technical data, no matter how comrehensive, can not transfer all of the know-how gained by the developing contractor.

Procurement Strategies of the 1970's

Procurement strategies in the 1970's have relied on prototyping to interject competition into the system acquisition process. Using this procurement strategy, competing contractors develop prototypes which the government evaluates and tests to determine the ultimate producer (Ref 26:17-18). However, this strategy does not extend competition into the production stages.

To introduce competition into the production phases of the system acquisition process, three strategies (second sourcing, technology licensing and leader/follower procurement) have been proposed to increase competition after the initial production run. In each technique one firm performs the system development while a second firm enters the process at a later stage in the acquisition cycle to provide a competitive force after the uncertainties of development and initial production have been resolved. One of the principal differences between the three techniques involves the method of transferring the technology of the developer to the new competitive producer.

Second sourcing has been used extensively by the Department of Defense and the Air Force to provide competition during reprocurement actions while technology licensing has primarily been used by commercial firms and in co-production programs. However, leader/follower procurement has been a little used technique.

Statement of the Problem

Since the Air Force has had limited experience with the leader/follower technique as a strategy to increase competition in the system acquisition process, attempts to use this technique have raised many unanswered questions on the critical factors necessary to adapt an acquisition program to this method of procurement. A comprehensive model or a set of quidelines for the application of the leader/follower technique is needed to determine what conditions would make this technique effective in promoting competition throughout the acquisition process. The advantages and limitations of this technique, their interrelationships, and the impacts of potential problems need to be analyzed to compare the costs and operational impacts with the benefits of achieving a competitive production posture.

Objective of Research

The primary objective of this research is to develop a comprehensive model for applying the leader/follower procurement technique to a specific weapon system acquisition program. This model will show the interrelationship of costs and benefits in achieving a competitive production posture.

The purpose of this model is to provide system program managers and contracting officers with a device to aid in the decision as to whether the leader/follower concept might be appropriate for a specific acquisition. This model will provide a basic framework which can be expanded and refined after further experience is gained with this procurement technique.

Scope

This research project is primarily concerned with identifying those critical factors which constitute a model for the application of the leader/follower procurement concept to introduce competition into a system acquisition program. It includes the development of a model to determine the adaptability of a program to leader/follower procurement. Specific parameters as to the scope of this study are as follows:

1. This research effort focuses on weapon system acquisition programs of the United States Air Force. No attempt is made to consider other acquisition programs.

2. This research does not attempt to describe or analyze all details of the system acquisition process or procurement process. Only those aspects which have an association with adopting the leader/follower procurement technique to a specific acquisition program are considered.

3. Discussion and analysis of the leader/follower procurement technique has been limited to the government's point of view. No attempt has been made to introduce or consider the position of the contractor.

4. This research effort considers the leader/follower technique only in its role as a procurement method intended to introduce competition into the acquisition process. The leader/follower concept can, however, be used for other objectives.

5. This exploratory study to formulate a model has been limited to the specific acquisition and procurement processes as defined by the United States Air Force.

Limitations

This study was constrained by a lack of empirical experience with the use of the leader/follower procurement technique as a method of introducing competition into a system acquisition program. This lack of experience has resulted in a limited amount of information on the leader/follower procurement technique:

1. There is a lack of empirical evidence to test the conceptual model developed by this study. The only acquisition program which has used the leader/follower technique solely to provide competition is in the early stages of the production phases of the acquisition process.

2. Literature on the leader/follower procurement technique is limited and generally involves modified versions of the leader/follower concept where the primary objective is not to introduce competition.

3. Total cost information was not available from the Air Force High Technology Ejection Seat (ACES II) acquisition program. Since the program is still active, certain cost data could not be released without compromising the contractor's pricing data. However, this lack of cost information is not considered a serious limitation since the research effort focuses on the methodology used to apply the leader/follower concept to the ACES II program.

4. There is a lack of procurement and contracting experts with an in-depth knowledge of and experience with the leader/follower procurement technique.

Approach and Methodology

The approach to this research effort has encompassed three stages. The first stage involved a general review of the literature and records associated with three competitive procurement techniques (second sourcing, technology licensing and leader/follower procurement) to obtain an understanding of the factors necessary to introduce competition into the acquisition process. This stage involved identifying criteria used to determine the capability of a particular technique to effectively introduce competition into the acquisition process.

The second stage in this effort involved a case analysis, using interviews and program office correspondence, of the High Technology Ejection Seat Program. This program is the only known application of the leader/follower concept solely to provide for future competition. Although the program is in its infancy, certain factors concerning the implementation of the leader/follower concept can be discerned from program records.

The third and final stage consisted of formulating a model for determining the adaptability of a specific program to the leader/follower technique in order to provide future competition. A set of factors which affect competition in the system acquisition process was identified and expressed in a conceptual model using a systems theory approach and cost-benefit analysis.

A description of the model is presented by narrative and visual display to provide an integrated view of the application of this procurement technique. The model provides a means of identifying critical factors which affect the application of the leader/follower technique. These critical factors, once identified, could be used by a program manager to determine if leader/follower procurement can be successfully applied to a specific weapon system acquisition program.

Systems Approach

The model was developed using the systems theory approach. The systems approach to solving a problem involves considering all of the interactions and interrelationships within a system as well as the interactions and interrelationships with other systems (Ref 41:1). This method of inquiry emphasizes the whole system instead of component parts and strives to optimize the system's effectiveness instead of improving only parts of the system, which can result in suboptimization (Ref 41:12).

Cost-Benefit Analysis

Cost-benefit analysis is a uniobjective model which uses a systems approach and encompasses evaluation procedures in which an economic criterion is calculated representing the difference or ratio between the costs and the benefits of an alternative. Cost-benefit analysis has been used extensively as a method to compare two or more alternatives (Ref 41:273). In this research effort, the costs and benefits of developing competition through the leader/follower procurement technique will be compared to the costs and benefits of maintaining a sole source producer to determine the most effective alternative.

Definition and Explanation of Terms

The following terms are defined to provide understanding and guidance for their use throughout this research effort.

The Systems Acquisition Process

The systems acquisition process consists of the sum total of the acquisition activities. This process consists of five stages (Conceptual, Validation, Full-Scale Development, Production and Deployment) separated by key decision points (Program Decision, Ratification Decision and Production Decision) between the first four stages (Ref 21:6-7).

The Procurement Process

The procurement process consists of several steps: (1) planning, (2) solicitation, (3) selection, (4) negotiations (when appropriate), (5) contract award and (6) contract administration. The process is accomplished through a legal and administrative structure which provides the foundation for procurement activities (Ref 8:159-161).

Competition

Competition in this research effort refers only to price competition in which two or more firms are attempting to secure a government contract and final determination is based solely on price. Competition will not be used to refer to design or political considerations.

Second Sourcing

Under the procurement strategy of second sourcing, one firm performs the initial development of a system and then furnishes the government with drawings, specifications and other technical information which the government validates. The government transfers at least part of the data to additional suppliers who submit bids for the right to establish production lines (Ref 26:19). The developer then produces the item in parallel with one other producer, thus creating a competitive atmosphere in which price is the sole evaluation factor for future contracts. The government acts as the technology transfer agent in this method.

Technology Licensing

The technology licensing concept consists of having the government obtain from the system developer, "...at the time of issuance of the development contract, a contractual commitment for rights to production data and an agreement to license whomever the government designates to produce the system" (Ref 5:v-vi). The developer may or may not receive any production contracts but must furnish technical assistance to another selected producer. The producer(s) is primarily selected by price considerations. In this case the developer acts as the technology agent.

Leader/Follower

The leader/follower approach to the procurement process is a special type of procurement which is defined in the Defense Acquisition Regulation:

> Leader company procurement is an extraordinary procurement technique under which the developer or sole producer of an item or system (the leader company) furnishes manufacturing assistance and know-how or otherwise enables a follower

company to become a source of supply for the item or system (Ref 11:Section 4, 4-703).

Leader/follower procurement requires the leader company to produce an item or system in parallel with the follower company. Price is the sole evaluation factor for future contracts. In this technique the technology transfer agent is both a developer and a producer.

Thesis Outline

The results of this study are presented in five chapters. Each chapter represents a major area of this research effort.

Chapter I has presented an introduction and background on the problem of obtaining and maintaining competition during the production phases of a military system acquisition program.

Chapter II, "Analysis of Competitive Procurement Techniques," presents a comparative analysis of the second sourcing, technology licensing and leader/follower procurement techniques. This analysis focuses on the factors or conditions that must be considered before any one of these three procurement techniques can be applied to a specific acquisition program to introduce competition after the development phases.

In Chapter III, "Analysis of the ACES II Program," an in-depth analysis of the High Technology Ejection Seat Program is presented. The analysis focuses on the factors which the program managers considered in implementing the leader/follower concept.

Chapter IV, "Development of a Model," consists of a narrative and visual description of a model to apply the leader/follower procurement technique to a specific system acquisition program. The model is developed using a systems theory approach with an emphasis on the uniobjective modeling technique of cost-benefit analysis.

The final chapter, "Summary and Conclusions," provides a summary of the research effort, the author's conclusions and recommended areas for further study on the leader/follower procurement technique as a method of introducing competition into the system acquisition process.

II. ANALYSIS OF COMPETITIVE PROCUREMENT TECHNIQUES

Introduction

This chapter contains an analysis of the three procurement techniques (second sourcing, technology licensing and leader/follower) which have been proposed as procurement methods to introduce competition into the production phases of the system acquisition process. This analysis includes a discussion of the advantages, disadvantages and method of technology transfer for each strategy. The second sourcing and technology licensing procurement techniques are analyzed to determine what factors or characteristics a specific system or item should exhibit before the technique can be employed to induce competition. Then, because of the basic similarities of these three techniques, the leader/follower procurement technique is compared to the second sourcing and technology licensing concepts to determine the factors which should be considered before a system acquisition program is adapted to the leader/follower technique.

The objective of each of these three procurement techniques is to induce competition into the system acquisition process. While the primary purpose of competition is to reduce the procurement costs of a system, product quality and a timely delivery schedule must also be maintained for the technique to be effective (Ref 5:68).

Product quality can be adequately controlled through a series of tests and specifications required of each producer in contractual agreements with the government. Since the quality of the products delivered by the second contractor has been found to be as good as that of the original developer or contractor (Ref 5:68), product quality will not be considered in evaluating the feasibility of adopting one of the procurement techniques to an acquisition program.

However, on-time delivery can be as important as cost and must be considered before employing one of these competitive procurement methods. "The possibility of delay in getting the product is usually the first question raised regarding the feasibility of any type of competitive procurement" (Ref 5:68-9). Thus the risk associated with receiving an item or system behind schedule and its impact on an acquisition program and other programs must be assessed before adapting the program to a competitive procurement technique.

Thus, for a competitive procurement technique to be effective, it should reduce costs while maintaining a timely delivery schedule. Consequently, any factor that affects the cost or timely delivery schedule of a system should be considered before a system acquisition program is adapted to a competitive procurement technique.

Second Sourcing

Background

Second sourcing, sometimes called competitive procurement, has primarily been used for reprocurement actions and has commonly been limited to small, low technology items and systems. The Navy has successfully applied this technique to a variety of programs for small missiles, target drones, aircraft engines and torpedoes (Ref 18:31). The Air Force has used this technique extensively in the procurement of replenishment spare parts for aircraft (Ref 31:18) and also on such items as motors for the Minuteman missiles.

Contractual Arrangements

Under the second sourcing technique, one firm usually performs the underlying research and development or the system may be designed by a laboratory or arsenal (Ref 16:11). The government contract for the development phases is commonly a cost-plus or incentive type contract because of the relative unpredictability of costs. The developer or original producer furnishes drawings, specifications and other technical information (the data package) to the government, which performs enough systems engineering to validate the data and transfer the technology to a new supplier (Ref 18:31).

"Competition can be obtained for the initial production run or for follow-on production contracts, or contracts at both stages" (Ref 16:11). Usually this is a negotiated price competition with firm fixed-price contracts, but there have been advertised procurements. Production by the original and second source producers may overlap in time with both producers maintaining production lines throughout much of the program, or one of the sources may drop out of the program with the award of the final contract (Ref 18:31). The final contract is normally awarded based solely on price.

<u>Advantages</u>

This strategy has the advantage of extending competition into the production phases of a system acquisition program through dissemination of the technical data package (Ref 26: 19-20). "Also, the government need not make long-term procurement commitments, but can procure on a year-to-year basis" (Ref 18:31). This gives the government greater flexibility and an atmosphere which closely resembles the open market place.

<u>Disadvantages</u>

There are two main disadvantages to the second sourcing procurement technique. First, an extensive engineering and technical staff must be maintained by the government to validate and support the data packages (Ref 26:20). This can be expensive and require a large, skilled staff of engineers and technical experts. Second, this technique requires a duplication of tooling and other set-up costs (Ref 18:31-32). To overcome these extra costs which diminish the benefits of competition, production runs must be large enough to absorb and amortize these costs. With small production runs or excessively high tooling and set-up costs, the second sourcing technique becomes prohibitively costly.

<u>Method of Technology Transfer</u>

As stated in Chapter I, the transfer of technology through data packages has serious limitations on the amount and complexity of technology that can effectively be transferred.

One researcher has identified several problems with data packages which surfaced in testimony before congressional committees. These problems include but are not limited to (1) cost of obtaining the data package, (2) worthless technical data due to design changes after the initial development of a system, (3) difficulty in obtaining and maintaining control of the data packages, (4) late delivery of the data package, (5) questions of data ownership and (6) problems of transferring the data because of differing company processes and vendors (Ref 3:142-3).

These problems can be categorized into three general types of difficulties: legal, economic and technological (Ref 14:2). The legal difficulties involved with data ownership can be overcome by the purchase of the proprietary data or by using performance specifications. The economic problems can be solved by a comprehensive cost-benefit analysis. If the whole system can not be adapted to the second sourcing procurement technique, then components of the system can be "broken out" for possible competitive purchase (Ref 26:19). The technological barrier is merely a matter of communication and requires a clear, concise data package. In cases of complex, sophisticated systems, qualified government technicians can assist the new producer during the initial learning and production stage (Ref 24:348-9).

However, each of these solutions result in additional costs to the government, either through direct outlays for the purchase of data or through increased manpower requirements for monitoring and assisting contractors. These costs can substantially reduce the benefits of a competitive posture. In addition, even with clear, concise data packages, new producers will probably have some difficulties in fabricating a system because of different production engineering approaches (Ref 24:348). These difficulties can cause increased costs and/or a late delivery schedule. Thus, the transfer of technology through data packages is generally inadequate except for low technology items.

Factors to Consider

Before a system acquisition program is adaptable to the second sourcing procurement technique, several factors or characteristics exhibited by the system must be considered. A complete analysis of these factors must be completed before a decision is made as to whether a specific system is suitable to a successful application of the second sourcing procurement technique.

Degree of Technology Required. As stated above, the more technologically complex an item or system is, the less likely it is that the procurement will be conducive to second sourcing. For a highly technical item, the extensive systems engineering required to validate the data package is very costly. In addition, no matter how comprehensive and concise, a data package can not transmit all of the knowledge and know-how gained through the development of a product by the original producer (Ref 15:2). Hence, for the second sourcing procurement technique to be effective, it should primarily be used with acquisition programs for systems requiring little technology and innovation.

<u>Extent of Proprietary Data</u>. Proprietary data significantly reduce an acquisition program's adaptability to the second sourcing technique (Ref 27:Attach 1, page 2). The government's data rights must be clearly delineated at the outset of the program to ensure all necessary specifications and methods are included in the data package. If the system is highly innovative or technologically complex, the cost to the government of the proprietary rights may outweigh the benefits of the increased competition provided by the second sourcing technique (Ref 28:22). A cost-benefit analysis of obtaining the proprietary data rights must be completed at the outset to determine if the second sourcing technique will be cost effective for a specific program.

In an effort to solve the problem of proprietary data, the Navy provides all available data to which the Navy has rights to prospective suppliers. In place of the design details for contractor proprietary items; form, fit and function specifications are customarily substituted (Ref 23:36). Although the Navy offers no assurance that production using the furnished data will yield a product that meets the required performance specifications, the firms have been able to bid effectively and produce the items without serious difficulty. However, these items have required relatively little innovation and were not technologically complex. In addition, this method can increase logistics costs if the items produced by the two sources are not interchangeable (Ref 17:7).

Contractor Capacity. The developer or prime contractor's productive capacity is an important consideration in employing the second sourcing technique (Ref 27:Attach 1, page 2). The normal situation is a required production quantity or rate that is greater than one firm can produce which usually forces the development of a second producer. However, the division of the production of an item or system between two firms can result in the loss of economies of scale for both firms if neither is producing at full capacity. The loss of economies of scale may result in the government paying higher overhead and general and administrative costs on all government contracts with these firms. Thus, an ideal program for the second sourcing technique calls for very large quantities to be produced over an extended period of time (Ref 27:Attach, page 3).

To solve the problem of contractor capacity, a minimum sustaining rate of production may be specified for each contractor (Ref 20:344). The minimum sustaining rate is the production rate required by each firm to maintain a cost effective production capacity. Although each firm would be quaranteed a specified portion of the production quantity to manitain production, the lowest bidder would receive the greatest quantity to be produced. As explained above, this method requires large quantities of the item to be produced.

Contractor Investment Requirements. The second sourcing technique requires two sets of capital investments in tooling and any other special facilities necessary for the production of a system (Ref 27:Attach 1, page 3). The production runs must be large enough to absorb these costs (Ref 16:32) or the potential benefits of competition will be lost. Thus systems which require costly tooling and other capital investment are less amenable to the second sourcing procurement technique than systems requiring less costly capital expenditures. Again, a cost-benefit analysis must be performed.

Production Lead Time. Long production lead times can negatively impact the use of the second sourcing technique on an acquisition program (Ref 27:Attach 1, page 3). The problems associated with on-time delivery require an accurate prediction of the required lead time and planning for the technology transfer (Ref 5:ix). Since long lead times tend to increase the cost of developing a new source (Ref 27:Attach 1, page 3) and increase the risk of late delivery, long lead times generally reduce the adaptability of an acquisition program to the second sourcing procurement technique.

Logistics Costs. Before adapting a system acquisition program to the second sourcing procurement technique, the impact on the logistics system is a consideration (Ref 27:Attach 1, page 3). The development of a second producer can affect the logistics costs involved with shipping the finished product to the user and also increase future logistics costs if the two producers do not manufacture identical systems (Ref 17:7). These two costsneed to be considered in the cost-benefit analysis of using the second sourcing technique.

Contractual Complexity. "The more complex the government's contractual relationship with a primary contractor, the less adaptable to second sourcing the program becomes" (Ref 27:Attach 1, page 3). Additional contractual responsibilities such as design to cost or reliability improvement warranties have a tendency to not only increase the costs of a program, but also increase the administrative workload of a program office. Further, the systems manufactured by each producer would have to be segregated to ensure compliance with the contractual terms, thus increasing logistics costs. Therefore, for the second sourcing technique to be effective, contractual complexity should be kept to a minimum.

Commercial Potential. If a system can be marketed commercially by a developer, the quantity and production rate demanded by the commercial market must be considered before adapting a program to the second sourcing technique. If the commercial demand is large enough, other firms will likely enter the market thus creating a competitive posture without government interference. However, if the commercial demand is not large enough to create two or more producers, the government must consider the total quantity and production rate requirements when evaluating a developer's capacity.

Amount and Type of Subcontracting. The amount and type of subcontracting employed by the original producer or developer is a consideration. If the developer is primarily an assembler where subcontractors provide the parts of a system for the developer to assemble, the cost reduction from a competitive posture is not likely to be as significant as if the producer manufactured all of the parts itself (Ref 27: Attach 1, page 3). Another consideration is the competitive posture of the subcontractors. If one subcontractor holds proprietary data to a key component or to several components, both producers will be forced to purchase components from a single firm, thus limiting competition.

Summary of Factors for Second Sourcing. Nine factors or characteristics of a system should be considered before a system acquisition program is adapted to the second sourcing procurement technique. These factors, along with the criteria to consider in evaluating each factor, are presented in Table I. Each of these factors should be considered as each can either negatively or positively affect the success of adapting a system acquisition program to the second sourcing procurement technique.

Technology Licensing

Background

Technology licensing, sometimes called direct licensing or separation and licensing, is a procurement technique originally proposed by Rand Corporation that emulates commercial technology transfer techniques (Ref 22:4-5). United States aerospace firms have been very active in transferring production technology to other firms using this procurement technique (Ref 22:4). "Technology licensing has been an important feature in various co-production programs ..." (Ref 18:27)

Table I

Second Sourcing Factors

Factor	Criteria to Consider
Degree of Technology Required	Technological complexity Systems engineering required
Extent of Proprietary Data	Cost of proprietary data Form, fit and function specifications Government data rights
Contractor Capacity	Required production quantity and rate Overhead and general and administrative cost increase Minimum sustaining rate
Contractor Investment Requirements	Cost of tooling and special facilities
Production Lead Time	Length of production lead time Accuracy of prediction of required lead time
Logistics Costs	Shipping cost changes Non-standardization of system
Contractual Complexity	Additional contractual responsibilities
Commercial Potential	Commercial demand Increase in production quantity and rate Independent development of a second producer
Amount and Type of Subcontracting	Developer resembles an assembler Proprietary data held by subcontractor Competitiveness of subcontractors

in which several thousand aircraft developed by firms in the United States have been manufactured by foreign firms that were not involved in the original development phases of the acquisition program. Carter, in a study on technology licensing, discussed several aircraft which have been successfully produced in other countries under licensing agreements. Included were the Lockheed F-104, the Sikorsky S-61, the Bell Model 205A and the McDonnell Douglas F-4E (Ref 5:20-53).

However, the technology licensing procurement technique has not been used by the Department of Defense in any major system acquisition programs (Ref 5:4) until recently. At the present time the Joint Cruise Missile Program Office is using the technology licensing concept to expand the production base for the production of cruise missile engines. Although expanding the production base is the primary objective of using the technology licensing technique, competition with the resulting lower costs is a secondary objective.

Contractual Arrangements

Under the technology licensing concept the firm that performs the underlying research and development "... would agree to license any other company designated by the government for the manufacture of any items of equipment developed" under the development contract (Ref 22:5). In addition to the normal drawings, specifications and method details, the developer or original producer would also be required to provide technical assistance to the licensee and would be paid royalties or some form of compensation for this service (Ref 26:20).

This royalty can be paid by either the government or the gaining producer, but should be specified in the original development contract (Ref 23:32-3) to avoid misunderstandings concerning data rights in the later production phases (Ref 23:35).

At the time of production and follow-on production orders, sufficient technical and manufacturing data would be disseminated to responsible prospective producers to allow them to prepare and submit pricing proposals (Ref 17:13). The developer would be forced to license the technology only if he failed to win the competition for a production contract (Ref 23:35).

The government contract for the development phases would commonly be cost-plus or incentive type contracts. These contracts would also include the royalty rates or compensation for technology transfer and could be either a lump sum payment or a percentage fee on the value of the system produced. The production contracts, on the other hand, should be firm fixed-price contracts since most of the uncertainity associated with the development phases will not be a consideration. After the initial production contract, all further contracts would normally be awarded based primarily on price.

Advantages

The technology licensing procurement technique, like the second sourcing technique, has the advantage of extending competition into the production phases of a system acquisition program through the transfer of technology. In addition to the benefits of increased competition, the technology licensing technique would (1) reduce government involvement with contractors in the technology transfer process (Ref 18:14), (2) reduce or avoid many of the problems with contractor proprietary data (Ref 17:13) and (3) reduce the data management and transfer costs associated with the second sourcing technique (Ref 23:38). The greatest advantage, however, is the reduction in costs as a consequence of a competitive posture which forces the producer from a monopoly position and encourages him to be an efficient producer (Ref 23:36).

Disadvantages

In a report on the feasibility of the technology licensing procurement technique prepared for a Senate subcommittee by the Comptroller General of the United States, this procurement technique was criticized on several points (Ref 10). The most serious drawback of technology licensing appears to be the time and cost necessary to transfer the technology from the developing firm to the new producing firm (Ref 16:13-14). Other disadvantages include a reluctance of firms to part with proprietary information (Ref 26:20) and a reluctance of firms to receive technological instruction from rival firms (Ref 22:11). Also, this strategy would be particularly vulnerable to "buy-ins" by competitors wanting to learn the trade secrets of the developing firm (Ref 26:20).

Method of Technology Transfer

As stated previously, the transfer of technology through technology licensing has been successfully accomplished under various co-production programs with foreign countries as well as in commercial programs. The technology licensing technique does not suffer from the lack of technical assistance characterized in the second sourcing concept. Instead, contractor reluctance to transfer the technology appears to be the greatest problem.

However, the same three general problems (legal, economic and technological) associated with the second sourcing technique of technology transfer also apply to technology licensing (Ref 14:2). But, unlike the second sourcing technique, each of these problems can be effectively overcome by employing sound contracting principles, cost-benefit analysis and adequate incentives to ensure the proper flow of technology between two firms (Ref 23:36).

Factors to Consider

Before a system acquisition program can be adapted to the technology licensing procurement technique, several factors or characteristics exhibited by the system must be analyzed. These factors are basically the same ones which were considered in applying the second sourcing technique.

Degree of Technology Required. Although the technology licensing concept is not limited by the lack of technical assistance or know-how supplied by the developer as in the second sourcing technique, there is some discussion as to the adaptability of a technically complex system to the technology licensing concept (Ref 5:11). The general consensus is that highly innovative systems would result in high royalty fees for the technical assistance. In turn, the high royalty fees would probably exceed the benefits gained through a competitive posture. Therefore, to evaluate the adaptability of a specific system to the technology licensing procurement technique, a cost-benefit analysis must be performed.

Extent of Proprietary Data. As in any procurement method the extent of proprietary data rights can significantly reduce a program's adaptability to the technology licensing technique. Contractors may be reluctant to supply needed information to other firms for fear of exposing "trade secrets" to competitors (Ref 5:10) while some firms may bid on programs primarily to obtain proprietary information on a contractor's design (Ref 5:11).

To solve this problem Johnson and McKie have proposed that components of a system that were developed at private expense and involve proprietary input would be purchased directly from the licensor (Ref 23:32). However, these items must be identified in the original development contract under present determination-of-rights policies (Ref 23:32). By using this method the government could ensure the rights of the developer while forcing the largest portion of the system into a competitive production situation.

Products could also be manufactured using form, fit and function specifications (Ref 23:36). As described in Chapter I, the item or system would be required to meet certain performance specifications but would not have to be identical to the developer's item or system. However, as with the second sourcing technique, problems with logistics may develop if there is more than one producer (Ref 17:7) and the items are not interchangeable.

The greatest problem with proprietary data appears to be contractor cooperation. Cooperation between licensor and licensee would be essential (Ref 5:11), especially when technologically complex systems are involved. However, "It is one thing to enter into an agreement with another company to produce all or part of your design for a fee, and quite another to be told by the government ..." (Ref 5:56) who will produce a system. For this reason firms that possess the know-how are not always anxious to hand over proprietary rights or knowledge to close competitors (Ref 23:34).

<u>Contractor Capacity</u>. The developer's productive capacity is not necessarily an important consideration when adapting a system to the technology licensing procurement technique. If one firm can produce the desired quantity and rate of the system at the lowest price including licensing fees, then it should receive the entire contract. With only one producer, the economies of scale gained through large production runs by one firm can decrease overhead costs for the government.

However, if the developing firm is also producing the system or two firms are to produce the desired system in parallel, the loss of economies of scale can force higher overhead and general and administrative rates on all government contracts with these firms. In this case the contractor capacity factor must be analyzed in the same manner as it was using the second sourcing technique.

<u>Contractor Investment Requirements</u>. The technology licensing procurement technique does not require two sets of capital investments in tooling and other special facilities as is required by the second sourcing technique (Ref 17:22) unless two firms are required to meet production quantity and rates. If the government has paid the developer for his tooling, this tooling can be transferred to the new producer as Government Furnished Equipment with only shipping costs to consider (Ref 5:90). If two sets of tooling and facilities are required, the contractor investment requirements should be evaluated using cost-benefit analysis as in the second sourcing technique.

<u>Production Lead Time</u>. As with the second sourcing technique, long production lead times can negatively impact the use of the technology licensing technique on an acquisition program (Ref 27:Attach 1, page 3). In a study on technology licensing by the Comptroller General of the United States, "interruptions to production" while the new producer is being qualified was a prime concern (Ref 10:49-50). However, this problem can be minimized by accurately estimating the necessary lead time to transfer the technology and establish a new production line by using multiple regression analysis on past systems of comparable characteristics and technological complexity (Ref 5:69-73). This problem "... reduces to one of obtaining an accurate prediction of the

required lead time and planning for production transfer" (Ref 5:ix).

Effect on Industry Initiative. There is some concern that technology licensing could stifle the development initiative of the industry because of reduced expectations of profits associated with production (Ref 5:11). These effects can be classified as either short term or long term.

In the short term industry initiative as to product improvement may be adversely affected if a production contract is not awarded to the developer. "The problem of deciding who should be responsible for product improvement and how he could be motivated is a very important one ..." (Ref 5:83) since many weapon systems evolve throughout the production phases of the acquisition process. An incentive to motivate the original designer or a producer to maintain design responsibility may be needed.

In the longer run the continued use of the technology licensing concept could negatively affect industry initiative through continual competitive pressure. This continued pressure could result in structural changes in the industry, an increase in the number of lawsuits, an attraction of marginal producers, an increase in development costs and an increase in the number of firms bidding only to obtain information (Ref 5:81-86). Before initiating a large scale use of technology licensing, the long term effects on industry initiative should be considered.

Other Factors. In addition to the factors listed above, several factors considered with the second sourcing technique must also be considered with the technology licensing technique, especially if two producers are involved. These factors include logistics costs, contractual complexity, commercial potential and the amount and type of subcontracting. The criteria to consider for each factor remains the same as for the second sourcing concept.

Summary of Factors for Technology Licensing. Ten factors or characteristics exhibited by a system should be considered before a system acquisition program is adapted to the technology licensing procurement technique. T~~hese~~ factors along with the criteria to consider are presented in Table II.

Leader/Follower

Introduction

Leader/follower procurement, sometimes called leader company procurement, is a special procurement technique that is defined in the Defense Acquisition Regulation (DAR). The technique, as described in the DAR is used to accomplish one or more of the following objectives:

(i) shortening the time for delivery;
(ii) establishing additional sources of supply for reasons such as geographical dispersion or broadening the production base;
(iii) making maximum use of scarce tooling or special equipment;
(iv) achieving economy in production;
(v) assuring uniformity and reliability in equipment performance, compatability or standardi-

Table II

Technology Licensing Factors

Factor	Criteria to Consider
Degree of Technology Required	Assistance by developer Complexity of system Royalty fees
Extent of Proprietary Data	Cost of proprietary data Items of a system involving proprietary data Form, fit and function specifications Cooperation between contractors
Contractor Capacity	Required production rate and quantity Economies of scale Overhead and general and administrative cost increases Minimum sustaining rate
Contractor Investment Requirements	Only if two producers are required Developer's tooling
Production Lead Time	Prediction of lead time
Effect on Industry Initiative	Short term: Product improvement Incentives Long term: Structural changes Lawsuits Marginal producers Development costs Bidding to obtain information
Logistics Costs	Shipping cost changes Non-standardization of system
Contractual Complexity	Additional contractual responsibilities
Commercial Potential	Commercial demand Increase in production quantity and rate Independent development of second producer
Amount and Type of Subcontracting	Developer resembles an assembler Proprietary data held by subcontractor Competitiveness of subcontractors

zation of components, and interchangeability of parts;

(vi) eliminating problems in use of proprietary data not amenable to other more satisfactory solutions; or

(vii) effecting transition from development to production and to subsequent competitive procurement of end items or of major components.
(Ref 11:Section 4, 4-703)

Recently, however, the leader/follower method of procurement has been proposed as a technique to introduce competition into the production phases of the system acquisition process (Ref 27:Attach 1, page 5; 7:353; 39:1-2; and 30:8-11).

Before adapting a system acquisition program to the leader/follower technique, each of the following circumstances which limit the use of the leader/follower procurement technique should be considered:

(i) the leader company possesses the necessary production know-how and is able to furnish the requisite assistance to the follower;

(ii) no source of supply (other than a leader company) would be able to meet the Government's requirements without the assistance of a lead company;

(iii) the assistance required of the leader company is limited to that which is essential to enable the follower company to produce the items; and

(iv) the government reserves the right to approve contracts between leader and follower companies.
(Ref 11:Section 4, 4-703)

Background

Unlike the second sourcing and technology licensing techniques, leader/follower procurement has been used by the government in the procurement of major, complex weapon systems. In the early 1950's Douglas Aircraft Company and Lockheed Aircraft Company produced some B-47's designed by Boeing Aircraft Company, and General Motors Corporation produced some F-84's designed by Republic Aircraft Company (Ref 5:3,6). In both cases the purpose of using the leader/follower procurement method was to broaden the production base and shorten delivery time because of Korean War and Cold War pressures for increased production. Since then, however, this technique has not been used by the Air Force to procure major weapon systems (Ref 5:8).

The Army has used an adaptation of the leader/follower technique to interject competition into its missile procurement. Using a combination of leader/follower procurement, options, "should cost" techniques and multi-year contracts; the Army has achieved savings of $36.4 million on the Shillelagh missile, $44.9 million on the TOW missile program (Ref 30:8) and an estimated savings of $90 million on the Dragon missile system (Ref 9:2). In each of these acquisition programs the Army established a second producer with the ultimate objective of a "winner take all" multi-year competition.

The Air Force has used the leader/follower technique in two recent small acquisition programs. The first, the GAU-8A 30mm ammunition program, had the primary objective of establishing and maintaining a defense mobilization base by sustaining two sources (Ref 20:344). Price competition was a secondary consequence of the program. The second program, the ACES II Ejection Seat program, had the primary purpose of establishing a competitive posture as soon as possible after the development phases of the acquisition program (Ref 7:353).

Contractual Arrangements

Under the leader/follower concept the firm that performs the research and development agrees to supply technical assistance to another firm to enable the new firm to qualify as a responsible producer. The DAR lists three different procedures for contractual relationships:

(a) One procedure is to award a prime contract to an established source (leader company) in which the source is obligated to subcontract a designated portion of the total number of end items required to a specified subcontractor (follower company) and to assist the follower company in that production.

(b) A second procedure is to award a prime contract to the leader company for the requisite assistance to the follower company, and another prime contract to the follower company for production of the items.

(c) A third procedure is to award a prime contract to the follower company for the items, under which the follower company is obligated to subcontract with a designated leader company for the requisite assistance.

(Ref 11:Section 4, 4-703)

After the second producer is fully qualified and can compete on an equal footing with the developer, the government provides for a limited competitive procurement between the two producers (Ref 9:6). After the limited competitive purchases, the remaining items to be produced are combined into a multi-year procurement contract (Ref 30:9) with the producer submitting the lowest price proposal receiving the last contract. After the second producer is fully qualified, all contracts are normally firm fixed-price contracts.

Comparison with Other Techniques

The leader/follower method exhibits some of the characteristics of both the second sourcing and technology licensing techniques of procurement. By comparing the structure of the leader/follower strategy with the second sourcing and technology licensing concepts, the advantages, disadvantages and factors to consider can be discerned for the leader/follower technique.

Advantages. The leader/follower method has the advantage of extending competition into the production phases of a system acquisition program (Ref 7:353) through the transfer of technology and know-how in a manner analagous to the technology licensing technique. This method of technology transfer reduces government involvement in the transfer process, reduces the data management and systems engineering costs and alleviates many of the problems with contractor proprietary data.

Disadvantages. However, the use of the leader/follower method requires duplicate tooling and set-up costs and a large volume of production (Ref 30:8) like the second sourcing technique. In addition, the method of technology transfer can increase the time and cost necessary to qualify a second producer, and contractor cooperation may be difficult to acquire.

Factors to Consider. Because of the similarities of these three procurement methods, the factors that must be exhibited by a system before an acquisition program can be successfully adapted to the leader/follower procurement technique are essentially the same as for the second sourcing and technology licensing techniques. Two of these factors, a large volume of production and cooperation between contractors,

Table III

Leader/Follower Factors

Factor	Primary Analagous Technique
Production Quantity and Rate	Second Sourcing
Degree of Technology Required	Technology Licensing
Extent of Proprietary Data	Technology Licensing
Contractor Capacity	Second Sourcing
Contractor Investment Requirements	Second Sourcing
Production Lead Time	Technology Licensing
Contractor Cooperation	Technology Licensing
Effect on Industry Initiative	Technology Licensing
Logistics Costs	Second Sourcing
Contractual Complexity	Second Sourcing
Commercial Potential	Second Sourcing
Amount and Type of Subcontracting	Second Sourcing

are particularly essential for an acquisition program to use the leader/follower procurement technique. The factors to consider before adapting a system acquisition program to the leader/follower technique, along with the primary analagous procurement technique which also utilized these factors, are listed in Table III.

Summary

This chapter presented an analysis of three proposed procurement techniques (second sourcing, technology licensing and leader/follower) to introduce competition into the production phases of a system acquisition program. Each technique was examined for advantages, disadvantages, method of technology transfer and factors to consider before adapting a program to one of the techniques. The factors to consider were evaluated as to their impact upon the cost and timely delivery schedule of an acquisition program.

Second Sourcing

The second sourcing technique has been used primarily for reprocurement actions. This strategy can extend competition into the production phases of a system acquisition program and can reduce the need to make long-term procurement commitments. On the other hand, this strategy requires an extensive government engineering and technical staff and a duplication of tooling and other set-up costs.

The second sourcing technique employs data packages to transfer technology from one firm to another. The data packages are generally inadequate as technology transfer agents because of legal, economic and technological problems. Even if these problems are overcome, the transfer of technology is likely to be difficult because of different manufacturing techniques among producers. Thus, this method of transferring technology should only be used for low technology items.

Nine factors or characteristics of a system should be considered before a system acquisition program is adapted to the second sourcing procurement technique. Each of these factors along with the criteria to consider with each factor is presented in Table I.

<u>Technology Licensing</u>

Technology licensing is a procurement technique used by commercial firms and has been used extensively in co-production ventures. This concept also extends competition into the production phases of an acquisition program. In addition, this strategy reduces government involvement, proprietary data problems and technology transfer costs associated with the second sourcing technique. However, technology licensing can be a time consuming and costly method of technology transfer and contractor cooperation may be difficult to obtain.

The method of technology transfer includes a data package and also technical assistance by the developer to aid a new producer. Even though legal, economic and technological problems are associated with this technique, each problem can be effectively overcome by sound contracting principles, cost-benefit analysis or adequate incentives.

Ten factors or characteristics exhibited by a system should be considered before a system acquisition program is adapted to the technology licensing procurement technique. These factors are presented in Table II.

<u>Leader/Follower</u>

The leader/follower procurement method has rarely been used as a technique to establish a competitive posture in a system acquisition program. However, by comparing the structure of the leader/follower technique with that of the second sourcing and technology licensing techniques, the advantages, disadvantages and factors to consider can be discerned for the leader/follower technique.

The leader/follower concept employs the same technology transfer method as the technology licensing concept but requires duplicate tooling and set-up costs analagous to the second sourcing technique.

Because of the similarities of these three methods, the factors to consider before adapting an acquisition program to the leader/follower technique are essentially the same as for the other two methods. These factors are listed in Table III.

III. ANALYSIS OF THE ACES II PROGRAM

Introduction

Aircraft ejection seats have experienced an evolutionary development over the past decade to meet the requirements of the new generation of fighter and ground support aircraft. This research and development has successfully resulted in the Air Force High Technology Ejection Seat which is presently being installed in all F-15, F-16 and A-10 new production aircraft. The new ejection seat is also slated to be retrofitted in these aircraft which are already operational (Ref 27:Attach 3, page 1).

The Air Force High Technology Ejection Seat, commonly called the Advanced Concept Ejection Seat (ACES II), acquisition program represents an unique effort to provide future competition in the production phases of a program by employing the leader/follower procurement technique. Although this program is far from completed, valuable insight into the application of the leader/follower procurement concept to a system acquisition program can be gained by analyzing the factors and guidelines which were considered before and during the implementation of this concept to the ACES II program.

This chapter presents a case analysis of the ACES II program. This analysis focuses on the factors which the program managers considered in implementing the leader/follower concept and lessons learned for application to future programs.

In addition, the factors that were derived in Chapter II are analyzed in relation to the ACES II program to determine if they are applicable in this case and if the program managers considered these factors before adapting the program to the leader/follower procurement technique.

Program Background

Purpose of Program

The primary purpose of the ACES II program is to standardize the new lifesaving fighter and ground support aircraft escape systems. This concept of standardization is expected to provide significant logistics benefits and permit large quantity purchases to be supplied to the aircraft prime contractors as Government Furnished Equipment (Ref 7:353). These large quantity purchases in turn require a substantial production run in order to satisfy the combined A-10, F-15 and F-16 aircraft production quantities and rates.

Desire for Competition

Since large quantity purchases are necessary and a lengthy production run is anticipated, the Air Force considered it highly desirable to introduce a continuing competitive pressure on the firm(s) selected to produce the ACES II ejection seat. To accomplish this continual competitive pressure and concurrently maintain standardization, qualification of a second firm to produce ejection seats identical to the original selected design was necessary. After considering the second sourcing procurement technique, the program managers abandoned this approach as a consequence of the risk of transferring manufacturing technology through data packages which could result in schedule delays and higher tooling and production costs (Ref 7:353). Instead, a plan to use the leader/follower procurement technique to introduce competition into the production phases of the ACES II program was devised.

Development Phases

The Standardized High Technology Ejection Seat is the result of much sole source development by Douglas Aircraft Company with the final configuration accomplished as a consequence of a competitively awarded production contract (Ref 27:Attach 3, page 1). The development phases of the acquisition program were conducted in a competitive "test-before-you-buy" posture with two firms constructing prototypes and competing for the initial production contract (Ref 32:2).

Source Selection

Leader Company. The leader company, Douglas Aircraft Company, was selected using formal source selection procedures as outlined in Air Force Regulation 70-15. The competition was limited to those firms who had previously completed an ejection seat for the "seat test program". The decision to select Douglas Aircraft Company was based upon technical, cost, life-cycle cost and schedule considerations as well as the contractor's willingness to participate in the leader/follower method of procurement (Ref 32:2).

Follower Company. The follower company, Weber Aircraft Company, was selected by the leader firm subject to the concurrence of the Air Force. The leader's decision to select Weber Aircraft Company was based on source selection procedures emphasizing cost, technical and schedule areas (Ref 32:2).

Qualification of Follower

To qualify the follower company, Douglas Aircraft Company subcontracted to Weber Aircraft Company the quantity of seats (four) required by the Air Force to demonstrate a capability to manufacture the ACES II ejection seat and to complete a quality test program. After the four qualification seats were fabricated by the follower company through the aid of the technology and know-how supplied by Douglas Aircraft Company, the seats were subjected to the quality control procedures of the leader company. Before the follower company was issued final certification of qualification, the four seats were subjected to the United States Air Force sled tests (Ref 32:2).

The fabrication of the qualification seats and subsequent qualification testing required eighteen months after which the follower was assumed to be "technically competitive." However, the program office will not consider the follower company "fully competitive" from a pricing standpoint until it has completed at least on production run (Ref 32:2).

Contractual Arrangements

Leader Company. The leader company, Douglas Aircraft Company, was awarded a fixed-price incentive fee contract in fiscal year 1977 for the first basic production award of 286 ejection seats. The contract is detailed:

Target Cost	-	$12.6 million
Target Profit	-	$ 1.3 million
Target Price	-	$13.9 million (Ref 32:3)

Included in the total price was $1.5 million to qualify the follower company. The contract included various options for an additional 1680 seats which could increase the contract to over $60 million.

Follower Company. The follower company, Weber Aircraft Company, was awarded a firm fixed-price contract for $.435 million to produce four ejection seats, with assistance from Douglas Aircraft Company, for qualification purposes (Ref 32:3). No other contracts have been issued to Weber Aircraft Company and the Air Force has made it clear to the follower that there is no future obligation for further production contracts (Ref 27:Attach 3, page 1).

Program to Date

Leader Company. Up to this point, in addition to producing the original 286 ejection seats, Douglas Aircraft Company has been awarded firm fixed-price contracts for the production of 441 seats in fiscal year 1977, 562 seats in fiscal year 1978 and 661 seats in fiscal year 1979. During this same period, the leader company also complied with the original contractual requirement to select and qualify a follower company (Ref 27:Attach 3, page 1).

Follower Company. Weber Aircraft Company, with the assistance of Douglas Aircraft Company, has successfully qualified as a producer of the ACES II ejection seat. However, "Weber has not yet been given the opportunity to demonstrate that it can successfully produce production run quantities of this seat" (Ref 27:Attach 3, page 1).

Future Outlook

The program office is presently evaluating alternatives for the fiscal year 1980 purchase and requirements for fiscal years 1981 through 1985. The purchase requirements are estimated to be 550 ejection seats for fiscal year 1980 and 1300 ejection seats spread over the next five years (Ref 27:Attach 3, page 1).

A prime factor driving the source selection process is the estimated $3.5 million required to tool up Weber Aircraft Company, the follower, for a production run (Ref 27:Attach 3, page 1). The program office is presently analyzing the proposals of Douglas Aircraft Company and Weber Aircraft Company for future production contracts to determine the most economical path considering the risk involved.

Decision Model Used

The decision to employ the leader/follower technique on the ACES II program was based upon a subjective determination that substantial economic benefits would be realized by being in a competitive posture for procuring the ejection seats through the 1980's (Ref 32:4). The savings realized from competition were determined to more than compensate for the initial costs to qualify the follower company, government test costs, and the higher initial follower company costs for tooling and learning (Ref 27:Attach 3, page 3).

Quantity

At the time of the decision to adapt the ACES II program to the leader/follower procurement technique, the Air Force had known requirements of 2500 ejection seats (Ref 27:Attach 3, page 1). There were also possibilities of retrofitting the seat to other Air Force aircraft plus foreign sales and other service adoption of the new ejection seat. However, to remain on the conservative side, only the original 2500 ejection seats were used in the cost-benefit analysis.

Price

The price for the first buy of seats was estimated to be approximately $50,000 (Ref 27:Attach 3, page 2). Using this price and an estimated learning curve rate, the program office was able to predict an approximate total cost for the program when using only one production source.

Cost of Competition

To determine the cost of providing a second producer, the program managers considered three main areas which could initially increase the cost of the ACES II program.

Qualifying Costs. The cost to qualify the follower was determined to be approximately $1.5 million. This included payment to the leader company to transfer technology and know-how as well as payment to the follower company for producing the qualification quantity less the unit price for each seat produced by the follower.

Extra Government Quality Test Costs. The qualification of an additional producer required extra test costs during the qualification period of the follower company. In this case the cost of performing the Air Force sled tests on the four qualification seats of the follower company was added to the cost of developing a competitive posture.

Initial Tooling and Learning Costs. Since the leader/follower requires a duplication of tooling and other set-up costs, the program managers had to add this cost to the cost of developing competition. After performing an economic analysis, the program managers estimated the tooling, start-up and learning costs for the follower company to be $3.5 million.

Final Decision*

After performing all of the requisite analyses to determine the costs of competition, the total cost to establish the desired competitive pressure was calculated by summing the above three costs. By comparing this total cost of competition with the estimated cost of the program if utilizing only one producer, the percent increase in costs to establish competition was calculated to be five and one-half percent. Thus, a reduction in the cost of the program of five and one-half percent through competition would be necessary to offset the investment of establishing a second producer (Ref 27:Attach 3, page 2). Since this five and one-half percent increase in costs was considerably less than the estimated savings of

*Total cost data are not available since the contract is still active.

twenty-five to thirty percent through competition, the decision to establish a competitive posture using the leader/follower procurement technique was finalized.

Factors Considered

The factors that the ACES II program management staff considered before applying the leader/follower procurement technique to this specific program include several of the factors proposed in Chapter II. The managers also considered some new factors not considered previously. The following paragraphs summarize these factors and how they were considered.

Proposed Factors

Production Quantity and Rate. Initially, the planned requirements for ejection seats necessitated large quantity purchases over an extended period of time. The production rate required to manufacture the required quantity of seats exceeded the estimated production capacity of a single firm. This characteristic of the program indicated the necessity for developing a second source. However, since the first purchase, budgetary reductions in the aircraft programs have reduced the required production rate to consequently allow one firm to meet the required rate.

Degree of Technology Required. The ejection seat is one of moderate complexity. Several firms have the necessary technology to fabricate the ejection seat and have built similar seats or components in the past (Ref 27:Attach 3, page 2). Nevertheless, the desire for standardization of the ejection seats in Air Force aircraft requires identical seats to the selected design, which makes the transfer of technology risky without the developer providing know-how expertise. These facts support the application of the leader/follower technique over the second sourcing technique.

Extent of Proprietary Data. In the ACES II program the government has sponsored the ejection seat development and thus holds considerable rights to the data. In addition, special attention in forming the Request for Proposal for the first production contract concerning legal rights to the data negated any further problems with proprietary information (Ref 7:353-54).

Contractor Capacity. As originally planned, no one firm would be able to produce the total requirements of the program at the desired rate. However, neither firm would necessarily be performing at full capacity either. Although this situation reduces the economies of scale possible with one large producer, the program managers considered the increased competitive posture economically preferential to possible gains from economies of scale. The possible increased overhead and general and administrative rates resulting from the loss of economies of scale were considered in the ACES II program. The resultant increased costs for other government programs were included as costs of the ACES II program for cost analysis purposes (Ref 33).

Contractor Investment Requirements. The start-up and tooling costs for the second producer were subjected to a cost-benefit analysis to determine if the costs of the duplicate tooling and initial learning requirements of the follower company were less than the possible benefits of competition. The capital requirements for this program are not excessively high (Ref 27:Attach 3, page 2) and are estimated at less than three percent of the total program cost. The low investment requirements coupled with a favorable cost-benefit analysis indicate that the leader/follower procurement technique would be beneficial to the Air Force in this case.

Production Lead Time. The estimated production lead time of eighteen months to qualify a second producer was not considered excessive by the program managers (Ref 27:Attach 3, page 3). However, as originally planned, the schedule, though somewhat flexible, did depend on qualifying a second producer to meet the future production rate. To reduce the risk of delaying the scheduled delivery of ejection seats caused by transferring technology to a new producer (Ref 7: 353), the program managers selected the leader/follower procurement technique over the second sourcing technique.

Contractor Cooperation. To ensure that the leader qualified the second producer, a source selection plan and incentive program were devised. If the leader is not producing at full capacity, his vested interests would be enhanced by failure of the follower to qualify as a second producer.

Thus the selection and qualification of the follower must be controlled by the government to guarantee that a responsible second producer is developed.

Three different methods of source selection were assessed: (1) directed by the government based on known capabilities; (2) selected by the leader company under acceptable controls; or (3) otherwise selected by the government through competition (Ref 7:354). After considering each of these methods, the program office selected the method involving selection of the follower by the leader company with the concurrence of the program office. This decision was based on the leader retaining the responsibility for the performance of the follower during qualification.

Several incentives were considered to ensure actual implementation of the qualification process by the leader subsequent to the selection and award of a contract for production. The traditional positive and negative incentives were considered; however, all seemed to be ineffective in this situation. Positive incentives would reduce the benefits of competition while the negative incentives could result in termination of the program for default (Ref 7:354). To avoid these problems, the program office focused on contract financing as an incentive to force the leader to perform. This was done by relating all progress payments for the leader under the original production contract to a milestone schedule of leader/follower events in the Request for Proposal.

Effect on Industry Initiative. The use of the leader/follower procurement method in the ACES II program apparently has had no long term effects on industry initiative to design and develop future ejection seats and escape systems since several firms in the industry are still building similar seats or components. The industry if very competitive in this area and the highly competitive posture of the development phases indicated a desire to participate in this program, even with no guarantee of long term production contracts.

The possible short term effects involving product improvement were solved by assigning the responsibility for all Engineering Change Proposals to the leader company (Ref 33). By assigning this responsibility to the leader company, the program office ensures standardization of the ejection seats while giving the primary developer a chance to improve the product.

Logistics Costs. Future logistics costs were not a factor in this program since the ejection seats fabricated by both firms are to be identical. The difference in the costs of shipping the seats from the leader and the follower companies to the aircraft assembly plants was not considered in the decision model since the second producer was unknown when the decision was finalized.

Commercial Potential of the System. The ACES II ejection seat has no commercial potential and was not a consideration in this program.

Contractual Complexity. Contractual complexity was kept to a minimum in the ACES II program (Ref 27:Attach 3, page 3). The contractual complexity was kept low by issuing a reasonable and through Statement of Work for the follower company and a comprehensive Request for Proposal for the first production contract.

Amount and Type of Subcontracting. Approximately one-half of the components involved in fabricating the ejection seats are subcontracted items. A portion of these components are produced by sole source subcontractors and some are produced by competitive subcontractors (Ref 33). However, the ACES II program managers did not consider the amount and type of subcontracting as a barrier for employing the leader/follower technique in this program.

New Factors

Competition in Development Phases. The ACES II program management staff considered the competitive forces maintained throughout the development phases of the program as a primary key to the employment of the leader/follower procurement concept (Ref 7:353). The leverage provided by the highly competitive posture of the initial production competition motivated the selected contractor to participate in this program even though the leader/follower concept forces the leader to aid a possible future competitor (the follower). Without this competition in the early phases of an acquisition program, it is doubtful a contractor would accept the leader/follower concept to develop his own future competition when he is in a monopoly position.

Definitive Request for Proposal and Statement of Work. The program management team considered a definitive Request for Proposal and realistic Statement of Work requisites to implement a viable leader/follower program (Ref 7:354). The Request for Proposal must thoroughly clarify such items as legal data rights, the leader company's responsibilities in relation to the follower, incentives for the leader company to maintain an acceptable performance level and a source selection plan subject to the approval of the government. The Statement of Work should reflect minimal requirements in order to avoid increased qualification costs, especially for the follower.

Lessons Learned

During the progress of the ACES II program several lessons have been learned concerning the application and administration of a contract involving the leader/follower procurement technique. These lessons can be used as guidelines for future applications of the leader/follower concept in a system acquisition program.

Planning Step

Estimate of Quantity Requirements. The accuracy of the cost-benefit analysis hinges on the accuracy of projected future quantity requirements (Ref 32:4). Any reduction in the original requirements, such as through budgetary cuts, will reduce the total benefits of a competitive posture for a system acquisition program.

Program Layout. After the decision is made to use the leader/follower procurement approach in an acquisition program, a plan should be designed to illustrate the entire leader/follower program from the onset to completion of the program (Ref 32:4). This layout should include options at different points in the program and include plans for a buy-out.

Solicitation and Source Selection Steps

Implementation Timing. The best "... chance for implementing a meaningful leader/follower program is on the first competitive production buy" (Ref 32:4). This is the point in an acquisition program's life in which prospective contractors are most likely to accept the leader/follower procurement concept as a consequence of receiving a production contract.

Government Concurrence with Follower. The buying office must retain the right to concur with the selection of the follower company (Ref 32:4). This concurrence factor ensures that the follower company which is selected will be a responsible firm which can provide a future competitive force, thus forcing the leader into a competitive situation.

The government should closely monitor the source selection procedures used by the leader company to select the follower. This includes a thorough review of the source selection plan, the Request for Proposal, the evaluation criteria and source selection briefings (Ref 32:4).

Leader Responsibility. The leader company must recognize that the qualification of the follower company is its responsibility (Ref 32:4). The qualification of a follower is a part of the production contract for the leader company and is not just an optional part of the contract.

Contract Award and Administration

Incentives for Leader. To provide an incentive for the leader company to cooperate with the follower, the leader company's progress payments should be linked to the follower company's progress (Ref 32:4). Since progress payments are a primary method of contract financing for contractors, they are very effective in ensuring the transfer of technology from the leader to the follower company.

Government Contact with Follower. Government contact with the follower company should be kept to a minimum consistent with sound monitoring practices (Ref 32:4). To avoid claims of government interference and requests for contract changes from the leader company, government contact with the follower should first go through the leader company.

Conclusion

The ultimate success of the ACES II program is uncertain at this point. All program costs and scheduled events up to now have been well within the estimated tolerance band even though the follower company has not been given the opportunity to demonstrate that it can successfully manufacture production run quantities of the ejection seat. It is very difficult, if not impossible, to estimate the affect that the existence of this potential supplier has had on the price requested by the leader company. "The final success of this leader/follower test case will be determined when the judgement can be made that effective competition provided ejection seats of requisite quality, when needed and at costs clearly recognizable as advantageous" to the government (Ref 7:355).

Summary

The ACES II acquisition program represents an unique effort by the Air Force to provide competition in the production phases of an acquisition program by employing the leader/follower procurement technique. Although the program is incomplete at the time of this study, several important factors concerning the implementation of the leader/follower concept have been identified.

The purpose of the ACES II program is to standardize new lifesaving ejection seats in fighter and ground support aircraft. This standardization will result in the requirement for the production of the ejection seat in large quantities which makes the introduction of a competitive force highly desirable. The leader/follower procurement concept was used as a tool to develop the competitive force.

The ACES II ejection seat was developed under a competitive "test-before-you-buy" posture with two firms participating in the competition for the initial production contract. Douglas Aircraft Company was selected as the leader company, and, in turn, selected Weber Aircraft Company as the follower company subject to the concurrence of the Air Force. The leader company then qualified the follower company to produce identical ejection seats.

Up to this point Douglas Aircraft Company has produced 1950 ejection seats during a four year period, while Weber Aircraft Company has fabricated only four qualification seats. The ACES II program office is now evaluating alternatives for the next production buy.

The decision model used to justify the use of the leader/follower technique involved a cost-benefit analysis of developing a second producer to provide competition. Factors used in the cost-benefit analysis were quantity of seats required, estimated unit price of the first buy, qualifying costs of the follower company, government test costs and initial tooling and learning costs for the follower company.

The factors considered by the ACES II program managers before employing the leader/follower procurement technique included most of the factors developed in Chapter II. The factors primarily taken into account were production quantity and rate, degree of technology required, extent of proprietary data, contractor capacity, contractor investment requirements, production lead time, contractor cooperation and contractual complexity. The factors either not considered or not applicable to this program were commercial potential of the system, effect on industry initiative, and amount and type of subcontracting. In addition, the program managers advocated two factors (competition in development phases and definitive Request for Proposal and Statement of Work) not previously proposed as essential considerations for the successful application of the leader/follower procurement technique to a systems acquisition program.

Since the leader/follower procurement technique was initiated in the ACES II program, several valuable lessons have been learned for application to future programs. These lessons include the necessity for accuracy in estimating quantity requirements, the need for a program layout from the onset, the timing for implementation of the leader/follower concept, government concurrence with the selection process, minimum contact with the follower company, and the need to establish incentives and responsibilities for the leader company.

The final success of the leader/follower procurement technique as used in the ACES II program is unknown at this point. The success of the program will be determined by a final analysis of cost, product quality and timely delivery considerations.

IV. DEVELOPMENT OF A MODEL

Introduction

The United States Air Force has had very limited experience with the leader/follower procurement technique as a strategy to increase competition in a system acquisition program. This lack of experience, coupled with the limited set of guidelines concerning the circumstances under which an acquisition program can be adapted to the leader/follower concept, has led several program managers to request a decision model to ascertain if the application of this technique to a specific acquisition program is beneficial as well as feasible.

This chapter presents a comprehensive model to determine if a specific acquisition program can be successfully adapted to the leader/follower procurement technique to introduce competition into the production phases of an acquisition program. The model is formulated from the various factors identified in the two previous chapters as criteria which should be considered before adapting an acquisition program to the leader/follower concept. This model is developed and formulated using a systems theory approach with a primary focus on the uniobjective modeling technique of cost-benefit analysis.

The model is presented by narrative and visual display to provide an integrated view of the application of the leader/follower concept to a specific acquisition program. The model is intended to aid program managers and contracting officers in identifying the critical factors exhibited by a system which should be considered before adapting an acquisition program to the leader/follower technique. In turn these factors are integrated to form a decision model to determine the adaptability of a specific acquisition program to the leader/follower technique. This decision model embodies evaluation procedures to permit the manager a choice between using the leader/follower technique or sole source procurement alternatives.

Model Development

In Chapters II and III fourteen factors were developed that should be considered before a system can be successfully adapted to the leader/follower procurement technique. These factors can be placed into three categories (critical factors in the planning step, economic factors in the planning step and factors in the solicitation and selection steps) that should be considered during the initial steps of the procurement process. These three categories are not mutually exclusive as the interactions of the various factors must be considered. In addition, several potential long term effects on the industry and on the government acquisition process should be considered prior to instituting the leader/follower procurement technique on a large scale within the Department of Defense.

In formulating this model the government is assumed to have a choice between systems that have been developed by different contractors. The primary intended use of the model is to provide a decision model which will enable the decision-maker to evaluate the adaptability of a specific system to the leader/follower concept after the system has been chosen by the government. However, the model can also be used to evaluate the adaptability of each system under consideration prior to the source selection in the system acquisition process.

Although this model tends to focus on costs, on-time delivery and quality of the product must be kept in mind as the manager progresses through each step of the model. The quality of the product can be controlled through quality control and testing procedures, but if these procedures are extensive, the risk of high costs and late delivery is increased.

Critical Factors in the Model

The critical factors in the planning step of the procurement process are defined as those factors exhibited by a system which must be considered to determine if a system acquisition program can be adapted to the leader/follower procurement technique. Satisfaction of these factors does not economically justify the use of the leader/follower concept, but the fulfillment of these factors supports the premise that a specific system is adaptable to the leader/follower procurement technique.

The critical factors and the criteria to be considered with each factor are presented in Table IV. Each factor may be considered independently of the other factors and the criteria for each factor must be satisfied before a program can be adapted to the leader/follower concept.

By using these critical factors as inputs, a decision model can be formulated to determine if a specific system is adaptable to the leader/follower procurement technique. This decision model is presented in Figure 2.

This adaptability decision model is depicted by a flow diagram with the seven critical factors used as inputs. To employ this model the decision-maker is forced to make decisions concerning the system and the environment surrounding the system at several different points in the model. Each decision point represents a dichotomous (yes/no) choice, and the decision-maker is required to separate the actual data into dichotomous responses. As the decision-maker progresses through the decision model, the model will yield the decision of whether a system is adaptable to the leader/follower procurement technique or sole source procurement should be used.

Economic Factors in the Model

After determining that a system is adaptable to the leader/follower procurement technique, a cost-benefit analysis must be accomplished to determine if the benefits of a competitive posture outweigh the costs of developing a second producer. The economic feasibility of using the leader/follower procurement concept can only be justified through a thorough and comprehensive cost-benefit analysis.

The economic factors and the criteria to be considered

Table IV

Critical Factors and Criteria

Critical Factor	Criteria to Consider
Production Quantity and Rate	What is the total production requirement? What is the required production rate to meet schedule requirements?
Contractor Capacity	How much can the developer produce? Does the developer have the required capacity to meet production requirements?
Commercial Potential	Does the system have a commercial potential? Will commercial demand for the system cause development of a second source? What is the estimated increase in quantity and rate requirements from commercial potential?
Degree of Technology Required	How innovative is the system? Can the technology be transferred? How widespread is knowledge of the technology in the industry? What risk is involved in transferring the technology?
Extent of Proprietary Data	Who owns the data rights? How reluctant is the developer to part with proprietary information? Can the legal rights issue be circumvented?
Production Lead Time	How long is the lead time necessary to qualify a second producer? Can a second producer be qualified in time to provide a competitive force? How schedule dependent is the program? What risk is involved if a second producer fails to qualify?
Contractor Cooperation	Will the developer cooperate to transfer technology and know-how? Can contractors be induced to cooperate through incentives such as progress payments or political pressure?

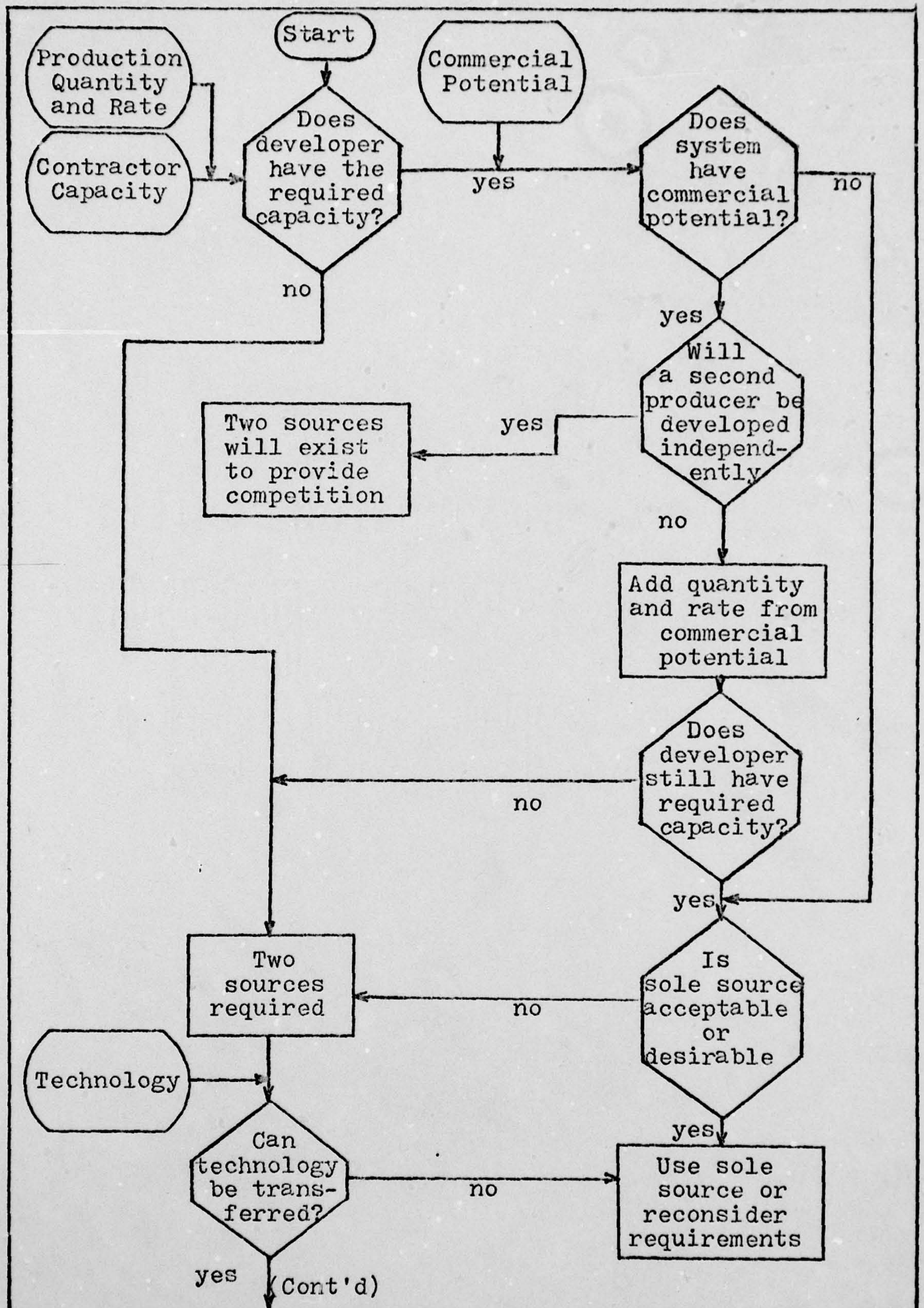

Figure 2. Decision Model to Determine Adaptability

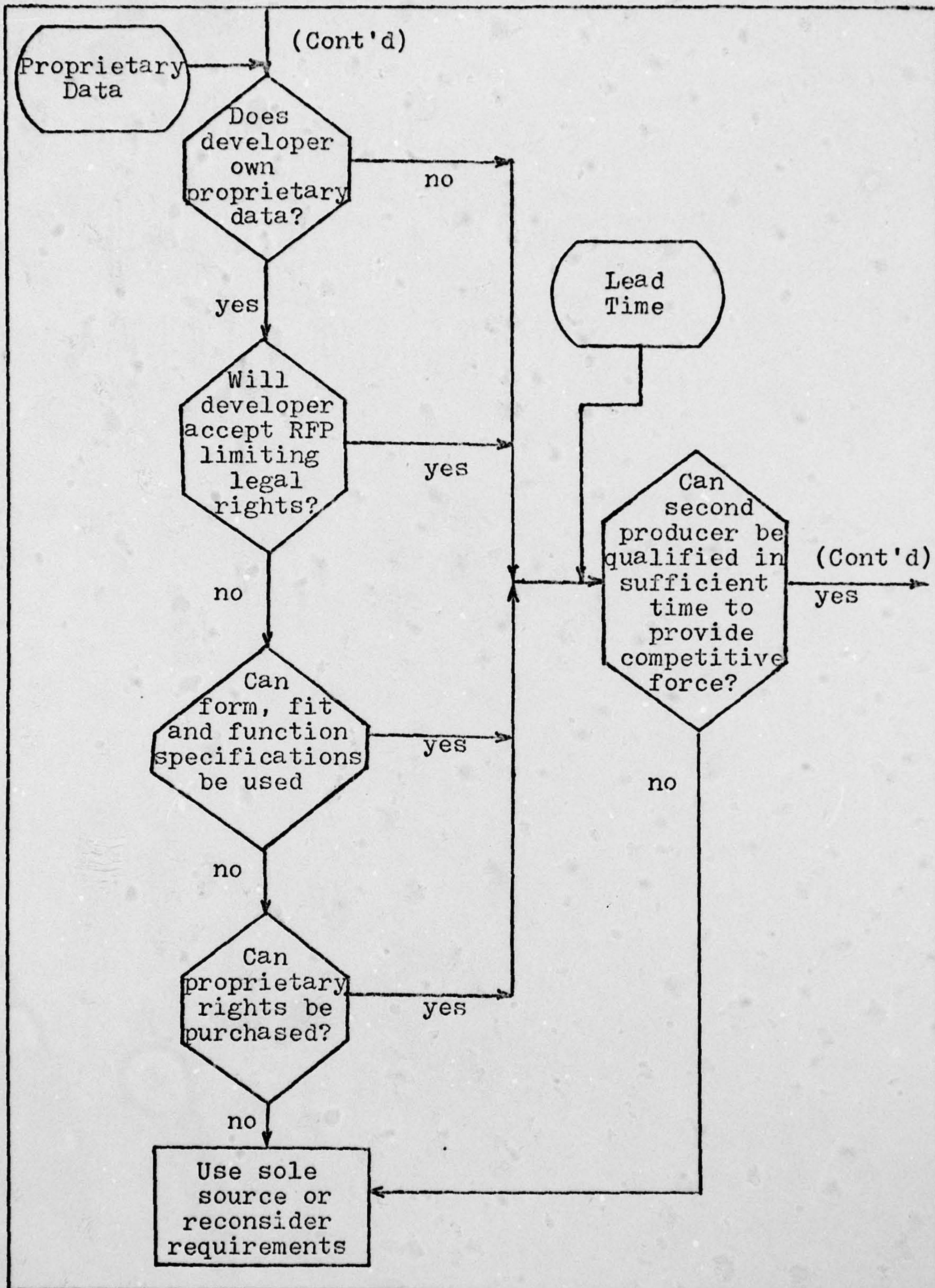

Figure 2. Decision Model to Determine Adaptability

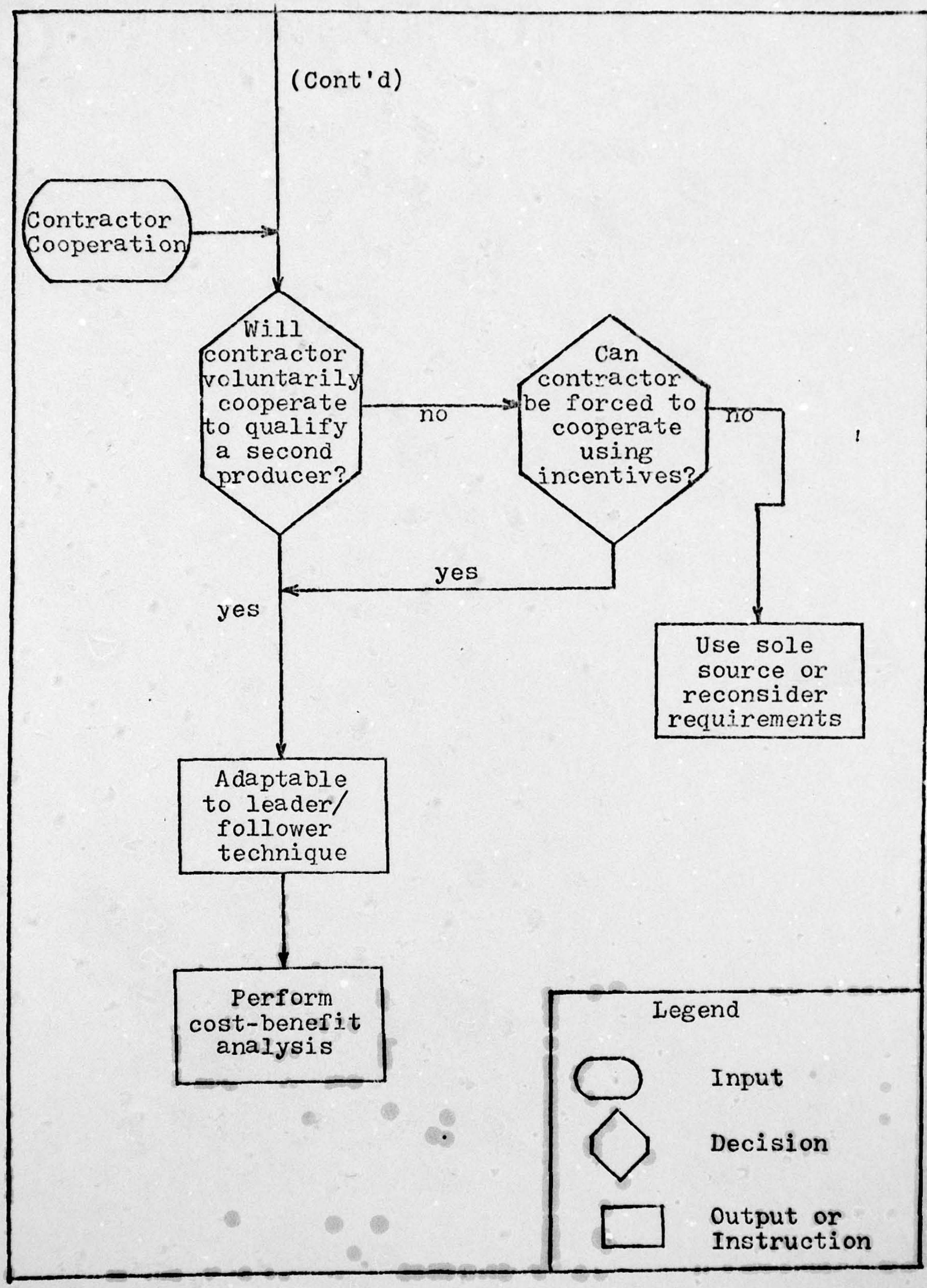

Figure 2. Decision Model to Determine Adaptability

with each factor are presented in Table V. As with the critical factors, the economic factors may be considered independently, but interrelationships between factors and interactions with the system as a whole must also be considered.

The economic factors presented in Table V can be combined into an economic decision model (Figure 3) to determine the cost of establishing a competitive posture using the leader/follower procurement technique in a system acquisition program. This cost of competition is compared to the estimated cost of the program using sole source procurement, which can be computed using parametric costing techniques and applying the concepts of learning curve theory, to determine the percent increase in costs due to competition.

To determine the final decision, the model requires an estimate of the price reduction in the program through the use of competition. This estimate is based on a statistical analysis of past system acquisition programs to determine the expected decrease in the total costs due to competition. Although the savings on defense contracts have averaged twenty-five to thirty-three percent in the past, the program manager can research savings on similar systems to obtain a more refined estimate of potential savings emanating from competition.

Factors in Solicitation and Selection Steps

After determining that a system can be adapted to the leader/follower technique and the technique is shown to be economically desirable, certain factors should be considered

Table V

Economic Factors and Criteria

Economic Factor	Criteria to Consider
Contractor Investment	What are the tooling, special facilities and learning costs for a second producer?
Technology Transfer	What is the cost of transferring technology to qualify a second producer? What is the cost of government testing for second producer qualifying items? What is the value of the qualification items fabricated by a second producer?
Proprietary Data	What is the cost of obtaining proprietary data?
Contractor Capacity	What is the total increase in overhead and general and administrative costs to all government contracts due to each contractor not producing at full capacity?
Logistics Costs	What is the change in total shipping costs with a second producer? What are the future logistics costs due to system non-standardization?
Contractor Cooperation	What are the special costs resulting from providing incentives to the developer to ensure contractor cooperation?

Increased Costs:

Contractor investment costs ______

Technology transfer costs to developer ______

Technology transfer costs to second producer ______

Government qualification test costs ______

Proprietary data costs ______

Contractor capacity costs ______

Increased shipping costs ______

Future logistics costs ______

Contractor cooperation incentive costs ______

Sum of Increased Costs ______

Reduced Costs:

Benefits from reduced shipping costs ______

Value of systems produced to qualify ______

Sum of Reduced Costs ______

Cost of Competition:

Increased Costs - Reduced Costs = Cost of Competition

Cost of Competition ÷ Cost of Sole Source Technique = percent increase in costs due to competition

Final Decision:

Estimated percent decrease in total costs due to competition

less

percent increase in costs due to competition

equals

percent savings attributable to competitive posture

Figure 3. Economic Decision Model

during the solicitation and selection steps of the procurement process to ensure a successful application of the leader/follower technique. Although these factors are not critical to determining if a specific acquisition program can be adapted to the leader/follower technique, consideration of these factors from a systems view point will provide the forethought necessary to obtain acceptable proposals from potential contractors.

Factors and Criteria. The solicitation and selection factors are presented in Table VI along with the criteria to be considered with each factor. These factors, in addition to the normal considerations in the solicitation and selection steps of the procurement process, must be analyzed prior to soliciting proposals from potential contractors and should be considered when structuring the Request for Proposal (RFP) and Statement of Work (SOW) for the program.

Two of the factors, definitive RFP and SOW, are controlled by the program manager and the contracting officer. By employing good contracting procedures and always tying future production contracts to fulfillment of the leader/follower concept objectives, these factors can be used to increase the probability of successfully adapting a system acquisition program to the leader/follower procurement technique.

Solicitation and Selection Model. The solicitation and selection model (Figure 4) is founded on a definitive RFP and SOW for the leader. The model is based on actions to establish a viable leader/follower program from the outset of the

Table VI

Solicitation and Selection Factors

Factors	Criteria to Consider
Amount and Type of Subcontracting	Is the developer primarily an assembler? Does one subcontractor hold proprietary data to a key component of the system? Is the subcontracting competitive?
Contract Complexity	Do the requirements of the acquisition program impose extra complexity on the contract such as design to cost, life cycle costing or reliability improvement warranties?
Competition in Development Phases	Did sufficient competition exist in the development phases of the acquisition program to force the developer to accept the leader/follower procurement technique?
Definitive Request for Proposal (RFP)	Does the RFP: Clarify legal data rights? Require participation in the leader/follower technique to receive a production contract? Clarify responsibilities of the leader? Clearly state incentives? Indicate method of selection of the follower?
Definitive Statement of Work (SOW)	Does the SOW: Provide minimal requirements for the leader/follower program? Include leader/follower obligations as a priced line item?
Industry Initiative	Is there sufficient initiative for the contractor to improve the system?

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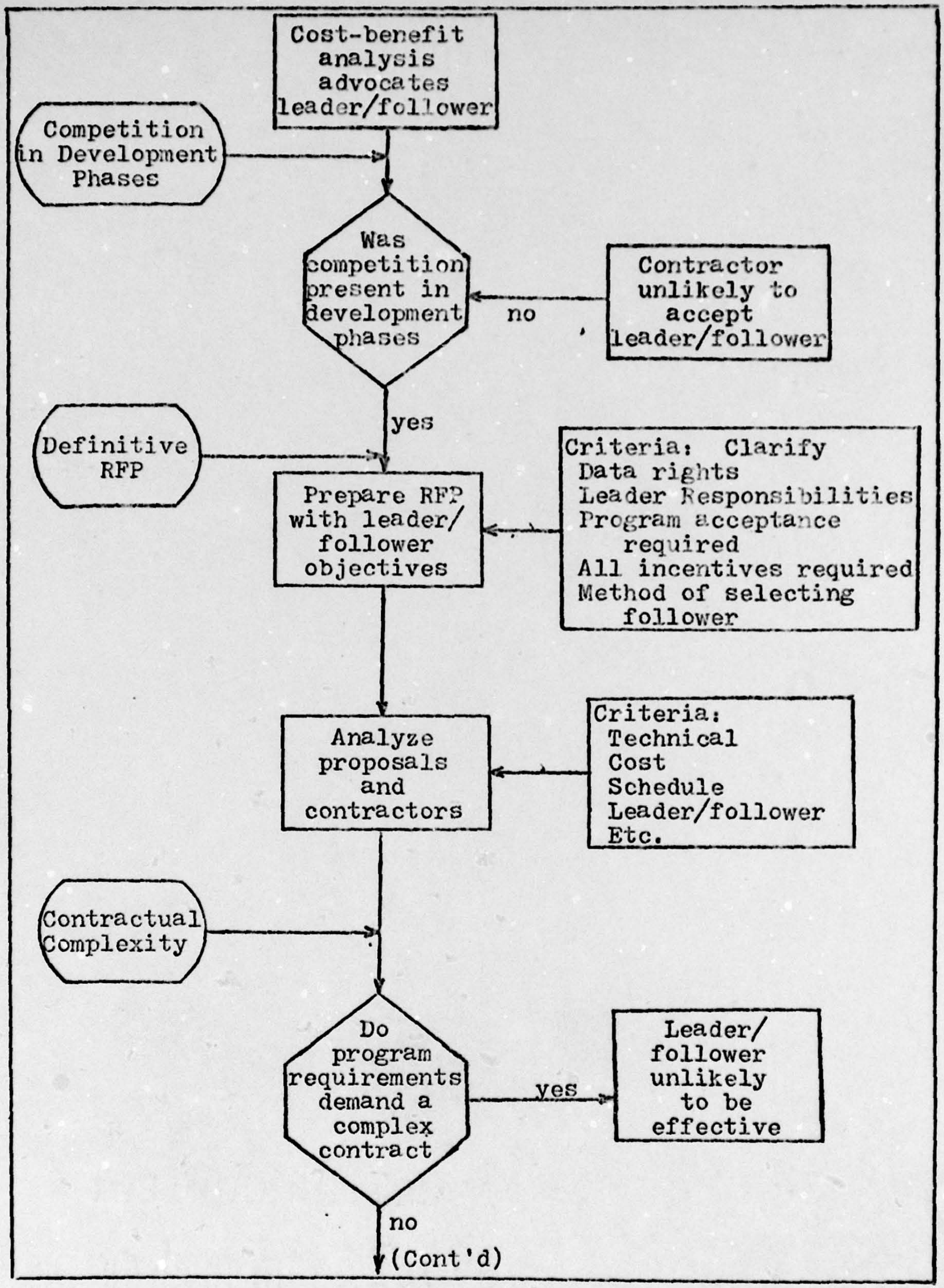

Figure 4. Decision Model During Solicitation and Selection

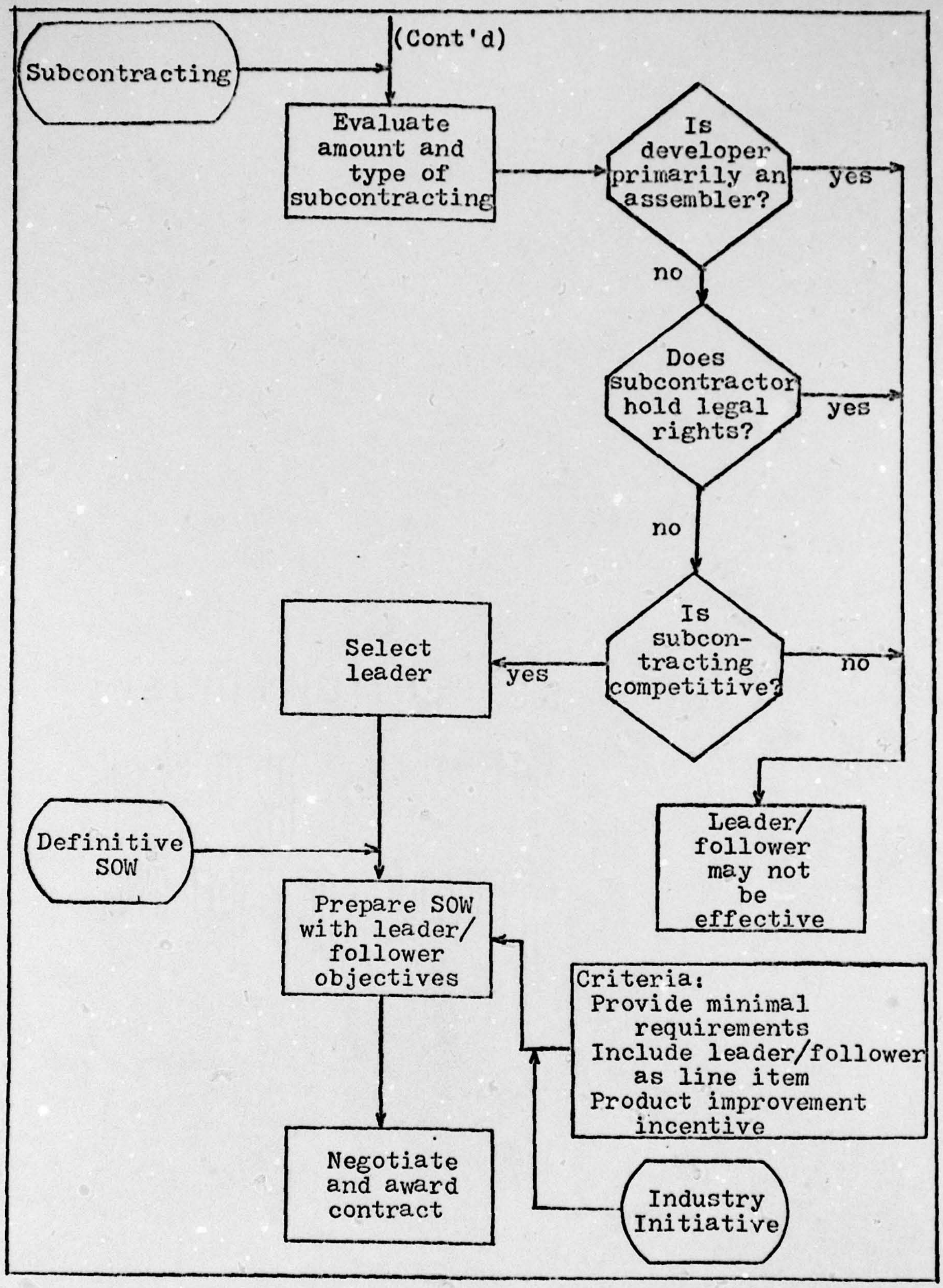

Figure 4. Decision Model During Solicitation and Selection

production phase of an acquisition program since, once a contractor is established in a monopoly position as the sole source producer of a system, a contractor is unlikely to accept the terms of the leader/follower technique to create his future competition.

The application of this model involves a case by case analysis of each contractor's ability to meet the system selection criteria along with the willingness of each contractor to participate in the leader/follower program. The model terminates with the contract negotiations and subsequent award of a contract.

Once a contract is negotiated and awarded, a major remaining problem is to develop "a method of ensuring actual implementation by the leader ..." (Ref 7:354). This may require a financial incentive, however, political pressure or control through progress payments appear to be very effective and are available at little or no additional cost. Of course, normal contract monitoring procedures should be followed after the contract is awarded.

Long Term Effects

Possible long term effects on industry and government contracting practices should be considered before embarking on a large scale program of using the leader/follower procurement technique to introduce competition into several system acquisition programs. A systems approach should be instituted to consider the possible interactions and interrelationships of the industry and the government and the possible effects on the economy.

Factors. If a total acquisition program is considered as a system, then certain long term effects can have a negative impact on the ultimate success of using the leader/follower concept to provide a competitive posture. For instance, the effect of using the leader/follower concept on the initiative of a contractor to improve a product through design changes when the contractor has reduced expectations of profits because of the competitive posture of the acquisition program should be considered. In other words, the ques- is: What effects will the leader/follower concept have on a program in the long run?

Taking a broader holistic approach, where a system is defined as the total government acquisition process, the interactions and interrelationships of the industrial complex and the government as a whole must be considered. For example, will the continued use of the leader/follower concept increase development costs on future programs or will the use of the leader/follower technique cause structural changes in the industry? These factors along with others presented in Table VII should be considered in relation to the industry as a whole and to the government acquisition process.

Model. A visual depiction of the long term factors and their interactions with the government and industry is presented in Figure 5. The interrelationships and interactions of these factors on the industry and the government can eventually affect the whole economy either negatively or positively depending on the resulting effects of the interactions.

Table VII

Long Term Factors and Criteria

Factors	Criteria to Consider
Development Costs	Will development costs increase because of the reduced expectation of future profits?
Structural Changes in the Industry	Will leader/follower lead to two groups--developers and producers? Will the number of firms decline which could limit competition?
Lawsuits	Will lawsuits by follower firms for deficiency in technology support increase?
Industry Initiative	Will the individual initiative of firms decline because of the reduced expectation of future profits?
Bidding to Obtain Information	Will contractors bid on programs primarily to obtain technological information about other producer's manufacturing methods?
Attraction to Marginal Producers	Will marginal producers be attracted to the follower position?
Economy	What effect will the leader/follower have on the whole economy?

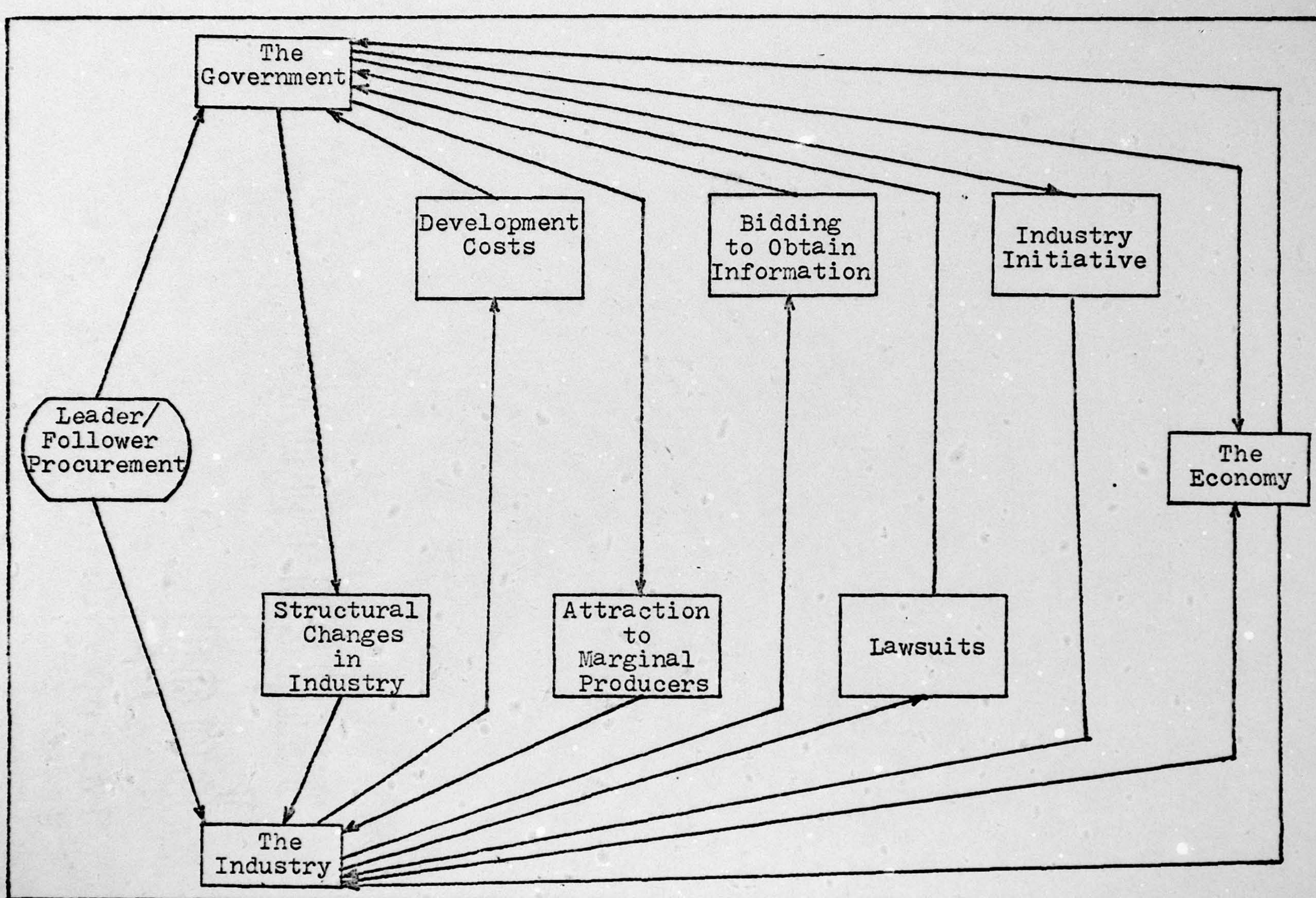

Figure 5. Long Term Effects Model

Because of the lack of empirical evidence, these possible effects can not be evaluated at this time. However, as more experience is gained with the leader/follower technique, empirical data can be used to determine the ultimate effect on the economy of using the leader/follower concept as a method of promoting competition.

Conclusion

The leader/follower procurement technique appears to have a limited application potential in the system acquisition process. The factors exhibited by a system which can be successfully adapted are rather restrictive. However, the leader/follower procurement method does provide a means of introducing competition into system acquisition programs which exhibit the necessary characteristics.

The ultimate success of the leader/follower procurement technique is very difficult to assess at this point because of its limited application possibilities and possible long term effects on industry, government and the economy. As more programs are adapted to the leader/follower technique, empirical data can be gathered to measure these effects.

Summary

The lack of experience with the leader/follower procurement technique as a method to increase competition in a system acquisition program has led several program managers and contracting officers to request a model for determining if a specific acquisition program can be successfully adapted to the leader/follower concept. Using a systems approach and cost-benefit analysis, this chapter constructs a model based on the factors developed in the two previous chapters.

The model is divided into four parts. The first portion of the model identifies those factors of a system which are critical to the use of the leader/follower technique. Using these critical factors, the decision maker can determine if a specific acquisition program is adaptable to the leader/follower concept. Second, an economic analysis decision model is used to determine if the leader/follower technique is a cost effective alternative. The third portion of the decision model identifies those factors to be used during the solicitation and selection steps of the procurement process so as to ensure the successful implementation of the leader/follower technique. Finally, a long term effects model identifies possible effects on industry and government of continued large scale use of leader/follower procurement.

The use of the leader/follower technique to provide competition in the system acquisition process is rather limited by the restrictive factors that a system must exhibit. However, to determine the ultimate success of the leader/follower concept, empirical data are needed to evaluate the long term effects.

V. SUMMARY AND CONCLUSIONS

The introduction of price competition into the Department of Defense weapon system acquisition programs has yielded average price reductions of twenty-five to thirty-three percent. However, three major barriers to competition (start-up costs for new firms, proprietary rights to technical information and the transfer of technology) restrict the entry of new firms into the production phases of the acquisition process of a weapon system.

During the 1970's three procurement strategies (second sourcing, technology licensing and leader/follower) were proposed to increase competition in the production phases of an acquisition program. Two of these strategies, second sourcing and technology licensing, have been used extensively by the government and commercial firms. However, leader/follower procurement has been a little used technique.

Summary

Because of the limited experience with the leader/follower procurement technique as a method of promoting competition during the production phases of an acquisition program, no comprehensive model for the application of this procurement technique is available. The purpose of this research effort is to identify critical factors which may affect the application of the leader/follower procurement method. In turn, the critical factors are used to formulate a model that will provide a device to aid program managers in the decision as to whether the leader/follower concept might be appropriate for a specific system acquisition program.

A comparative analysis of the second sourcing, technology licensing and leader/follower procurement techniques identified similar factors that must be exhibited by a system before an acquisition program can be adapted to any one of the procurement techniques. A total of twelve factors, along with the criteria to consider with each factor, were developed. The factors that must be considered before adapting an acquisition program to the leader/follower procurement technique are (1) production quantity and rate, (2) degree of technology required, (3) extent of proprietary data, (4) contractor capacity, (5) contractor investment requirements, (6) production lead time, (7) contractor cooperation, (8) effect on industry initiative, (9) logistics costs, (10) contractual complexity, (11) commercial potential and (12) amount and type of subcontracting.

An analysis of the Air Force High Technology Ejection Seat (ACES II) acquisition program, an unique effort by the Air Force to provide competition in the production phases of an acquisition program by employing the leader/follower procurement technique, yielded two additional factors. The factors, competition in the development phases and a definitive Request for Proposal and Statement of Work, were considered as essential for the successful application of the leader/follower procurement technique to the ACES II program.

By using a systems theory approach and cost-benefit analysis, a model was developed to determine if an acquisition program can be adapted to the leader/follower procurement technique. The model is presented in four parts.

The first portion of the model identifies factors of a system which are critical to the use of the leader/follower technique. These critical factors are formed into a decision model to aid the decision-maker in determining if a specific acquisition program is adaptable to the leader/follower procurement concept.

The second portion, an economic decision model, identifies factors that are used to determine if the leader/follower technique is a cost effective alternative. This decision model utilizes a cost-benefit analysis of developing competition through the leader/follower procurement technique by comparing the costs and benefits of establishing a second producer with the costs and benefits of maintaining a sole source producer.

The third portion of the model identifies those factors to be considered during the solicitation and selection steps of the procurement process. These factors are combined into a decision model to aid the program manager in ensuring the successful implementation of the leader/follower technique.

The final portion, a long term effects model, identifies possible effects on industry and government of the continual large scale use of the leader/follower procurement technique. The interaction of the leader/follower technique with industry and government could eventually effect the economy of the country. However, because of the lack of empirical evidence, these possible effects can not be evaluated at this time.

Conclusion

The model developed in this research study is an initial effort to provide a device to aid program managers and contracting officers in the decision as to whether the leader/follower concept might be appropriate for a specific acquisition program. This model provides a basic framework for the the decision-making process but is not intended to be a substitute for good judgement and experience.

Three qualifications as to the use of this model are necessary. First, each decision point in the model requires a yes/no answer. In practice, many of the conceptual questions may not have such a dichotomous answer.

Second, some of the costs associated with the economic decision model require estimations and projections that may border on "crystal ball gazing." For example, the change in the shipping costs for a system when adding a second producer are almost impossible to estimate since the identity of the second producer will usually not be known during the planning stage of the acquisition process. Perhaps a larger problem is determining the estimated percent decrease in total costs due to competition. Although savings from competition on selected items have been published, no analysis by system type or design is available.

Third, the economic model ignores the time value of money.

The majority of the costs to establish competition are "front end" costs of a program and need not be discounted while the largest portion of the savings is realized toward the end of a program and should be discounted. If the future savings are discounted, the benefits of competition can be substantially reduced. For example, using a discount rate of ten percent would reduce the anticipated savings in the eighth year of a program by over one-half.

Despite these qualifications, the model provides a broad, holistic approach to the problem of adapting an acquisition program to the leader/follower procurement technique. By using this approach, managers can acquire a better understanding of the problems and attain a more desirable perspective for making a final decision.

The leader/follower procurement technique appears to have a limited application potential in the system acquisition process inasmuch as the fourteen factors that must be considered serve to restrict the number of acquisition programs that can be successfully adapted to this procurement technique. However, before a decision as to the ultimate success of the leader/follower technique as a method of introducing competition into the acquisition process can be formed, more experience with the technique is needed to gather empirical data to measure long term effects.

Recommendations for Further Research

The conceptual model developed in this research effort is recognized as being only the first step in the development of a complete systems model for the application of the leader/ follower procurement technique. As more experience is gained with this procurement method, empirical data can be used to quantify the factors which must be considered. One approach would be to assign values to the various factors and then use regression or discriminant analysis to determine the appropriate weight of each factor.

After sufficient empirical data are available, the long term effects of using the leader/follower concept could be identified. One method of determining the long term effects could be developed using a systems dynamics approach with its associated computer program, DYNAMO, to form a computerized model.

Finally, additional research is needed to determine the savings that can be expected from the introduction of competition into a system acquisition program. This research could categorize systems by type and procurement technique to supply statistical data on the expected savings from competition.

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