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Second sourcing in the acquisition of major weapon systems.

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THESIS

SECOND SOURCING IN THE ACQUISITION OF MAJOR WEAPON SYSTEMS

by

Dennis Scott Parry

June 1979

Thesis Advisor: David V. Lamm

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Second sourcing, then, is found to be an acquisition strategy that can result in significant benefit to the government. It is a strategy that must, however, be selectively applied. If attempted in a random or haphazard manner, the cost to the government can be astronomical.

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Second Sourcing in the Acquisition of Major Weapon Systems

by

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I. INTRODUCTION

OBJECTIVES OF THE RESEARCH -- The purpose of this study was to formulate a working definition of "second sourcing" in the acquisition of weapon systems; and, to investigate the feasibility of formulating an evaluative model to be used in potential second sourcing situations.

RESEARCH QUESTION -- Can an evaluative model be developed that will aid the decision maker in determining: (1) whether or not second sourcing should be attempted, and, (2) which second sourcing methodology would be most suitable for the acquisition in question?

RESEARCH METHODOLOGY -- The data expounded upon in this study were collected through: an examination of acquisition literature; an examination of business clearances, procurement plans, and other applicable project office and contracting officer files and records; personal interviews with government and contractor personnel involved in second sourcing efforts; and, telephone interviews. Since the literature was rather limited on the subject of second sourcing, the majority of the examples and information included herein were collected during interviews -- personal and telephonic.

SCOPE AND LIMITATIONS -- The scope of this study is essentially limited to weapon system acquisitions and to buys of major components of such systems. Further, the study did not consider such concerns as component break out, small business

and labor surplus area set-asides, nor procurement from another source following default termination. That is not to imply that none of the observations provided herein can be considered applicable to such cases, but only that data was not collected to support such conclusions.

ASSUMPTIONS -- Throughout this report it is assumed that the decision maker is free to make second sourcing determinations (directed sole-source acquisition has not been mandated); that standard Department of Defense (DOD) contracting terminology and concepts are known to the reader; and, that the reader is familiar with DOD project/program management structure, operation, and terminology.

DEFINITION OF SECOND SOURCING AS USED IN THIS REPORT -- A review of the acquisition literature failed to uncover a uniform definition for second sourcing. At the inception of the research, the following definition was pre-supposed: Second sourcing is a method of obtaining alternate producers through the use of a technical data package which is utilized when the specifications of the system are relatively stable and a sole source producer (usually the developer) is currently producing the system. Such a definition assumed that a stand alone reprocurement data package would be sufficient to bring a second source producer on line. During the course of this research, however, it became apparent that this definition was too restrictive in that it focused on a single method of developing a second source producer. Also evident was the

fact that no two field contracting personnel defined second sourcing in exactly the same manner. For the purposes of this report, therefore, the following definition (a much less restrictive one) shall be utilized: Second sourcing is a compendium of techniques and methodologies with the avowed purpose of ensuring the development of alternative production sources such that the original developer/producer of a weapon system does not become a monopolistic sole source for future reprocurements. The definition, as stated, is intended to encompass acquisitions based on: FORM-FIT-FUNCTION (F^3), TECHNICAL DATA PACKAGES (TDP), DIRECTED LICENSING (DL), LEADER-FOLLOWER (LF), CONTRACTOR TEAMING (CT), or any other strategy that, when applied, accomplishes the stated objective of developing an alternate source of supply. Examples of acquisition actions that are not considered to be covered by this definition include: obtaining a system from a new source subsequent to default termination; and, "component breakout, involving the decision as to whether components should be purchased by the government directly and furnished as Government Furnished Material (commonly referred to as GFE) or purchased by the contractor (CFE)." /I:347/

ORGANIZATION OF THE STUDY -- This study consists of several related topical discussions. Chapter II describes briefly the framework within which the acquisition and contracting process must function. Included therein is a discussion of the acquisition process itself, a brief description of the defense market, and an overview of the two major reasons for

second sourcing (competition and the maintenance of the mobilization industrial base). Chapter III presents some generalized findings regarding the perceptions of field contracting and project office personnel and of selected contractor representatives with respect to second sourcing. These findings take the form of paraphrased answers to a research questionnaire prepared by the originator of this study [Appendix A]. Chapter IV presents some actual cases wherein second sourcing has been or is being attempted. Both successes and failures are included along with a short discussion of the lessons to be learned therefrom. Chapter V is an exposition of the cognitive model that is the product of this research. This model was developed in cooperation with LCDR Benjamin R. Sellers, SC, USN whose study entitled, "Competition in Major Weapon System Acquisition," is forthcoming (September 1979). Finally, Chapter VI contains the conclusions drawn from this study and proposes the need to test the model developed herein on active projects to determine its usefulness as an analytical tool.

II. FRAMEWORK AND BACKGROUND

THE MAJOR SYSTEM ACQUISITION PROCESS -- Appendix B is a flow chart depicting the acquisition process. The acquisition of a major system begins with the "evaluation and reconciliation of needs in the context of agency mission, resources, and priorities." /2:7/ When such an evaluation identifies a deficiency in existing capabilities or an opportunity to establish new capabilities, a mission element need statement (MENS) is developed. The MENS must identify the mission area; assess the projected threat; identify existing capabilities; assess the need in terms of such things as the task to be performed, deficiency in capability, obsolescence of old systems, technical advantage to be realized, and cost savings potential; outline known constraints such as NATO rationalization, standardization, and interoperability (RSI); assess the impact of not acquiring or maintaining a given capability; and, provide a program plan for meeting the perceived need.

The MENS, then, is submitted via the Defense Acquisition Executive (DAE) to the Secretary of Defense (SECDEF). This stage of the process constitutes Milestone Ø. Based on the MENS and an associated DAE position paper, SECDEF determines whether or not to initiate a project. If SECDEF approves the MENS, a Program/Project Manager (PM) is assigned to oversee the project. Both the assignment and tenure of the PM are the concern of the agency head who submitted the MENS. When assigned, the PM's first duties are concerned with staffing the

project office and the development of an acquisition strategy (based on a consideration of the project's goals and objectives) that is tailored to that particular project. It should be noted, at this point, that SECDEF milestone decisions do not authorize the commitment of funds. It is therefore necessary to initiate action that will reflect such decisions in the Planning-Programming-Budgeting System (PPBS) for congressional authorization and appropriation action.

A mission need solicitation is next offered to potential contractors for "competitive exploration of alternative systems." This solicitation is in terms of mission need (not hardware) because the objective is to gleen all the benefits of industry's innovative talents and of competition. Also outlined in the solicitation are scheduling objectives, program cost, constraints, and operating requirements for the system.

The resulting proposals from industry are then evaluated, and, the most promising concepts are chosen for further exploration. Parallel short-term contracts (usually fixed-price type) are awarded to explore and expand upon the chosen concepts and to allow for reduction of the technical uncertainties accompanying the various concepts. Upon evaluation of the fruits of these explorations, the most promising concepts are recommended to the agency head and a Decision Coordinating Paper (DCP) justifying the recommendations is prepared. The DCP is then submitted to the Service System Acquisition Review Council (SSARC)/Defense System Acquisition Review Council (DSARC) for review and comment, en route to the SECDEF, with the agency head's request to proceed into the next phase.

Approval of this Milestone I DCP, then, constitutes a reaffirmation of the MENS and permission to proceed with "competitive demonstrations" of the alternative concepts. Such demonstrations are designed to "verify that the chosen concepts are sound, perform in an operational environment, and provide a basis for selection of the system design concept to be continued into full-scale development." /2:16/ During this timeframe, it becomes important to identify tradeoffs and potential delays, define program details, encourage innovation, and maximize competition. Finally, the results of the demonstrations are utilized in the formulation of an updated DCP with which the agency head will recommend the preferred system(s) -- based on concept performance, risk analysis, cost considerations, contractor management, technical, and financial capability -- for continuation into full scale development, test and evaluation. At Milestone II, then, this revised DCP is forwarded to SECNAV via the SSARC and DSARC for approval.

During the full scale development phase, scheduling and control become more important considerations of the PM structure; negotiation techniques are emphasized (high risk situations usually resulting in cost-reimbursement type contracts while low risk situations usually result in fixed-price type contracts); there is a continuing evaluation of progress through formal reviews, engineering reports and like indicators; budgetary controls are stepped up; and, independent test and evaluation of the systems is performed. Also during this phase,

long lead time production items may be ordered as required. Finally, design/engineering/manufacturing specifications are prepared and production models may be built. The object of this phase is to develop a weapon system that will gain the approval of both the SECDEF and Congress. Milestone III, therefore, involves a decision on whether or not to proceed into full production. Once again, the DCP is updated and a request for approval to proceed is submitted.

On approval of full production, it becomes necessary to award the production contract(s) and shift the emphasis of the project to that of contract administration -- including production and user acceptance testing. Effective documentation of the company's performance becomes especially important as a basis for subsequent contract negotiations and for determining the effectiveness and efficiency of contractor performance.

This, then, is the project environment in which second sourcing decisions must be made. The factors of importance to these decisions will change in accordance with the phase of the acquisition cycle in which the decision is made. The earlier in the cycle that second sourcing is considered, the more varied will be the options available to the decision maker and the greater will be the probability of success.

THE DEFENSE MARKET -- The defense market has been characterized, in recent years, by a decline in real dollar expenditures. The competition between firms in that market, at least in the

design/development phase of an acquisition, is therefore quite fierce. There tends to be a notable excess in the capacity of many defense oriented firms; a strong incentive to maintain a reasonable level of engineering and manufacturing talent; a desire to prevent heavy fluctuations in corporate workload; and, a relative inflexibility on the part of the defense contractors that makes it quite difficult to utilize their resources effectively in alternative markets.

Since the market is essentially monopsonistic, the government (as the only buyer) enjoys a significant level of power over the competing firms throughout the early stages of the acquisition cycle. This relationship tends to change, however, upon award of the production contract. From that time forth, the atmosphere usually becomes one of a bilateral monopoly (one buyer and one seller). The power position previously enjoyed by the government becomes significantly eroded -- although its position is bolstered by its significant legal and regulatory authority. Nonetheless, the fact that most production contracts are awarded on a sole-source basis reduces the government's leverage considerably.

The usual absence of production competition tends to increase the incidence of "buy in" during the design phase. That is to say that the contractors may tend to intentionally quote unrealistically low prices, secure in the belief that there will be sufficient opportunity to "get well" on subsequent sole-source reprocurements. It is exceptionally difficult to eliminate such tactics since the very nature of the buy is

such that the purchaser is without the benefit of a market determined price for the system. The government is dependent on informed judgement in evaluating the cost estimates on systems that have no commercial counterparts, are technologically complex, and frequently push the state-of-the-art.

The sheer size of most systems acquisitions is another factor of note. When millions or even billions of dollars are to be spent over the life of a project, winning or losing a contract may be a life or death determinant for an individual firm. At the very least, the constitution of the market can be changed drastically on the basis of a single award.

COMPETITION -- A review of Contressional testimony, the literature of the acquisition community, or Federal and Defense Department instructions and regulations reveals that competition is almost universally acclaimed as being good and desirable. This support derives from competition's promise of both direct and indirect benefits in a free enterprise society.

In 1965, SECDEF, then Robert McNamara, declared to the Joint Economics Committee of Congress that savings on the order of twenty five percent or more generally resulted from a conversion from sole source to competitive purchases. More recently, the Army Procurement Research Office (APRO) concluded that there is no empirical support for such expectation /Lovett and Norton 1978/. That office then went on to attempt the development of a methodology for estimating the savings potential of competition. The study showed, among other things, that savings have been and may be realized through competition.

It further demonstrated, however, than when savings do occur, they cannot all be credited to competition; that there are expenses that must be incurred to obtain competition; and, there are other collateral problems created when competition is introduced.

The question of whether or not competition will result in benefits that exceed the costs incurred involves a careful analysis of the trade-offs involved. There are effectively two ways to increase competition in an acquisition: extend design competition through later phases of the development process (as with competitive prototyping) or introduce price competition into the production phase of the cycle.

The history of government acquisition is filled with examples of development/design competition -- reflecting the general acceptance of this strategy. When one looks at the production phase of the process, however, competition for reprocurements tends to be the exception rather than the rule. This fact seems to be the result of the widely held belief that the costs of obtaining production competition usually outweigh the benefits to be obtained.

MOBILIZATION INDUSTRIAL BASE -- The Defense Acquisition Regulation (DAR) states that:

> Pursuant to 10 USC 2304 (a)(16) purchases and contracts may be negotiated if 'he (the Secretary) determines that (A) it is in the interest of national defense to have a plant, mine, or other facility, or a producer, manufacturer, or other supplier available for furnishing property or services in case of a national emergency;

> or (B) the interest of industrial mobilization in case of such an emergency, or the interest of national defense in maintaining active engineering research, and development, would otherwise be subserved.' /Appendix C/

The Secretary, then, is authorized to take action that will provide for an industrial mobilization base which can meet production requirements for essential military supplies and services. This authority takes on special meaning when considering the need to second source an acquisition. In particular, it allows the government to eliminate the original producer from consideration for at least a "minimum sustaining rate" production quantity. Only then can the government be sure of developing an alternate production source since the competitive advantage of the original source is no longer a factor.

The reasoning behind the mobilization base exception runs along the following lines: during national emergencies it is reasonable to assume that a single producer would be unable to provide the system in the quantities necessary to respond to the emergency; or, alternate producers should be available for critical systems to prevent the possibility of a single strike knocking out the country's entire production capacity for those systems. When mobilization is the prime reason for second sourcing, competition and price become only secondary decision factors.

III. RESEARCH QUESTIONS

The purpose of this chapter is to present paraphrased renditions of the more sanguine answers to the questionnaire utilized by the originator of this research /Appendix A/.

SECOND SOURCING DEFINITION -- When asked to define second sourcing, the answers provided by those interviewed were many and varied. For the most part, however, they were centered around the concepts of production competition and mobilization base maintenance. The definitions extracted emphasized the goals and objectives to be achieved by second sourcing more than the methodologies to achieve these goals.

Some of the replies that emphasized both the competition and mobilization base aspects of second sourcing include:

1. Second sourcing is an acquisition strategy usually attempted to obtain price concessions through competition. It can also become necessary when monthly production requirements are greater than the original producer can provide.

2. Second sourcing is the creation of a competitive atmosphere. Dual sourcing, on the other hand, involves the maintenance of more than one source of production concurrently.

3. Second sourcing runs the gamut of (1) finding another source for production after contractor default, (2) developing an alternative producer for spare parts support, (3) obtaining production competition via a technical data package, licensing agreement, or leader-follower arrangement. Sole sources may

often be considered unacceptable for systems vital to our national defense because of the danger of a first strike destruction or other crippling disruption.

Some other answers seemed to stress the mobilization aspect of second sourcing to the virtual exclusion of any competitive effect:

1. Second sourcing merely means getting more than one production source. Practically, it may be impossible to achieve second sourcing without invoking exception 16 (mobilization base).

2. It is perceived that second sourcing is a tactic that can be used when one wishes to ensure more than one source for mobilization base reasons (in which case competition is not a primary consideration). It is also used when one already has one successful producer but it seems desirable to get competition. Unfortunately, it doesn't often work in such circumstances because the costs outweigh the potential competitive benefits.

3. Second sourcing is, very simply, an attempt to "break out" an item so that we will have two contractors capable of producing that item to specifications.

PROBLEMS -- When asked what problems had been encountered in second sourcing, a wide range of answers was provided:

1. There were not sufficient funds available to allow successful second sourcing, so we had to abandon the idea.

2. Proprietary data problems arose which made it impossible to transfer the necessary technology to a second source.

3. The original producer was extremely hesitant to "share the wealth" with a second source. It may have been possible to force his hand if the idea of second sourcing had been mentioned in the original production or development contract; but, by the time we thought of it, it was too late.

4. A pre-determined budget locked us into one contractor until the end of Research and Development (R&D). By then moreover it was tough to identify both the funds needed and the competitors capable of bidding on a second source contract.

5. By the time second sourcing was considered, there weren't enough years left in the project. You need two to three years to bring a second source on line ... so it is virtually impossible for short lived projects or those in their out years to accomplish second sourcing.

6. We never get enough respondents to second sourcing overtures. Most of those we do get are small businesses who really can't handle the job but are trying to get a foot in the door.

7. Engineering Change Proposals (ECP's) are a real headache with two production sources. The administrative burden of coordinating the review, approval and implementation of ECP's when multiple sources are involved is stiffling. In fact, the entire contract administration function becomes excessively complicated when you have two or more sources of supply for the same system.

8. With techniques like leader-follower, there is a real question about the sincerity and willingness of the leader to truly develop competition for himself. He will promise anything to get that original contract, but once he gets it, it becomes a whole new ball game. His first loyalty is to his stockholders, and, he therefore wants to ensure that he remains on top. This desire frequently results in a situation where the lead company ensures that the follower is approximately comparable, but, never quite equal to the leader. This is accomplished by leaving little "holes" in the data or other covert actions.

9. One very ticklish problem that can develop when one attempts to develop a second production source is that the original producer (especially when he is a heavily commercial oriented firm) may decide that split buys do not provide him sufficient return to remain in production. Loss of that original producer altogether could be disastrous.

10. The second source was never able to produce a qualified product. Following the data package just wasn't enough.

11. Sometimes the pre-award survey teams are too quick to certify a second source contractor. A small business frequently lacks the skilled engineering talent needed to reconcile data package problems without extensive governmental assistance. Second source contractors should, thus, be chosen very carefully or the effort will cost the government dearly. Those chosen should have vast experience in the type of production involved; sufficient engineering and production expertise in

addition to the required technology and equipment; and, they must be financially capable of performing the contract.

ADEQUACY OF THE DATA PACKAGE -- The following are some of the methods recommended for ensuring the adequacy of a technical data package:

1. Government laboratories such as China Lake can be tasked with the audit and certification of the data packages.

2. The second source should be provided with a "Chinese copy" that can be torn down and examined with reference to the data package.

3. The technical data package can never be made totally satisfactory! There will always be omissions -- either intentional or inadvertent -- that will make the data deficient. Further, it is not always possible to identify, on paper, all the "tricks of the trade" or process peculiarities that make a particular producer successful.

4. Until a second source attempts to produce the item based on the developer's data package, there is no way of knowing whether or not the data is complete and adequate. Once found deficient, the government must be prepared to assign technical experts to the task of helping the second source resolve the problems encountered. This is an expensive proposition that is subject to both manning and funding constraints.

5. We can state in the contract provided to the second source that resolution of any difficulties with the data package is his responsibility. Unfortunately such a clause does not help much when delivery slippages result in critical shortages in such systems.

6. From years of experience, it is important to keep government laboratories out of the contractor's hair. These labs are certainly not without technical competence (often far superior to the contractor's) but it seems that their main objective is to justify their own existence at the expense of the contractor.

MEASURES OF SUCCESS OR FAILURE -- When asked to describe the measures of success or failure that are utilized in evaluating a second sourced acquisition, the responses usually centered around cost savings/increases associated with application of a second sourcing strategy.

1. If the unit cost of the system is lower from the second source than was projected from an extrapolation of the original producer's learning curve, the second sourcing effort is a success.

2. Even when the follow-on contract is awarded to the original producer after an attempted second sourcing, if (based on past procurement experience) the price of the system is less than would have been projected, the effort is a success.

When asked for a quantification of the costs and benefits of second sourcing, most of those interviewed were hard pressed to come up with any definitive responses. An Army Procurement Research Office study, "Determining and Forecasting Savings from Competing Previously Sole-Source/Non-Competitive Contracts provides one method of estimating such factors, however. Examination of that publication is therefore recommended.

AWARD SPLIT -- When questioned about the best method to calculate the production split between alternative manufacturers, several means of determining the split were offered:

1. The low quantity should never drop below the minimum sustaining rate. As to how to determine what that rate is, the easiest method is to ask the contractor.

2. Splits can be determined arbitrarily -- usually thirty or forty percent should go to the high offeror with the remainder going to the low bidder.

3. Have the two sources bid on a "stairstep" quantity profile and award the contracts on the basis of that combination of quantities that is most advantageous to the government.

4. Require bids that allow for extrapolation between the high and low quantities. Award on the basis of that split that is cheapest overall.

OTHER RESEARCH QUESTIONS -- Answers to other questions, included in the questionnaire but not covered in the preceding discussions, have been incorporated into the model to be discussed later.

IV. CASE STUDIES

The following case studies are provided as illustrations of second sourcing efforts that have been attempted to date. Included are examples that have been declared successful as well as some that have been branded failures. It is hoped that examination of such cases will point out some of the benefits that can be achieved through second sourcing as well as the costs associated with application of the method.

ARN-84 AIRBORNE TACAN NAVIGATION SET -- The original developer/producer of the solid state ARN-84 was Hoffman Electronics, now the NAVCOM Division of Gould, Incorporated. Hoffman was the sole-source producer of the ARN-84 until 1975 when the Naval Air Systems Command (NAVAIR), believing that Hoffman's price of $26,000 per set was excessive, decided to second source the following year's acquisition. The Navy utilized a re-procurement data package, originally prepared by Hoffman, to initiate the competition. Although Hoffman drastically cut its previous price for the ARN-84 (quoting $17,000 per set), they were underbid by ASC Systems which submitted a bid for only $13,000. Hoffman informed the Navy that the $13,000 figure was less than the direct material and labor costs it had experienced over the duration of its previous production contracts. At that time, however, Hoffman had lost a great deal of its credibility -- evidence the $9,000 drop in the price quoted by Hoffman.

ASC Systems (a small business) is a wholly-owned subsidiary of LaPointe Industries and is located in Connecticut. Historically, ASC Systems had, after some initial production difficulties, performed successfully as a second source for production of the ARC-51 airborne UHF radio communications transceiver. When identified as the low bidder on the ARN-84, a Navy pre-award survey team visited the company and concluded that it appeared qualified as a producer of the TACAN. The initial contract was subsequently awarded on 12 September 1975 for a quantity of 200 sets at a total price of $3.2 million -- with first production units to be delivered in February 1977.

By June 1977, the Navy was in a position wherein it needed at least 200 more units to meet subsequent years requirements. In a four firm competition, ASC Systems again underbid all competitors at a price similar to that of its first contract. The pre-award survey team again visited ASC Systems and reported good progress on the original contract.

The first production prototype passed qualification tests in the fall of 1976. Later that year, however, the Navy received a request for a several month extension of its first production deliveries on the grounds that it had never been notified "in writing" that the first production prototype had passed qualification tests (specifically a 500 hour mean-time-between-failure test). Unfortunately, the Navy found that someone in the contracts branch had, indeed, failed to mail the required notification. The Navy was thus forced to accept an extension of the first deliveries until mid-1977.

Concurrent with this revised delivery schedule, the Navy had a third ARN-84 buy in sight. Hoffman informed the Navy that, if a third buy went to ASC Systems, Hoffman would close its TACAN production line. At this time, it was becoming evident that ASC was experiencing difficulties in the manufacture of acceptable full production models. If Hoffman dropped out of the market and ASC failed to resolve the difficulties it was experiencing, the Navy would be in real trouble. Navy representatives thus contracted with Arinc Research Corporation to act as consultant to ASC Systems. In late 1977, however, ASC Systems' production units were failing to pass required tests. The situation, at that point, was so critical that aircraft were coming off the production lines without TACANs. Ferry pilots were even carrying TACAN sets with them to allow acceptance of the new planes.

Consequently, the Navy awarded a sole-source contract to Hoffman for the third year buy at a price of $17,000. In July 1978, ASC Systems' full production units still had not passed the required 500 hour Mean-Time-Between-Failure (MTBF) tests, but, because of the urgent need for the units, the Navy agreed to accept twenty sets if they could merely pass a fifty hour burn-in test. In the following month, only two units were delivered. In September, it was decided to terminate both contracts. The terms of the settlement (called a discontinuation) were to entail three distinct phases. Phase I allowed payment of up to $4.3 million in allowable/allocable costs on the two contracts. In phase II, ASC Systems can submit a

"termination claim" -- to be examined by the Termination Contracting Officer who has the right to determine whether or not more than the initial $4.3 million is due. In phase III, the door would be opened for the submission of claims, however, the total settlement cannot exceed $5.2 million under any circumstances.

When questioned about the problems ASC Systems encountered, Jack Lopes (president of La Pointe) stated that "There is a lot of information that is not included in the drawings." /3:53/ He also claimed that the delivery schedule was exceptionally tight and that he had had insufficient engineering talent on board to resolve the data package difficulties. An additional problem noted was that the sub-contractor, responsible for providing a required voltage regulator micro-circuit, was providing ASC with units of inadequate quality. Since ASC did not inspect these units on receipt, the quality problems were not identified until it was too late.

The bottom line in this case is that second sourcing to ASC Systems has cost the Navy approximately fifty percent more than purchase from the original source would have cost. Though, as noted, it appears obvious that Hoffman's 1975 price was indeed inflated and in need of trimming, the case illustrates how second sourcing can result in many problems -- especially where actual qualification of the second source is not achieved or where its production units cannot pass necessary acceptance tests. Also in question is the quality of the pre-award survey and the ability of small business to perform adequately in major systems acquisitions.

TSEC/KG-40 MICROMINIATURIZED KEY GENERATOR -- The KG-40 is utilized for encription and decription of data being transmitted over certain military tactical data links. In 1971, the Naval Electronics Systems Command (NAVELEX) awarded a development contract to Collins Radio Company of Newport Beach, California for the KG-40. In 1973, a sole-source letter contract was awarded to Collins for a quantity of 266 serial units at a price of $22,874 each and 94 parallel units at $33,367 each. Two years later, Collins was again awarded a sole-source contract for 288 serial units at $20,463 each and 74 parallel units at $30,581. In 1977, believing that Collins was exploiting its sole-source position, NAVELEX decided to attempt second sourcing of the KG-40. In coming to the decision to second source that year's contract, NAVELEX did a careful analysis of the risks and of the quantity projections for future buys. Additionally, NAVELEX identified several established and responsible contractors that were believed capable of performing the contract. NAVELEX also audited and verified the KG-40 technical data package -- finding it sufficiently complete and accurate.

The 1977 contract was awarded competitively to Honeywell Corporation of Tampa Florida. The contract called for 245 serial units at $8,931 each and 686 parallel units at $11,882 each. Collins' offer had quoted prices of $15,384 and $20,523 for the serial and parallel units respectively. NAVELEX, in trying to estimate the total savings associated with the second sourcing of the KG-40, applied three years inflation to the

unit prices paid to Collins on the previous sole-source buy and then reduced these figures for the volume of the current but on a 90 percent learning curve. The savings, so calculated, are estimated at a healthy $14,800,000. Another directly measurable benefit of the competition was the fact that NAVELEX was able to increase the quantity of the contract by approximately two thirds -- as a result of the lower prices paid to Honeywell. Also noteworthy was the significant drop in Collins' quoted prices (ostensibly as a direct result of the competititon).

Though the cost savings achieved are significant, there are other collateral benefits associated with this particular second sourcing effort. There are now two fully qualified producers of the KG-40; five other sources have been identified as technically capable of producing the KG-40 (valuable to future competitions); and, although the technical data package was not totally flawless, with the aid of models and careful contracting, the acquisition achieved success.

AIM-7F SPARROW MISSILE -- The Sparrow is a medium range air-to-air missile, with solid state electronics, which guides semi-actively to a target. Several major components of the Sparrow have been second sourced or considered for second sourcing and therefore deserve exploration:

Guidance and Control (G&C) Sections -- Development studies leading to the AIM-7F G&C were initiated with Raytheon in 1964. The first production contract was awarded to Raytheon to furnish not only the G&C sections but also such

related items as telemetry, wings, fins, integrated logistic support (ILS), special tooling, special support equipment, design data tests, technical support services, and data. Later awards to Raytheon required such tasks as performance improvement, G&C design simplification, aircraft interface and operational testing, and evaluation (including user system testing and production units). The data package resulting from this work was considered adequate to permit second source production of the Sparrow, so, in 1973, a CPFF contract with a CPAF option was issued to General Dynamics (GD) as a result of a technical/cost competition to establish GD as a second source G&C producer. The contract provided for performance in two stages: (1) data generation in connection with production preparations ($1,158,233), and (2) manufacture and delivery of 15 first articles and a total of 70 learning quantity production units ($21,189,961). First article delivery took place in May/June 1976, and, for funding reasons, the learning quantity was later transferred to a separate contract which was issued as a letter contract with government liability limited to $8.1 million. Since issuance, however, the cost of those 70 units has risen to $13.5 million. The following will demonstrate the full production contract profile of the two sources from 1976 to the present:

RAYTHEON			GENERAL DYNAMICS		
CONT TYPE	# UNITS	($K) APPROX UNIT PRICE	CONT TYPE	# UNITS	($K) APPROX UNIT PRICE
FFP	880	89	FPI	210	164
FFP	1110	74	FPI	210	106
FFP	1398	70	FFP	750	83

When the Navy announced that it intended to second source the Sparrow, Raytheon prepared a rather interesting analysis that concluded the need for a 34 percent reduction in program costs before second sourcing could be justified on the basis of cost savings (assuming a 70/30 split on the purchase of 4570 missiles over a five year period). Raytheon further concluded that not until production rates of 2200 missiles per year were required would second sourcing be "in the national interest." Instead, Raytheon recommended two alternatives to second sourcing that it claimed held excellent potential for savings:

(1) Allocate funds to provide for multiple sourcing of additional components beyond those now multiple sourced and by that means achieve the benefits of increased competition at the component level.

(2) Increase the effort on value engineering. Those components which can be made more economically through value engineering changes will benefit the Navy with a single source as well as with a second source if one is established. /4:37

Among the other arguments against second sourcing the Sparrow that Raytheon offered were:

(1) Additional tooling, qualifying, and management costs associated with second sourcing

(2) Progress along any assumed learning curve is more rapid in the case of a single source than when procurement is split.

(3) Additional costs are realized because of production verification testing with two manufacturers. /4:47

Raytheon, then, did not argue that the concept of second sourcing, as such, was invalid -- only that it should not be applied to the Sparrow. Based on production experience with two sources, Raytheon went on to calculate what it claims is a $108.2 million cost increase between sole-source and dual source production of the Sparrow between 1974 and 1978 (including $48.6 million in learning missile qualification, tooling, and test equipment).

NAVAIR's analysis of the AIM-7F second sourcing effort was somewhat different. By extrapolating along the learning curve for Raytheon's sole-source production of the Sparrow, NAVAIR estimated that through FY 1977 Raytheon's price under competition was $42.2 million less than would have been expected. NAVAIR thus estimated that it would break even on the Sparrow in FY 1979. Regardless of the economic analysis utilized, NAVAIR achieved several non-financial benefits from this second sourcing (including design improvement and mobilization base expansion).

Mark 58 Model 3-Rocket Motors -- Hercules, Incorporated developed the Sparrow's rocket motors under a fixed price subcontract to Raytheon. Subsequently, Hercules became a sole-source producer for the motors. Prior to fiscal year 1976, the net cost per unit for the Mk 58 was approximately $8,400

and there appeared little hope that the price would ever go below $6,500 per copy. At that time, the government representatives estimated that second sourcing the motors could eventually lead to a price of about $5,500. At the same time, however, Hercules was able to identify a new supplier of metal parts. That find, coupled with an increase in procurement quantities for the motors, enabled Hercules to cut its prices to about $5,400. Since it seemed unlikely that a new source could attain this lower price, Class Determination & Findings (CD&F) 77-73 disapproved the request to second source the motors. Subsequent problems with the metal parts producer and with Hercules, however, have resulted in NAVAIR reconsideration of the need to second source. Depending of a reassessment of future needs, a second source may be pursued.

Safety and Arming (S&A) Device-Mark 33 -- The Mk 33 was originally developed by Barry L. Miller, Incorporated of Gardena, California. Consolidation of Miller's activities as a consequence of the purchase of the Gardena plant and the subsequent decision to cease production of the S&A device resulted in the loss of the only qualified production source. Competitive RFP's were utilized to award the 1973 buy of 150 units and first articles to Piqua Engineering of Piqua, Ohio (FFP contract for $66,240). The 1974/1975 contract requirements for 710 units were split under a mobilization base exception. Four hundred fifty units went to Piqua (FFP contract for $159,660) and 260 units went to Raymond Engineering at a price of $230,980. In FY 1976, the split awarded 800

units to Piqua and 360 units to Raymond; and, in FY 1977 the split was 1320 units to Piqua and 362 to Raymond. Although the FY 1978 award has not been definitized, it is known that Raymond will receive the largest portion of the award. Unfortunately, deliveries over the past few years have been running about six months behind schedule. NAVAIR is therefore planning to add a third source in the future.

Experience with the Sparrow has shown that, with some complex systems, the use of a TDP for development of a second source is feasible; however, the costs associated with such action may be significant.

TALOS MISSILE -- In 1961, Bendix Corporation was awarded a sole-source contract for the production of the TALOS surface-to-air missile system. Bendix subsequently produced this missile for the Navy as a sole-source until 1966. In that year, the Navy decided to attempt second sourcing of the TALOS. The "know how" and experience gained by Bendix over the course of five years of production as a sole-source supplier of the system stood them in good stead during the second sourcing effort. Bendix won the contract for production of the TALOS through the end of the program in 1968. Of real interest is the analysis of the costs associated with the procurement of the TALOS from 1961 to 1968. The original production contract was awarded at a per unit cost of $219,000. The learning curve demonstrated over the next five years was a shallow one (indicating little improvement), with the unit price on the 1965 purchase

being $160,000. Extrapolating the learning curve, the expected sole-source price of the 1966 contract totalled $155,000 per unit. The award price for that contract, however, was only $92,000 per copy -- 41 percent less than projected. The savings on the 470 missiles purchased under this contract is thus estimated at $32 million. It seems that even though the original producer won the contract, the mere existence of competition for the reprocurement extracted significant concessions in the price charged.

SIDEWINDER MISSILE -- The Sidewinder is the name given to a family of heat seeking air-to-air missiles (AIM-9 series). The first Sidewinder was developed at the Naval Ordnance Test Station (NOTS) in the early 1950's and was originally produced in 1954. The fourth version of the missile was developed in 1960 and PHILCO was awarded a contract to help with pilot production and data package development for the G&C System. In 1964, the Navy advertised in the Commerce Business Daily (CBD) for production of the AIM-9D. Raytheon was the low bidder (40 percent below PHILCO) at $5,000 per missile. Raytheon was thus awarded a FFP contract for production of the Sidewinder in January 1965. As a term of the contract, Raytheon had to prove its ability to produce by manufacturing a quantity of ten G&C units (4 for standard Navy testing by Raytheon itself 6 for extensive ground, sled, launch, and in-place flight tests by NOTS). Raytheon failed in its first attempt to qualify as a Sidewinder producer but was finally successful three months later. Although PHILCO had been able to build its missiles

from Navy drawings, Raytheon attributed its difficulties to an inadequate data package. The resulting systems had experienced low yields, and, as a result, many components had required extensive rework in order to meet specifications. It took substantial effort on the part of Raytheon, NOTS, and NAVAIR before the problems were overcome.

Raytheon claimed that following the requirements of the data package did not guarantee production of qualified units -- they thus sued the Navy for $14.0 million. The case never got to court, but, the $6.6 million settlement agreed to by the Navy tends to support the validity of Raytheon's claim. Subsequently, Raytheon produced several hundred AIM-9D's and approximately 6,500 of the successor AIM-9Gs. The Navy instituted competitive second sourcing attempts for the AIM-9G production lots, but, Raytheon always won the competition.

The next version of the system was the solid state AIM-9H. With this system, the Navy received developmental assistance from both Raytheon and General Dynamics. In the following production phase, Raytheon was awarded a contract for 1,100 missiles and PHILCO-FORD won an additional 700 units in competition with General Dynamics. The Navy, then, offered a contract for an additional 470 missiles which was eventually awarded to PHILCO-FORD. Of special note, here, is the tactic utilized by the Navy to preclude recurrence of the data package problems encountered with the AIM-9D. Provision was made for the payment to Raytheon (the development contractor) for the identification and correction of inconsistencies in the

data package and specifications. The consequent successful performance was considered to have more than justified the additional expense incurred. This success also tends to reinforce the contention that the data package alone is frequently inadequate for the transfer of technology whereas interface between the development/original production contractor and the second source can assure effective transfer. The fact that engineering liaison is one of the first prerequisites cited as necessary for successful commercial licensing makes this observation all the more convincing.

GAU-8A 30MM AMMUNITION -- In 1973, the Air Force A-10 System Project Office (SPO), at the completion of a competitive prototype phase, awarded a contract to General Electric Company (GE) for the GAU-8A gun system. The contract called for full-scale development and follow-on production of both the gun and its associated ammunition. GE's subcontractof for the ammunition development and production was Aerojet Ordnance and Manufacturing Company. DSARC II, in 1974, directed GE to develop a second source for ammunition to satisfy mobilization base and production quantity requirements and to provide for production competition. In fact, the concern was voiced that even if it were impractical to second source the gun itself, a real cost savings potential existed in the case of the ammunition. As in the case of razors and razor blades, ammunition, though not the major implement/tool, accounts for a great deal of the overall life cycle cost of the system.

Three major companies competed for the second source contract. Honeywell was finally selected. GE was still the gun system integrator, but there were to be two ammunition suppliers. Another interesting aspect of this buy was the stipulation that not technological transfer/transfusion between the two ammunition manufacturers could occur. The only requirement was that the ammunition be "form-fit-function" compatible. This stipulation was enacted because of fears that if Honeywell were to merely produce the ammunition to Aerojet's drawings, both companies would be likely to use the same sources for their materials -- a move that would do nothing to expand the mobilization base even though it would introduce some measure of price competition.

At the end of full-scale development, the procurement plan and the DCP specified that initial production buys of the ammunition would be achieved through the integrating contractor. It was further averred that it was too early to bring the second source into production since Honeywell has not yet been fully qualified. The SPO, however, took a calculated risk and directed production sub-contracts to both sources in the hope that Honeywell would soon qualify. A split of 60 percent to Aerojet and 40 percent to Honeywell was awarded on that initial production buy.

In 1976, the procurement plan still called for purchase of the ammunition through the prime integrator, but, the SPO decided to break away from the integrator and buy directly from the two sub-contractors pursuant to the mobilization base

exception. The RFP specified a minimum sustaining rate (20 percent of the total buy) -- guaranteeing that no less than that amount would be awarded to either competitor. Above that minimum level, the offerors were to bid at 16 percent intervals (six separate proposal points) for the entire buy. The major evaluation criteria were cost and mobilization support and planning. Cost and pricing data were required and full field analysis by the Defense Contract Administration Service (DCAS) and the Defense Contract Audit Agency (DCAA) were accomplished, with the results used in the discussions with the two sources. Eventually a best and final offer was solicited and both offerors were awarded quantities in excess of the minimum sustaining rate, indicating a fair degree of competition had been achieved.

Another interesting aspect of this acquisition was the requirement that the offerors build a capacity for a defined peak production (FY80 requirement). In other words, both had to have peak year tooling -- meaning excess individual capacity. The two contractors refused to comply at first, however, the SPO overcame the problem by the use of a special termination clause entitled "Cost Recovery for Contractor Facilities Investment." This clause effectively says that if the acquisition is terminated, the government will assume the cost of the unammortized book value of the extra capital equipment. At the same time, there was a great deal of controversy surrounding the use of this clause; however, it was determined that the clause would not constitute a violation of the Anti-

Deficiency Act since termination of an out-year contract would also mean cancellation of the instant contract thereby freeing funds for the termination. The SPO claims that the only real risk to the government occurs in the first two years. After that, given that used machine tools are constantly appreciating, risk is believed to drop to zero.

Among the lessons learned by the Air Force during the FY77 buy were that there were too many proposal points; there should have been an interpolation method between points; every potential award point should be incentivized (thereby preventing any "loading" of the low award points); and, there was no need to include any subjective evaluation criteria (price alone was a sufficient criterion for this acquisition).

For the FY1978 award, a Dual Competitive Award Methodology (DCAM), which incorporated the above lessons learned, was utilized /Hoppe 1978/. The results of that buy were truly noteworthy. Procurement cycle times were reduced dramatically, and, the savings estimated for that single buy are on the order of $17.0 million -- which allowed a 15 percent increase in the acquisition quantity to be awarded at a price lower than had been projected for the original quantity.

This case illustrates how Form-Fit-Function can be used to effect successful second sourcing of relatively simple systems. Here, although second sourcing was initiated for mobilization base reasons, use of contractual language that indemnified the second source from loss as a result of tooling-up for production, resulted in the qualification of two sources who then

competed vigorously for the larger portions of the awards. Price concessions thus were realized as a collateral benefit for follow-on purchases.

CRUISE MISSILE -- The Cruise Missile engine is an example wherein a directed technology licensing (DL) arrangement is being utilized to provide a second production source. The Cruise engine was originally developed by Williams Research Engineering and Manufacturing. Given the importance of the Cruise Missile to the national defense effort, it was determined that alternate sources must be developed to ensure the integrity of the system against destruction of the sole-source of manufacture. The Joint Cruise Missile Project Office (JCMPO) thus tried to enduce Williams to agree to a licensing agreement whereby a second source for the manufacture of the engine could become qualified. When all attempts to secure such an agreement failed, it was decided that the requirement for an alternate engine be advertized in the Commerce Business Daily and draft RFP's be submitted to industry.

Faced with the development of an alternative engine, Williams finally agreed to the licensing of its engine. The project office told Williams to consider a total of six manufacturers as potential second sources. Since the government believed that more than enough adequate production facilities already existed in the market, it was stipulated that no new facilities were to be constructed in connection with the contract. The first source recommended by Williams was rejected by the government evaluation team; however, Teledyne,

which was determined to have sufficient capacity, technical competence (since they were presently producing Harpoon Missile engines), and an excellent engineering staff, was approved as a second source by the government.

The JCMPO is presently negotiating a definitive licensing agreement. Among the important factors being addressed are sharing arrangements, royalties, and, where applicable, maintenance. The fact that both sources will be capable of competing for both manufacture and maintenance of the Cruise missile engine has stimulated optimism about the potential for significant cost savings downstream.

The Air Launched Cruise Missile (ALCM) is expected to be produced under a Leader-Follower concept (under a mobilization base exception). Two alternative methods of selecting the follower are being considered: (1) competitive selection of the follower, or (2) selection, by the government, of the unsuccessful development offeror as the follower. One important element in the source selection process will be the technology transfer plan of the offerors. This plan is to have three elements: a master schedule for follower development (complete with meaningful contract events); a statement of work outlining what the leader must do to make the follower capable of producing forty percent of the contract requirement; and, a proposed work task statement for the follower. The initial contract period for the leader-follower arrangement is fiscal year 80/81. The first year's technology transfer effort is to be directed at completely indoctrinating the follower (acting as a sub-

contractor) in the leader's manufacturing approach and at preparing the follower for pilot production.

During the next year, the follower still operates as a subcontractor and the technology transfer effort is designed to result in limited production of the complete system. A capability must be developed such that the follower is capable of producing between 40 and 60 percent of the FY 1982 purchase.

In FY 1982, it is projected that the follower will be tasked with producing 40 percent of the leader company's production requirement -- still in a subcontractor capacity. In case the follower encounters difficulties, the leader can reduce this quantity in consonance with the level of production capability demonstrated by the follower.

In all subsequent buys, awards will be made under full competition with government contracts being awarded to both sources. Government tooling will be shared by both contractors with a minimum of 40 percent going to either contractor. Buy-out (winner take all award) may be executed at any time by the government. Although this acquisiton is in its early stages, the procedures being utilized appear instructive. Another good example of the use of the leader-follower technique is found in shipbuilding contracts. Much has been devoted to this program in the literature /e.g. ASN(MRA&L) 1978/ so it will not be covered in this study.

AIRBORNE SELF-PROTECTION JAMMER (ASPJ) -- The U. S. Naval Research Laboratories originally designed and developed the ASPJ with the stated objective of providing all Navy tactical aircraft with an acceptable probability of success and survivability during the 1980's and beyond. It is currently scheduled for the F-18/A-18, F-14A, EA-6B, A-6E, and AV-8B aircraft as a minimum. Eventually, as many as four thousand aircraft could carry these units, making this program worth some $2.0 billion.

One of the objectives of the program is to have a high initial production rate that will be maintained for a considerable period of time. No single company could handle the projected production schedule; and, at the same time, the potential dangers of sole-source acquisition make the idea of production competition especially attractive on a project of this magnitude. NAVAIR, thus, introduced a relatively new concept for this acquisition -- contractor teaming. Presently, two teams have been selected to produce engineering development models: ITT/Westinghouse and Sanders/Northrup. Following a critical design review in January 1980, a single team (both members of which will be fully qualified producers of the entire ASPJ system) will be selected and production quantities will be awarded to the members of that winning team. Quantities awarded to the individual team members will be determined on the basis of an award competition between the two former team mates. The split itself will be determined on the basis of cost to the government -- the combination that is cheapest

overall. Initial production deliveries are scheduled to begin in mid-1980.

The teaming concept is an intellectually intriguing one. The question remains whether or not two historical adversaries can or will engage in the full interchange of information and technology necessary to enable both to establish fully competent independent production lines capable of producing the entire system. Since the resultant product will have been co-developed, the award criteria for production buys will hinge on price, quality, and delivery performance. To date, problems encountered encompass such factors as management coordination, proprietary data and process considerations, division of labor, and other such parochial concerns. It is yet to be determined whether or not the incentives for cooperation ($2 billion in combined sales) will be able to overshadow the selfish concerns of the individual team members.

The enormity of this project will most definitely have an adverse effect on any losing team -- in fact it has been postulated that the Electronics Warfare market will necessarily shrink because many of the losing contractors will be unable to recover from the loss of this contract. Perhaps the advantages of cooperation, in this case, are too overpowering to be overlooked. One government representative expressed sincere concern, however, that the lead member of any team will have significant incentive to ensure that the other member is never quite fully equal to the leader -- thereby securing for that leader a competitive advantage on future procurements. Regard-

less of the outcome, teaming is a stimulating concept and ASPJ should be studied carefully in order to determine the viability of the method for future projects.

V. THE SECOND SOURCING METHOD SELECTION MODEL (SSMSM)

PREFACE -- As outlined in Harvey T. Gordon's memorandum of 13 February 1979 /Appendix D/, there are a number of techniques for establishing a second source for production of a weapon system. The process of deciding which, if any, of these techniques to use should follow a logical series of steps: (1) specific objectives/policy goals to be fulfilled must be clearly stated and understood, (2) a determination must be made as to the adaptability of the project in question to second sourcing, and, (3) the acquisition alternative that will best achieve the stated goals must be selected. Mr. Gordon went on to delineate seven potential reasons for establishing a second source:

(1) broadening the production base

(2) evening out the flucutation in the defense industry which leads to feast or famine situations for individual firms

(3) achieving savings through increased competition

(4) achieving superior equipment through increased competition

(5) facilitating NATO participation as co-producers or through offsetting co-production as sub-contractors

(6) facilitating the attainment of socio-economic goals by increased award to minority and small business contractors, and,

(7) preserving competition for the sake of competition per se.

It is fully conceivable that some of these objectives may, in fact, be in conflict. If such is the case, a determination

must be made as to the relative importance of said objectives so that those having the greatest impact may be considered as controlling.

Once the reasons for second sourcing have been established, this chapter presents a model which may be used by the Program Manager and/or the Contracting Officer in determining (1) whether or not the generation of a second source is feasible, and (2) which second sourcing methodology is best suited to the given acquisition situation. It is intended that this chapter be of sufficient breadth and depth that it can stand alone -- apart from the rest of the thesis. As a stand alone document, the chapter can be extracted from the thesis and used as a decision tool by Program Managers faced with second sourcing decisions. The Second Sourcing Method Selection Model (SSMSM) was developed jointly by this researcher and LCDR Benjamin R. Sellers, SC, USN who will also be utilizing the model (under the title: Competitive Method Selection Model) in his forthcoming thesis entitled, "Competition in Major Weapon System Acquisition."

The following topics will be discussed in the remainder of this chapter: methods of generating a second source; variables affecting the second sourcing decision; and, the model itself -- including its format, the rationale behind the effectiveness factors incorporated therein, and, a discussion of the actual use of the model.

METHODS OF GENERATING SECOND SOURCES -- This section discusses five methods which can be used to provide two or more sources

for second source production of a weapon system. Each method has advantages and disadvantages. The five methods to be described in the following pages are: form-fit-function, technical data package, directed licensing, leader-follower, and contractor teams. It should be emphasized that, where possible, the decision of whether or not to pursue second sourcing be made as early as possible in the life of the program so that the development contracts can be structured to facilitate the technology transfer which is essential to production competition. If the program manager waits until the design selection is made to consider production competition, he will encounter stiff and possibly insurmountable opposition from the "other half" of the bilateral monopoly which he has created.

Form-Fit-Function (F^3). This method involves introduction of a second production source without need for a technical data package or for interaction between production sources. The second source is provided with functional specifications regarding such parameters as overall performance, size, weight, external configuration and mounting provisions, and, interface requirements. This is the classic "black box" concept where it is not necessary to define the internal workings of the product. It is used frequently for the acquisition of expendable non-repairable items where the ability of the system to perform as required is not dependent on what is inside the "box." The method does not work well where field level maintenance of the system is envisioned since the provision of non-identical items makes stockage of repair parts and training of

maintenance personnel potentially insurmountable problems. These objections can sometimes be overcome by the use of warranty provisions, renewable maintenance contract provisions and/or provisions for contractor services to set up the necessary government maintenance capabilities to support the equipment throughout its lifetime. The advantages of acquisition by F^3 specifications include:

(1) Detailed design responsibility is clearly assigned to the contractor. If the item fails to meet specifications, the contractor must alter the design until specified operation is achieved.

(2) There is no design data package for the government to procure or maintain.

(3) Requirements for technical capability within the government are minimized. This is the path of least involvement on the part of the government in contracting, contract monitoring, etc.

(4) Standardization can be achieved among multiple sources through two-way interchangeability of products which may differ internally. These multiple sources may be exercised simultaneously.

The disadvantages include the following:

(1) Each procurement contains a development effort unless the product is off-the-shelf modified. Some time and money are involved each time the item is procured for engineering, changes, production learning curves, and debugging.

(2) Each time a procurement is made, the contractor who has the least appreciation for the total significance of the specification and the effort to accomplish the task is likely to be the low bidder. This means the source selection criteria must be very carefully constructed to include mechanisms to demonstrate contractor awareness of critical elements as well as his capabilities to produce the item.

(3) The costs of repair parts will tend to become excessive when a contractor realizes that he is in a somewhat sole-source position with respect to his equipment unless the total maintenance for the service life of the equipment is provided for in the

procurement contract while competition is still being maintained.

(4) Careful specification of all external parameters is required to ensure true interchangeability. /5:vi-10/

Technical Data Package (TDP). This method involves utilization of a stand alone technical data package to solicit proposals from manufacturers who may not have been involved in initial development of the system or in initial production. Ordinarily this is accomplished through the invocation of an appropriate data rights clause in the original R&D or initial production contract. Even where no such clause exists, it may be possible to buy the data package subsequent to production. In the absence of such a clause, the original developer/producer may consider the design, or portions of it, to be proprietary; and, hence, may be reluctant to provide a complete TDP to the government. The cost of procuring the data package subsequent to initial production may thus be prohibitive. This method assumés that the data package alone is sufficient to allow production of the system by alternate manufacturers. Although it has been successfully utilized, there are frequent examples where significant difficulties have been faced in applying the method. Its chief attraction is that the existence of an adequate data package can result in the maintenance of a competitive environment throughout the life of the project.

Although theoretically sound, this method is perhaps the most hazardous of all the second sourcing methodologies. It is not well suited for use with highly complex systems or

systems with unstable design or technologies. Experience has shown that drawings and specifications alone are often insufficient to secure effective transfer of manufacturing technology. "The critical factors may be craftsman's skills, ingenious processes, 'tricks of the trade' and esoteric shop practices that cannot be reduced to formal or informal paper." [6:83] Once the data package has been accepted from the developer, the government effectively guarantees its accuracy and adequacy to the second source. If defects are subsequently discovered in the TDP, as is almost always the case, the second source may have the basis for a claim against the government. Some methods of minimizing this particular problem include: requiring the producer of the data package to certify its adequacy; pre-production evaluation by the second source; and, the use of a latent/patent defects clause in the contract with the second source, to name a few. The use of a latent/patent defects clause, however, is experiencing significant disfavor, because it is being maintained by many legal representatives that the mere existence of such a clause is tantamount to governmental acknowledgement of the inadequacy of the package. This puts the government in a precarious legal position in the event of subsequent claims.

There are other problems associated with the TDP approach. Although there are those who maintain that if the system was developed under government contract, there should be no proprietary rights to any of the data; the fact remains that much of the data required for successful technology transfer may be

encumbered with claims that the information is proprietary. These problems center on the definition of "proprietary data" and "trade secrets" and on whether or not the government has the right to require the dissemination of such information. A complete discussion of these questions is beyond the scope of this study, however, they are discussed in detail in a Rand Corporation report by James W. McKie entitled "Proprietary Rights and Competition in Procurement." A 1975 report of the National Materials Advisory Board of the National Academy of Sciences entitled "The Effectiveness of the Army Technical Data Package in Technology Transfer for Procurement" provides valuable information regarding the use of the TDP as a vehicle for generating production competition.

The major advantages of second sourcing via the TDP include:

(1) The TDP can be used repeatedly in maintaining a competitive atmosphere throughout the production phase of the acquisition.

(2) Once the TDP is validated and proven adequate for production of the system, the mechanics of second sourcing are relatively simple. There need not be any contact between production sources and it is even possible to eliminate the original source altogether.

The primary disadvantages of the method are:

(1) It may be exceptionally difficult to obtain a complete and accurate TDP that is free of encumberances and which, when followed, will yield a qualified product.

(2) The procuring authority must have access to whatever "in-house" talent is necessary to ensure resolution of data package problems.

(3) Even where drawings and specifications are complete and accurate, transfer of complex technology is often impossible without the benefit of engineering liaison between sources of production.

(4) Technological differences between companies (e.g., differing process methodologies) may be such that the second source does not have the capability of performance in accordance with the data package.

Directed Licensing (DL). In its pure form, this method involves the inclusion of a clause in the early development contract allowing the government to re-open competition for follow-on production, select a winner, and appoint him as a licensee. Then, in return for royalty and/or technical assistance fees, the licensor (development contractor) will provide the licensee with manufacturing data and technical assistance to help the second source become a successful producer.

As used in many current acquisitions, licensing agreements are also being negotiated where no provision for such an agreement was included in the development contract. Such arrangements may, however, be considerably more costly than those specified in the original development contracts. There has also been a trend toward allowing the licensor to choose his own licensee -- subject to government approval.

This method involves not only the transfer of data from the developer to the second source, but also provides for the transfer of manufacturing "know-how." The developer is normally awarded the first production contract and is contractually bound to licensing another contractor for production of an unspecified number of future systems. In fact, the provisions of the licensing agreement (including royalty fees; if any) should normally become one of the source selection criteria used in choosing the winning developer.

Directed Licensing seeks to solve technology transfer problems associated with the TDP methodology by providing for necessary engineering and manufacturing liaison between the sources which is then incentivized through the royalty procedure. It derives its attractiveness from the fact that subsequent reprocurements can be competed -- in whole or in part -- even where complex systems technology is involved. The technique of commercial licensing has been used successfully in industry for years -- especially by firms desiring the sale of their products in foreign markets. In fact, more than 10,000 aircraft have been manufactured by companies that were not involved in the original R&D work. [Johnson 1968]

Promising as directed licensing may appear, it does entail the incursion of significant identifiable costs. If the royalty fee is unreasonable, the benefits of competing the production buys will be significantly reduced. If the developer can provide an acceptable product at a lower price than could a second source, however, the government need not exercise the licensing option. The mere threat of competitive options may be a sufficient incentive for the developer to maintain efficiency and keep costs to a minimum.

For a more detailed discussion of directed licensing examination of the Rand Corporation report by Gregory A. Carter entitled "Directed Licensing: An Evaluation of a Proposed Technique for Reducing the Procurement Cost of Aircraft" [Carter 1974] is invited. In 1969, the General Accounting Office (GAO) performed an evaluation of the feasibility of

implementing directed licensing. The resultant report [Comptroller General 1969] cites several potential problems with the technique and concludes that directed licensing would not provide a workable solution to the problem of reducing the cost of major systems. The potential problems cited by GAO are addressed in the Carter article and are considered critical to understanding and evaluating the potential effectiveness of directed licensing.

The advantages of directed licensing include:

(1) The potential for production competition is maintained throughout the acquisition cycle.

(2) The government need not become closely involved with the actual transfer of technology between sources.

(3) Quantity production decisions and source of supply decisions can be postponed until later in the acquisition process.

(4) The designer is provided with protection as to how, or in what markets, the second source is to be licensed to sell the product; and, the designer is compensated for each item produced by the second source.

The disadvantages of directed licensing include:

(1) The existence of royalty and technical assistance fees increases the cost of the acquisition and could be prohibitive.

(2) It may be difficult to achieve the necessary degree of cooperation between alternative production sources, and the licensee may have little recourse against half-hearted cooperation on the part of the licensor.

(3) Some contractors may bid on projects simply to obtain proprietary information on other producers' designs.

(4) It may become difficult to maintain design accountability.

Leader-Follower -- The DAR defines leader-follower as "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." DAR limits the use of this technique to situations when all of the following conditions are present:

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

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

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

(4) the government reserves the right to approve contracts between the leader and follower companies.

DAR suggests the following three methods for establishing a leader-follower relationship (no preference is indicated as to which method should be used):

(1) 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.

(2) 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.

(3) 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.

Leader-follower procurements have been undertaken in the past more for the purpose of meeting delivery schedule requirements due to the lack of capacity of a single source, rather than for increasing competition. However, since the concept encompasses dual or parallel production lines, splitting the award quantity on a high-low percentage basis would still insure a significant degree of competition for the annual production contracts.

The advantages of leader-follower are similar to those of directed licensing in that:

1. It provides a technique for transferring part or all of the production of a complex system to a second source.

2. Competition can be utilized to determine the acquisition split awarded to each qualified producer even when two sources are maintained throughout the acquisition cycle.

3. It has been used successfully in the past.

The major disadvantage of the leader-follower technique is:

1. "Leader" companies may be less enthusiastic about this technique than directed licensing because leader-follower contains no royalty provisions for proprietary data nor does it provide some of the protection that may be present in a licensing arrangement.

Contractor Teams. A recent innovation in the generation of production competition is represented by the contractor teams which are currently competing in the design selection phase of the Airborne Self-Protection Jammer (ASPJ) system. In the solicitation for the design of the ASPJ, the Naval Air Systems Command (NAVAIR) required that offerors form teams of two or more contractors. This acquisition strategy envisions the

award of a production contract to the team which eventually wins the design competition. Following initial production, both contractors are expected to have the capability to produce the complete system. DAR provides a brief discussion of contractor teams including a policy statement on the use of teaming arrangements. The implication of DAR is that the government will generally permit contractor teams, but it does not mention actions by the government to require the formation of teams as was done on the ASPJ. DAR does mention that some contractor teaming arrangements may violate anti-trust statutes. The program manager and/or the contracting officer must be sensitive to this possibility in order to prevent its occurrence.

The advantages of requiring contractor teams are:

(1) It should prevent most of the problems in qualifying a second source, since at least two contractors were involved in the design and initial production.

(2) It should also reduce or eliminate the feeling on the part of either contractor that trade secrets or proprietary data are being given away to outside sources.

(3) No liaison fees or royalties will be involved in the establishment of the second source.

(4) The design talent of two contractors will be brought to bear on each proposal, thereby increasing the opportunity for successful and innovative designs.

(5) It provides a vehicle for increasing the capacity of the industrial base.

The disadvantages of contractor teams are:

(1) The design phase may be more costly since at least two contractors are involved on every proposal.

(2) It requires a great deal of cooperation and coordination by the contractors.

VARIABLES AFFECTING THE PRODUCTION COMPETITION DECISION -- The selection of the "best" method for generating production competition will vary depending on a number of factors extant in any acquisition program. The existence of these factors (i.e., decision variables) presents the program manager with a difficult, multi-faceted decision situation. He must consider the strengths and weaknesses of each competitive method in relation to the influence of the variables in his acquisition program.

In order to assist the program manager in logically and systematically selecting the optimal competitive method, an evaluative model is needed. The model should rank each of the competition techniques against each of the decision variables. Then, by objectively evaluating the influence of each of the variables, the program manager will be led to an optimal choice of which method of competition to use in his program. At a minimum, one or two of the methods may be shown to be clearly superior to the others, thereby reducing the complexity of the decision situation.

The next section presents such a model. Before describing the model, however, it is necessary to define the decision variables on which the model is based and to describe the general impact which each of the variables has on the feasibility of production competition.

SECOND SOURCE DECISION VARIABLES --

Quantity to be Procured -- The ultimate quantity to be procured and the rate at which the government will place orders

for production will have a significant effect on the adaptability of the project to second sourcing. In general, the larger the quantity to be procured, the more feasible it is to have production competition. The ideal situation for second sourcing would entail large quantities needed at a rapid rate over a number of years. Any deviation from this ideal will tend to lessen the cost effectiveness of generating a second source.

Duration of Production -- As alluded to above, it is generally true that the longer the duration of the projected production, the more feasible second sourcing becomes. For example, suppose the production phase is to be only four years long, and it takes at least two years to bring a second source on line (including source selection, start-up of the plant, and production of a learning/qualification quantity). In this case, there would be only a year or so left for production of the system by the second source, in which case second sourcing would be an inappropriate strategy.

Slope of the Learning Curve -- The flatter the slope of the learning curve, the more adaptable the project becomes to second sourcing. With a steep learning curve, the more units produced by the original source before a second source is brought "on-line," the more unlikely it becomes that the second source can effectively compete with that original producer who is, by then, a more experienced and efficient producer.

Complexity of the System -- The more complex the system, the more essential is the need for cooperation and liaison between the two production sources, and the less adaptable is the project to second sourcing.

State-of-the-Art -- If the technology employed in the system is at the leading edge of (or advances) the state-of-the-art, it becomes unlikely that a second source will be able to produce the system without significant difficulties -- probably necessitating significant cooperation between the original and second source producers.

Other Potential Government or Commercial Applications -- If the system has wide applicability for other government or commercial uses, the original developer is more likely to demand some form of protection for his "trade secrets" or "proprietary data" than if the market for the product is very limited. On the other hand, the interest of potential second sources in the project will be stimulated if other applications for the hardware exist.

Degree of Privately Funded R&D -- The greater the degree of privately funded R&D on which the design is based, the more reluctant the developer will be to release his design to a second source. This is particularly true if no restrictions are placed on the use of the design by that second source.

Cost of Unique Tooling/Facilities -- As special tooling/facilities requirements and costs increase, the number of potential second sources decreases and the probability of being able to bring a second source on line in a cost effective

manner decreases. Also pertinent will be other start up and non-recurring costs, including first article acceptance testing. The higher these costs become, the more difficult it is to amortize them over the duration of the acquisition.

Maintenance Concept to be Employed -- Second sourcing, with its multiple producers, can have significant impact on the maintenance considerations of the system. Wherever two systems of the same type are non-identical, the ability to support those systems with field level repair parts and maintenance personnel becomes diluted.

Cost of Transferring Unique Government Owned Tooling/ Equipment -- If any unique government-owned tooling is difficult or expensive to transfer from one contractor to another, it may be necessary to provide duplicate sets of tooling in order for a second source to become a viable competitor. The cost of transferring tooling, then, can work in the same manner as the cost of the tooling itself in inhibiting the adaptation of the project to second sourcing.

Contractor Capacity -- If the original producer does not have the ability to produce needed quantities of the system according to the required delivery schedule, development of a second source may become mandatory. Lack of adequate capacity may thus be considered a controlling factor in deciding for second sourcing. If, on the other hand, the original producer has sufficient or even excess capacity, reduction in the production quantities awarded may significantly increase the costs of production through increased overhead.

Production Lead Time -- The longer the production lead time, the longer it will take to bring a second source on line and the less appealing becomes the second sourcing option.

Contractual Complexity -- The more complex the original production contract (e.g., Life Cycle Cost parameters, Design to Cost considerations, Warranty Agreements) the less adaptable to second sourcing the project becomes. With warranties, for instance, it may be necessary to keep two sources capable of performing warranty work throughout the life of the project -- even though a production buy-out may have been exercised at some point in the acqusitiion.

Amount and Type of Subcontracting -- If the number of qualified subcontractors is limited and the degree of reliance on those subcontractors is necessarily heavy, the benefits to be realized through second sourcing are necessarily lessened.

THE MODEL -- The Second Sourcing Method Selection Model (SSMSM) shown on the following pages is heuristic in nature. Its objective is to provide a logical and systematic framework for evaluating the applicability of each of the competitive methods in light of the variables present in the acquisition situation. The end result of the evaluation process will (at best) be the selection of the optimal competitive technique. At worst, use of the model should serve to eliminate one or more techniques from further consideration. In that case, the decision situation will have been simplified and certain of the variables should emerge as being critical, thereby, suggesting the areas which need further investigation and/or consideration.

Format of the Model -- It should be noted that the model is actually two models. The pre-production model (page 77) is for use by the program manager who is developing his overall acquisition strategy. In other words, the program second sourcing decision is being made at some point prior to DSARC II. The post-production model (page 78) is for use by a program manager who is already in the production phase of the program and is considering the generation of a second source for part or all of the remaining life of the acquisition. It is necessary to differentiate between the two situations because the effectiveness factors assigned to each of the methods change significantly depending upon whether the second sourcing decision is being made early or late in the program's life cycle.

The SSMSM lists the fourteen decision variables vertically on the left. Each of these variables is divided into two or three categories (e.g., high-medium-low, yes-no) to allow the model to be tailored to the refinements of a given acquisition situation. Across the top of the model are listed the second sourcing methodologies. It should be noted that the five methods, (F^3, TDP, DL, LF, and CT), when placed in that order, represent a line of continuum with respect to the degree of cooperation and contact needed between the original developer and the second source. For example, second sourcing on the basis of F^3 or TDP involves no need for contact between the two contractors. At the other extreme is CT which represents a formal alliance between two or more contractors. Recognizing this relationship among the methods provides a better under-

standing of the way each method relates to the variables and to the other methods. Understanding this relationship may even lead to effective modification or hybridization of the techniques not previously considered.

Effectiveness Factors -- The model rates the effectiveness of each of the methods with respect to each of the decision variables. A simple three point system of "+", "0", or "-" is used to denote whether a given method is particularly strong, neutral, or weak with respect to each of the variables. An "X" is used to denote a situation where the use of a given method is particularly inappropriate, or, to caution that particular care should be used in applying a given method in that situation. A "*", on the other hand, indicates that the method is particularly well suited to the situation under consideration.

The three point system is used because of the non-quantifiable nature of the model. A wider scale (-5 to +5, for example) would merely invite argument over the rankings assigned and would detract from the main purpose of the model. The primary value of the model is that it serves as a guide to the subjective decision process and that it gives recognition to the differences among the methods. It is not intended to provide an elaborate quantification scheme which removes the need for experience and judgement.

DISCUSSION OF THE MODEL'S WEIGHTINGS --

Quantity -- Low production quantities make successful second sourcing difficult, at best. None of the methods will

work well under such circumstances. By the time the second source is qualified as a producer, the savings potential on the remaining quantities will probably not justify the associated expense. In the post-production phase, the difficulties usually associated with the qualification of a second source through the use of a TDP make that method especially undesirable; whereas, the relative simplicity of the F^3 technique yields the greatest probability of success when low quantities are involved. Only where the magnitude of the system and its price are truly significant will small quantities justify the use of the DL, LF, or CT methods. As quantities rise, the viability of all the methods increases. Because there is a dilution of the total quantities to be produced subsequent to initial production, the pre-production portion of the model appears slightly more favorable than the post production portion with respect to quantity.

Duration of Production -- The rationale provided in the discussion on quantity also pertains to the duration of production variable. Any attempt to qualify a second production source will take time, and, the likelihood of success decreases as the time required for the qualification of a second source increases. DL and LF techniques are therefore especially unsuitable since both assume original production by the development contractor.

Slope of the Learning Curve -- If the demonstrated learning curve of the original producer is flat, all methods are worthy of consideration. Where steep learning is exhibited,

the original producer will experience a significant competitive advantage for future awards; and, if cost savings is the object of the second sourcing effort, it may be extremely difficult to justify going to an alternate source. It should be noted, however, that a steep learning curve might also indicate that the base price was unrealistically high in the first place -- resulting in an unjustifiably inflated original award.

Technical Complexity -- DL, LF, and CT are techniques that are designed to provide the necessary liaison and cooperation to assure effective transfer of even highly complex technology. CT is especially effective under such circumstances since the teams can be constituted such that complementary technologies can be brought together. When production by an original source has begun, CT, in the pure sense is not possible, however, a team of competitors might be attracted to vie for follow-on production contracts. Problems with TDP's are often insurmountable without costly and labor intensive effort when high levels of technology are involved. It is not impossible to use this method in such cases, however, extreme care must be exercised to ensure the adequacy of the data package and to ensure the choice of a second source which is likely to be capable of overcoming data package problems. The simpler the system, the more probable becomes the success of all the methods.

State-of-the-Art -- The same rationale provided for the technical complexity factor applies to the state-of-the-art

variable. The more liaison between the production sources, the greater is the chance of successful technology transfer -- transfer of state-of-the-art technology by data packages alone is virtually impossible.

Other Government and Commercial Applications -- Where there are expected to be significant alternative uses for the system, the original producer may be expected to claim or generate legal or quasi-legal barriers (patents, trade secrets, proprietary data) to the dissemination of his design unless he is handsomely compensated or is given specific protection in the form of limitations placed on the use of his design. DL provides royalty payments to the developer/original producer; F^3 does not require the transfer of data; and CT arrangements specify that both members of the team will be capable of producing the end item so these methods facilitate the award of alternate follow-on production contracts. With a TDP, the post-production use of the method is less attractive since the original producer will usually have proof of alternative uses rather than conjectured alternatives.

Degree of Privately Runded R&D -- If the contractor's privately funded R&D led to the development of a design that the government selects for production, it is almost certain that a significant amount of proprietary data will be included in the design package. In such a circumstance, he is likely to vehemently resist any attempt to disseminate that information. With DL and CT methodologies his rights will be protected or he will receive compensation for the use of his data so

his resistance will be somewhat less violent. Although it is difficult to imagine a situation wherein all the R&D would be privately funded, the existence of a single critical process that is truly proprietary will greatly lessen the chance of second sourcing success.

Special Tooling Costs -- When the cost of special tooling is significant, the willingness of potential competitors to enter the market -- without provision of government-owned tooling or unless the quantity and duration of production is sufficient to allow ammortization of the costs of such tooling -- is limited. Regardless, the original producer will have a real competitive advantage where high tooling costs are included. Even where the tooling is government-owned, the potential disruption associated with the transfer of the tooling may be unacceptable -- requiring duplicate tooling to be provided. A contractor teaming arrangement, subsequent to initial production, might result in the need for three separate sets of tooling -- making such an arrangement particularly unpalatable.

Cost of Transferring Unique Government-Owned Tooling -- Shifting of production units from one source to another implies one of two alternatives: (1) shifting the government-owned tooling, or, (2) providing additional -- perhaps excess -- capacity in the form of duplicate tooling and equipment. Of course, where mobilization base considerations are controlling, the latter is mandated. Also, where the cost of buying duplicate tooling is less than or equal to the cost of transfer-

ring the tooling from year to year (including disruption costs), this variable may be eliminated from consideration. Since the cost of transferring tooling and equipment has an equivocal affect on all methodologies, the weighting assigned to each is identical.

Capacity of the Developer/Original Producer -- When the original producer does not have sufficient capacity to allow him to manufacture the desired systems in required quantities, at required quality and to deliver those systems in accordance with the prescribed schedule, any of the methods may be considered. Where sufficient or excess capacity exists with the original producer, it may be more costly (especially in the short run) to second source than it is to remain with the original source alone. Cutting the quantities awarded to a source, with existing excess capacity, usually means that the fixed overhead must still be spread over the now lower quantities -- yielding higher prices.

Maintenance Requirements -- Where field level maintenance needs are relatively insignificant, second source production presents little or no problem. As the need for field maintenance increases, however, the non-identical nature of second sourced systems becomes more difficult to accommodate. F^3 systems usually exhibit the least degree of commonality and therefore cause the most severe maintenance and support problems.

Production Lead Time -- The longer the lead time associated with the production of the system, the more difficult it becomes to bring alternative producers on line early enough

to realize the potential advantages of second sourcing. This holds true regardless of the second sourcing method chosen.

Contractual Complexity -- The more complex the contractual relationship between the original producer and the government, the greater are the barriers to successful second sourcing. Life Cycle Cost parameters, Reliability Improvement Warranties and other contractual complexities become difficult to enforce when dealing with multiple sources. In fact, the cost of maintaining multiple source warranties may become prohibitive.

Degree of Subcontracting -- Where there is a great deal of subcontracting or where the number of firms capable of performing subcontracting functions is limited, the advantages of second sourcing the prime contract will be diluted. Given the fact that the primes may be forced to compete for the services of the same subcontractors, or use the materials of a single supplier, the prices may even rise with second sourcing.

USE OF THE MODEL -- As stated earlier, the model is not designed to be a strictly quantified decision-making device wherein the evaluation factors for each method are summed and the method with the highest "score" is selected. The correct use of the model requires the use of judgment at every step. The first (and possibly most difficult) step is to evaluate the acquisition situation in terms of the decision variables (that is, to determine whether the acquisition will cover high, medium, or low quantities; whether technical complexity is high, medium or low; and to make similar judgements about the other variables). The program manager is encouraged to add

new variables to the list as he sees the need for them. The next step is to evaluate the second sourcing methods in relation to the variables which exist in a program -- realizing that some variables will be more important than others. One method may turn out to dominate all the others or there may be more than one feasible method. Additional judgement will, therefore, be required. It may even be possible to allow the competing contractors to have an input to the decision process. If the model can simplify and guide the thought process so that: (1) all significant variables are recognized and objectively evaluated, (2) clearly inappropriate second sourcing strategies are eliminated, and (3) an appropriate method is selected, then the model will have served its purpose.

SECOND SOURCING METHOD SELECTION MODEL (PRE-PRODUCTION)

Variables		Methodology				
		F^3	TDP	DL	L-F	CT
Quantity	High	+	+	+	+	+
	Medium	+	+	0	0	+
	Low	0	0	-	-	0
Duration	Long	+	+	+	+	+
	Medium	+	+	0	+	+
	Short	0	0	X	X	0
Learning Curve	Steep	-	-	-	0	0
	Flat	+	+	+	+	+
Technical Complexity	High	0	X	+	+	*
	Medium	+	-	+	+	+
	Low	+	+	+	+	+
State of the Art?	Yes	0	X	+	+	*
	No	+	+	+	+	+
Other Application	Yes	+	0	+	0	+
	No	+	+	+	+	+
Degree of Private R&D	High	0	X	0	X	-
	Low	+	0	+	+	+
Tooling Costs	High	-	-	-	-	X
	Low	+	+	+	+	+
Govt. Tool Transfer Cost	High	0	0	0	0	0
	Low	+	+	+	+	+
Contractor Capacity	Excess	-	-	-	-	-
	Deficient	+	+	+	+	+
Maintenance Requirement	Significant	X	0	0	0	0
	Minimal	+	+	+	+	+
Production Lead Time	Long	-	-	-	-	-
	Short	+	+	+	+	+
Degree of Subcontracting	Heavy	0	-	-	-	-
	Light	+	+	+	+	+
Contractual Complexity	Complex	-	-	-	-	-
	Simple	+	+	+	+	+

SECOND SOURCING METHOD SELECTION MODEL (POST-PRODUCTION)

Variables		F^3	TDP	DL	L-F	CT
Quantity	High	+	+	+	+	+
	Medium	+	0	0	0	0
	Low	0	X	-	-	-
Duration	Long	+	+	+	+	+
	Medium	+	0	0	0	0
	Short	0	X	X	X	-
Learning Curve	Steep	0	0	0	0	0
	Flat	+	+	+	+	+
Technical Complexity	High	0	X	+	+	+
	Medium	+	-	+	+	+
	Low	+	+	+	+	+
State of the Art?	Yes	0	X	+	+	*
	No	+	+	+	+	+
Other Application	Yes	+	-	+	0	+
	No	+	0	+	+	+
Degree of Private R&D	High	0	X	0	X	0
	Low	+	0	+	+	+
Tooling Costs	High	-	-	-	-	X
	Low	+	+	+	+	+
Govt. Tool Transfer Cost	High	0	0	0	0	0
	Low	+	+	+	+	+
Contractor Capacity	Excess	-	-	-	-	-
	Deficient	+	+	+	+	+
Maintenance Requirement	Significant	X	0	0	0	0
	Minimal	+	+	+	+	+
Production Lead Time	Long	-	-	-	-	-
	Short	+	+	+	+	+
Degree of Subcontracting	Heavy	0	-	-	-	-
	Light	+	+	+	+	+
Contractual Complexity	Complex	-	-	-	-	-
	Simple	+	+	+	+	+

VI. CONCLUSIONS/RECOMMENDATIONS

Although second sourcing is a term familiar to most acquisition personnel, there is no generally accepted definition of the term. It is therefore recommended that a rather loose and all encompassing definition be adopted for the term as follows: "second sourcing" is a compendium of techniques and methodologies utilized to ensure the development of alternative production sources. Any methodology which seeks to secure the qualification of more than one major system production source, then, can be defined as a second sourcing technique. Although the only second sourcing methods examined in this study are: Form-Fit-Function (F^3), Technical Data Package (TDP), Directed Technology Licensing (DL), Leader Follower (LF), and Contractor Teaming (CT), these methods are by no means considered all inclusive.

Even though second sourcing is frequently alluded to in the acquisition literature, it is a subject on which little definitive research has been accomplished (neither do current instructions on major weapon system acquisition contain specific reference to second sourcing or the methods through which second sourcing is accomplished). Several current studies, however, are being pursued on the general topic of production competition. The Institute for Defense Analyses, the Logistics Management Institute, and the Army Procurement Research Office are all involved in such studies. The results of these inquiries may add significantly to the body of knowledge avail-

able to the Project Manager.

In the present atmosphere of a decreasing defense budget, it becomes imperative that each and every person responsible for the acquisition of weapon systems be on the lookout for ways to improve the acquisition process. Historically, it has been demonstrated that the existence of sole-source producers of defense hardware is often a less than optimal situation -- there is often little motivation for such a contractor to be truly effective and efficient, and, the cost benefits of competition are lacking.

There are a number of possible reasons for pursuing second sourcing on a given project. Cost savings from increased competition; broadening the production base; evening out fluctuations in the defense industry; achieving superior equipment through increased production competition; meeting NATO rationalization, standardization, and interoperability objectives; attainment of socio-economic goals; and, political considerations may all be facilitated by second sourcing.

Having decided on the objectives to be achieved through second sourcing, it becomes necessary to determine the adaptability of the project to second sourcing. Among the more important considerations in making that determination are: it must normally be established that there is a requirement for a sufficiently large quantity of the system to be provided over a number of years; problems associated with the transfer of necessary technology must be surmountable; there must be sufficient lead time to allow for the qualification of the second

source; and, there must exist, in the marketplace, viable contractors who are capable of performing as alternative manufacturers.

If it appears that the project is, indeed, adaptable to second sourcing, reference to the Second Sourcing Methodology Selection Model developed and expounded upon herein should assist the decision maker in determining the most effective means of establishing the second source. The model allows the decision maker to compare the various second sourcing methodologies with respect to fourteen decision variables so that it becomes possible to make a qualitative judgement regarding the probable efficacy of the different methods given the parameters of his project. The weightings assigned to the model factors are not considered immutable. In fact, it is desirable that the model be subjected to the test of experience in an attempt to ascertain its true utility as a predictive tool.

The earlier in the life of the project that second sourcing is considered, the more varied are the methodologies that hold a potential for success. This does not mean that successful second sourcing cannot be achieved when no provisions therefor have been made prior to initial production. It does mean to imply, however, that the options available become more constrained, and the cost associated with development of a second source is likely to be greater than if provision for such things as data rights were negotiated prior to initial production.

The measure of success or failure in a second sourcing effort should be consistent with the objectives initially espoused. There can be no single measure of success or failure when it is recognized that there can be many reasons for second sourcing the project in the first place. If cost savings is the prime reason for second sourcing, then the effort may be considered a failure (even if an alternative source is eventually qualified) as long as the total cost of the acquisition, subsequent to second sourcing, is greater than would have been experienced with a sole-source. Where mobilization base maintenance or expansion is the major objective, the development of a qualified second source, capable of producing acceptable systems according to performance and delivery requirements, could be deemed a success regardless of the cost involved. Even in such a case, however, choice of that methodology which can accomplish the stated goal at the least cost to the government must be considered an important consideration. Reference to the model will, hopefully, help the Project Manager to make this choice.

In closing, a note of caution is deemed appropriate. As has been seen, second sourcing is an acquisition strategy that can result in significant benefit to the government. On the other hand, it is a strategy that must be selectively applied. If attempted in a random or haphazard manner, the cost to the government can be astronomical. There are severe economic, legal, and technological barriers that must be overcome before second sourcing can enjoy any measure of true success. Not

every project will be able to overcome these obstacles, so ... "the bottom line" is that there must be an awareness of not only the potential benefits of second sourcing but also of the dangers inherent in the inappropriate application of the technique.

It may also be appropriate, at this time, to recommend potentially useful areas for further research in the general area of second sourcing or production competition:

(1) Contractor Teaming is a relatively new concept that deserves in depth analysis.

(2) The Model presented herein (SSMSM) can be tested on current projects to determine its utility.

(3) Other second sourcing methods and decision variables may be identified and examined in the hope of refining the SSMSM.

(4) Quantification of the costs and benefits of second sourcing can be attempted.

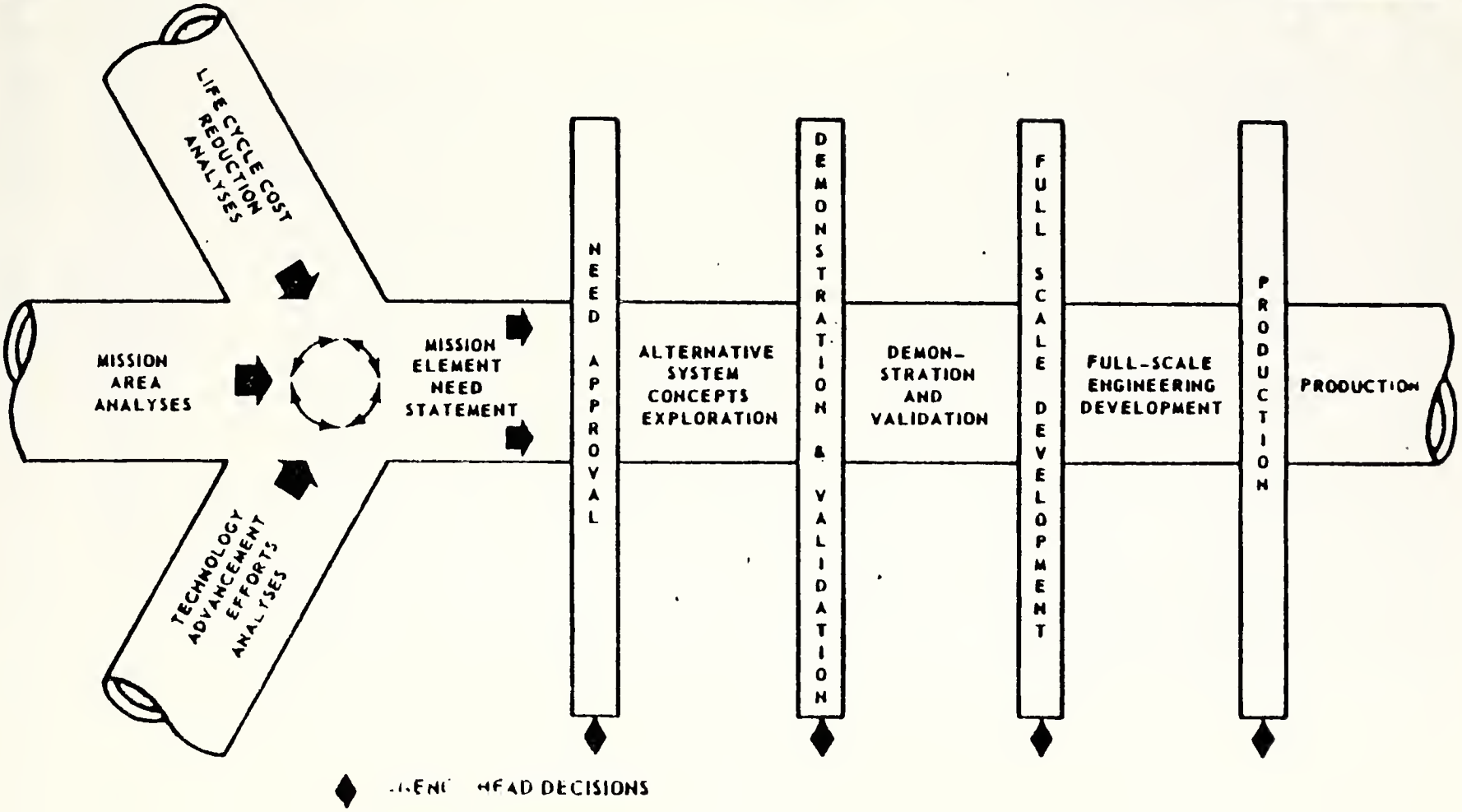
(5) Examination of second sourcing method hybrids may result in identification of new methods that are more effective than any single method.

SECOND SOURCING/DUAL SOURCING QUESTIONNAIRE

1. What is "second sourcing/dual sourcing"?
2. What goals, objectives, or policy considerations are satisfied by second sourcing (Why is second sourcing considered)?
    a. Production competition?
    b. Mobilization base?
    c. Types of projects facilitated?
    d. Cost savings?
3. What problems have been encountered in second sourcing your project?
    a. How were problems overcome?
    b. Any unsolved problems?
    c. Affect of contract type/clauses?
    d. How do you determine the quantity split between original and second sources?
4. What measures of success/failure do you utilize in evaluating a second sourced acquisition?
    a. Costs involved and their quantification
    b. Benefits to be realized and their measurement
    c. Reasons for success/failure
    d. Specific factors enhancing or detracting from second sourcing
    e. Factors that might encourage the government or the contractor to pull out of a second sourcing situation
    f. Concessions/modifications to contractor behavior realized from the mere threat of second sourcing
    g. Minimum production run requirements
5. How are viable competitors attracted to second sourcing?
    a. Identification of contractors
    b. Incentives
    c. Contract type
6. What are the methods used to ensure the adequacy of the technical data package?
7. What are the mechanics of second sourcing?

8. If you were to advise another PM/PCO regarding the pre-requisites for second sourcing, what would you tell him? What pitfalls would you warn him against?

LIFE CYCLE OF MAJOR SYSTEM ACQUISITIONS



Moreover any evidence of bids not independently reached shall be forwarded to the Department of Justice, as provided in 1–111.

3–216 Purchases in the Interest of National Defense or Industrial Mobilization.

3–216.1 *Authority.* Pursuant to 10 U.S.C. 2304(a)(16), purchases and contracts may be negotiated if—

"he [the Secretary] determines that (A) it is in the interest of national defense to have a plant, mine, or other facility, or a producer, manufacturer, or other supplier, available for furnishing property or services in case of a national emergency; or (B) the interest of industrial mobilization in case of such an emergency, or the interest of national defense in maintaining active engineering, research, and development, would otherwise be subserved".

3–216.2 *Application.* The authority of this paragraph 3–216 may be used to implement plans and programs developed under the direction of the Secretary to provide an industrial mobilization base which can meet production requirements for essential military supplies and services. The following are examples of situations when use of this authority should be considered:

(i) when procurement by negotiation is necessary to keep vital facilities or suppliers in business; or to make them available in the event of a national emergency;

(ii) when procurement by negotiation with selected suppliers is necessary to train them in the furnishing of critical supplies or services, to prevent the loss of their ability and employee skills, or to maintain active engineering, research, and development work; or

(iii) when procurement by negotiation is necessary to maintain properly balanced sources of supply for meeting the requirements of procurement programs in the interest of industrial mobilization; (*When the quantity required is substantially larger than the quantity which must be awarded in order to meet the objectives of this authority, that portion not required to meet such objectives will ordinarily be procured by formal advertising or by negotiation under another negotiation exception.*)

(iv) when procurement by negotiation is necessary to limit competition for current procurements of selected supplies or services which are approved for production planning under the Industrial Preparedness Program only to planned producers with whom industrial preparedness agreements for those items exist; or to limit award to offerors who agree to enter into industrial preparedness agreements;

(v) when procurement by negotiation is necessary to create or maintain the required domestic capability for production of critical supplies by limiting competition to items manufactured in the United States or the United States and Canada; (It is not necessary to use this negotiation authority when procuring items covered by 1–2207.)

(vi) when procurement by negotiation is necessary to continue in production contractors who are manufacturing critical items when there would otherwise be a break in production,

(vii) when procurement by negotiation is necessary to divide current production requirements among two or more contractors to provide for an adequate industrial mobilization base.

3-216.3 *Limitation.* The authority of this paragraph 3-216 shall not be used unless and until the Secretary has determined, in accordance with the requirements of Part 3 of this Section III, that:

(i) it is in the interest of national defense to have a particular plant, mine, or other facility or a particular producer, manufacturer, or other supplier available for furnishing supplies or services in case of a national emergency, and negotiation is necessary to that end;

(ii) the interest of industrial mobilization, in case of a national emergency would be subserved by negotiation with a particular supplier; or

(iii) the interest of national defense in maintaining active engineering, research, and development, would be subserved by negotiation with a particular supplier.

3-216.4 *Records and Reports.* Each Department is required to maintain a record of the name of each contractor with whom a contract has been entered into pursuant to the authority of this paragraph 3-216, together with the amount of the contract and (with due consideration given to the national security) a description of the work required to be performed thereunder. These records, and reports based thereon, are maintained through the Department of Defense procurement reporting system described in 1-110 and Section XXI, Part 1.

3-217 Otherwise Authorized by Law.

3-217.1 *Authority.* Pursuant to 10 U.S.C. 2304(a)(17), purchases and contracts may be negotiated if—

"otherwise authorized by law."

3-217.2 *Application.* The authority of this paragraph 3-217 shall be used only if, and to the extent, approved for any Department and in accordance with Departmental procedures.

February 13, 1979

MEMORANDUM FOR DR. MARTIN

SUBJECT: Establishing Second Source for Production of Defense Equipment

By memorandum addressed to the Assistant Secretaries of the Services and the Director, DLA, dated 18 January 1979, Mr. Dale W. Church expressed his desire to identify one or more alternative acquisition strategies which would more often lead to establishment of a second source at an early period in a production cycle. He solicited recommended alternatives to be discussed at a meeting on 14 February 1979, the purpose of which was to arrive at a point where some uniform guidance may be drafted (Atch 1).

By memorandum dated 29 January 1979, you designated the undersigned to attend as the AF representative and expressed your intention to be kept fully informed as to the proposed recommendations (Atch 2).

I have met with representatives of the Air Staff for the purpose of discussing the nature of the problem and to consider our inputs, including responses to a message sent by the Air Staff to AFSC and AFLC (Atch 3). The result is a Talking Paper (Atch 4) which I propose to give to Mr. Church at tomorrow's meeting.

HARVEY J. GORDON
Deputy for Procurement

4 Atchs
1. Dale Church Memo dtd 18 Jan 79
2. Memo 29 Jan 79
3. Message to AFSC/AFLC
4. Talking Paper

Cy: AF/RDS

ESEARCH AND
ENGINEERING

OFFICE OF THE UNDER SECRETARY OF DEFENSE
WASHINGTON, D.C. 20301

18 JAN 1979

MEMORANDUM FOR ASSISTANT SECRETARY OF THE ARMY (RD&A)
ASSISTANT SECRETARY OF THE NAVY (MRA&L)
ASSISTANT SECRETARY OF THE NAVY (RE&S)
ASSISTANT SECRETARY OF THE AIR FORCE (RD&L)
DIRECTOR, DEFENSE LOGISTICS AGENCY

SUBJECT: Establishing Second Source for Production of Defense Equipment

When a second source in production is determined to be a justifiable goal in the acquisition strategy, a reprocurement data package is normally obtained from the initial source for use in open competition at a later date.

Based on a review of many previous programs, the data package which is procured is seldom used. The main reason is that the lead time to establish a second production source, after obtaining a suitable data package, is so long that competition is no longer considered a viable strategy. Thus the original sole source continues as the only production source.

It is our firm belief that increased use of second sources for production of defense equipment will broaden our production base and even out the fluctuation in the defense industry which lead to feast or famine situations for individual firms.

Given the foregoing, we are attempting to identify one or more alternative acquisition strategies that would more often lead to the establishment of a second source at an early period in a production cycle.

Your assistance, in the form of recommended alternatives, is requested. A meeting on this subject will be held on 14 February 1979 in my office (3E144) at 1000 hours. The purpose of this meeting will be to hear your suggestions and arrive at a point where some uniform guidance may be drafted.

DALE W. CHURCH
Deputy Under Secretary
(Acquisition Policy)

18060-79

SAFALP/Mr. Gordon/ls/January 25, 1979

29 JAN 1979

MEMORANDUM FOR MR. DALE W. CHURCH, DEPUTY UNDER SECRETARY OF DEFENSE (ACQUISITION POLICY)

SUBJECT: Establishing Second Source for Production of Defense Equipment

Reference your memorandum of 18 January 1979, this subject.

Since the purpose of the proposed meeting is to explore and identify acquisition strategies that would more often lead to establishment of a second source early in production, I have concluded that my Deputy for Procurement (Harvey Gordon) would best represent the Air Force. Although he will attend in my place, I expect to be kept fully informed as to his proposed recommendations and any draft uniform guidance resulting from this collaborative effort.

Signed
JOHN J. MARTIN
Assistant Secretary
Research, Development
and Logistics

Cy: AF/RDC

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SAFALP SUBJECT CHRON
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HQ USAF WASH DC/RDC

HQ AFSC ANDREWS AFB MD/PM

HQ AFLC WPAFB OH/PM

UNCLAS

SUBJECT: ESTABLISHING SECOND SOURCE FOR Production

1. THE DEPUTY UNDER SECRETARY OF DEFENSE FOR RESEARCH AND ENGINEERING (ACQUISITION POLICY) HAS EXPRESSED CONCERN ABOUT OUR APPARENT INABILITY TO OBTAIN COMPETITION DURING THE PRODUCTION PHASE OF MAJOR PROGRAM ACQUISITIONS. HE HAS NOTED THAT EVEN WHEN A REPROCUREMENT PACKAGE IS OBTAINED FROM THE DEVELOPER/INITIAL MANUFACTURER, THE COST AND TIME REQUIRED TO HAVE ANOTHER SOURCE USE THE DATA ARE GENERALLY PROHIBITIVE. A POLICY FOR INCREASED USE OF SECOND PRODUCTION SOURCES COULD, HOWEVER, BROADEN THE DEFENSE PRODUCTION BASE AND EVEN OUT THE FLUCTUATIONS SO OFTEN SEEN BY DEFENSE RELATED INDUSTRY.

2. BASED ON THE POTENTIAL POSITIVE BENEFIT OF SECOND SOURCES, USDR&E WOULD LIKE TO IDENTIFY SOME ALTERNATIVE ACQUISITION STRATEGIES WHICH MIGHT FOSTER THIS OBJECTIVE. YOUR VIEWS AND SUGGESTIONS ARE THEREFORE SOLICITED ON THIS MATTER. AMONG THE STRATEGIES WHICH

YOU SHOULD CONSIDER ARE THE LEADER-FOLLOWER CONCEPT, AND THE USE OF REQUIRED SECOND SOURCES AT SUBSYSTEM LEVEL. ANY SPECIFIC PROGRAM EXPERIENCE IN DEVELOPING A SECOND SOURCE, WHETHER SUCCESSFUL OR NOT, WHICH WE CAN RELATE TO USDR&E WOULD ALSO BE WORTHWHILE.

3. YOUR THOUGHTS AND RECOMMENDATIONS ARE REQUESTED NLT 12 FEB 79 IN ORDER TO MEET THE REQUIREMENTS FOR A MEETING WITH USDR&E ON 14 FEB 79.

TALKING PAPER

ESTABLISHING SECOND SOURCE FOR PRODUCTION OF DEFENSE EQUIPMENT

There is no one recommended alternative to best establish a second source for production of defense equipment. There are a variety of acquisition methodologies which can be used, but each approach has attendant consequences which may be either assets or liabilities. Therefore, it is our view that the subject is best addressed in the following logical sequence: policy goal(s); intrinsic nature of the defense equipment to be acquired; and, available acquisition strategies/methodologies.

There are many reasons for establishing a second source, one or more of which may apply to any given acquisition. Some of these reasons are compatible with one another and some are not. Those we have identified are: (1) broadening the production base, (2) evening out the fluctuation in defense industry which leads to feast or famine situations for individual firms, (3) achieving savings through increased competition, (4) achieving superior equipment through increased competition, (5) facilitating NATO participation as co-producers or through offsetting coproduction as subcontractors, (6) facilitizing the attainment of socio-economic goals by increased award to minority and small business contractors and/or subcontractors, and (7) preserving competition for the sake of competition per se.

To insure selection of the acquisition alternative which would best accomplish establishment of a second source early in a production cycle first requires prioritization of the above goals. There is no one methodology which can accommodate all these goals in any given acquisition. OSD guidance must recognize this fact and should not be couched in terms of recommended contracting alternatives. There are contracting alternatives but their order of preference is dependent upon which policy goal or combination of goals is sought in the instant acquisition.

Having resolved the policy goal(s) to be met, it is essential to then understand and evaluate the intrinsic nature of the defense equipment to be produced. The following list, perhaps not all inclusive, enumerates the kind of factors which influence acquisition planning in selecting the preferred alternative:

(1) Intrinsic nature of the item to be produced in terms of its technical complexity, the state of the art, the fabrication processes involved, and the tolerances required;

(2) Existing industrial capacity;

(3) Ultimate quantity to be produced and the rate at which the Government will place orders for production;

(4) Production leadtime;

(5) Investment in capital facilities and tooling required for production;

(6) Production startup and other nonrecurring costs, including first article acceptance testing;

(7) Logistics concept to be employed;

(8) Political environment;

(9) Degree to which production will require access to proprietary technical data and/or manufacturing processes; and

(10) Potential for commerciality and/or the existence of essentially equivalent hardware in the commercial sector.

With answers to the aforementioned, together with identification of the DOD goal(s), it is feasible to evaluate which of the following contracting methodologies may best accommodate establishment of a second source early in the production cycle. These options, not listed in any particular order of preference, are:

(1) Establishment of a Qualified Products List (QPL), best suited for instances where there is a continuing requirement, the costs for qualifying the product are not unreasonable, and the quantity and rate at which the equipment is acquired facilitates uninterrupted production by competing producers.

(2) Leader/Follower Concept wherein the producer provides technical assistance and data rights necessary for other concerns to coproduce. The coproducer can be a designated subcontractor, a subcontractor selected by the prime producer, or a direct supplier to the Government. This is best accomplished by competition for full scale engineering development in the form of data rights and priced options for technical assistance.

(3) Coproduction wherein the Government, in proposal evaluation and source selection for full scale engineering development, requires submission of a detailed coproduction plan to insure there is a subcontractor(s) who will produce concurrently deliverable end item equipment, priced in the production option.

(4) Use of 10 USC 2304(a)(16) to permit award of two concurrent production contracts with a price premium paid to insure award to a second source.

(5) Direct licensing (providing for the payment of a royalty or a license fee) to facilitate one or more additional sources to compete in follow-on production.

(6) Acquisition of a reprocurement data package either for the entire system, selected subsystems, and/or selected components.

(7) Two-phase acquisition in which the first phase is limited to design and development with unrestricted competition for production in accordance with the Government's detailed production specification.

(8) Breakout after initial production of subsystem(s) or major components for direct acquisition by the Government.

(9) Multi-year procurement of production after the initial production buy to insure a production base sufficiently substantial to facilitate meaningful competition by concerns other than the initial producer.

There are several acquisition policies which, to varying degrees, impede second source production. To the extent we emphasize design-to-cost and life cycle costs, these operate against competing the subsequent production and/or second sourcing. It is not feasible to impose RIW commitments on a developer in the case of production equipment manufactured by a second source. It may not be feasible to implement design-to-cost incentives on a developer for production equipment manufactured by another source. Equally troublesome is the difficulty of incentivizing life cycle cost goals when production equipment may be manufactured by two or more producers. Where the logistics concept and life cycle costs considerations are pre-eminent and strongly favor manufacture of standardized equipment by one source, the policy objective of establishing a second source in an early period of the production cycle may be inherently inconsistent.

While there are several possible alternatives, no particular one is ideally suited to best accomplish the early establishment of a second source in the absence of consideration of and regard for competing DOD policy goals and objectives. The selection of the preferred methodology is in large measure dependent upon an indepth understanding of the nature of the equipment to be produced and the nature and funding of the program. This means that the problem must be worked on a case by case basis. Evaluation must be made as early in the development/acquisition cycle as possible to insure that the various options are not inhibited by business, budgetary and/or policy decisions made in the absence of a full understanding of their consequences.

SAFALP/Harvey J. Gordon/February 13, 1979

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