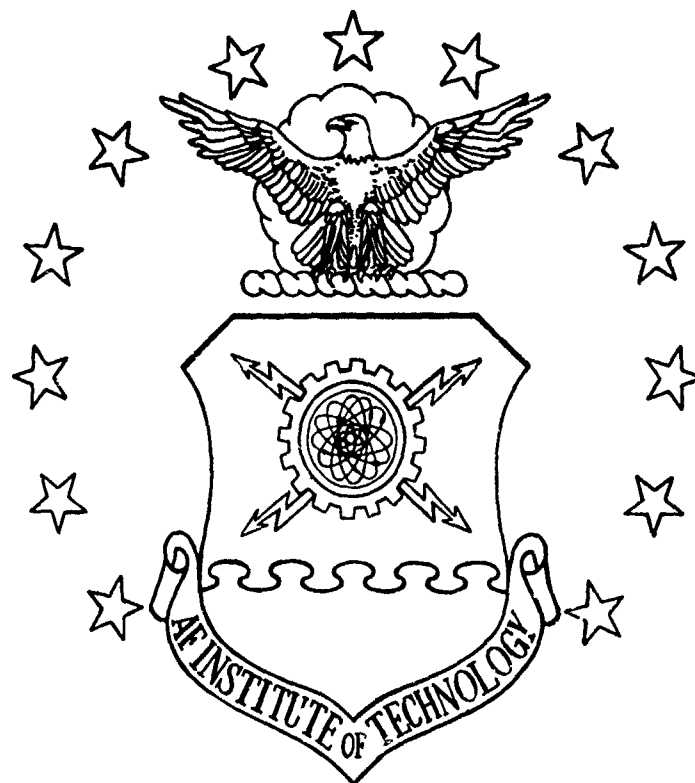


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AN ASSESSMENT OF US ARMY SUBCONTRACT MANAGEMENT
POLICY AND SURVEILLANCE OF SUBCONTRACTED EFFORT
IN MAJOR SYSTEM ACQUISITION

THESIS

Michael L. Landon
Captain, USA

AFIT/GLM/LSP/85S-41

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AN ASSESSMENT OF US ARMY SUBCONTRACT MANAGEMENT
POLICY AND SURVEILLANCE OF SUBCONTRACTED EFFORT
IN MAJOR SYSTEM ACQUISITION

THESIS

Presented to the Faculty of the School of Systems and Logistics
of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the
Requirements for the Degree of
Master of Science in Logistics Management

Michael L. Landon, B.S.

Captain, USA

September 1985

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Preface

The purpose of this research project was to reevaluate current DOD/US Army policy and procedures in the area of subcontract management for major systems acquisitions. The use of subcontractors to assume increasingly complex portions of major systems production has generated concern that this production diversity has outstripped current management surveillance of the same. More importantly, the expanded use of subcontracting has placed virtually 50% of acquisition outlays beyond direct governmental control.

The modest results of my investigation support the conclusion that current procedural measures do provide the requisite capability to monitor subcontracted effort. However, this is only a small step in the direction of a complete reassessment.

Throughout this endeavor, I have been fortunate to have superb guidance and encouragement from my thesis adviser, LTC Brian Maass. His patience and direction as well as vast experience were invaluable. I am similarly indebted to CPT George Pappas who was instrumental in getting me much needed appointments with MG Bunyard and BG Infante. A note of thanks is extended to the faculty and staff of AFIT as well. Finally, I thank my wife Kathleen and my daughter Kellie for their patience and perserverence.

Michael L. Landon

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Abstract

This study examines the appropriateness of the government's policy on subcontracting and the procedures used to achieve visibility of and leverage upon a prime contractor's subcontract management. Based on a literature review of the subject, a survey instrument was developed and distributed to gain field perspective on the issue. The survey data was analyzed using non-parametric statistical techniques and provided the basis for the study conclusions and recommendations.

The perspective expressed by acquisition management practitioners is that the current policy to rely on a prime contractor to manage subcontracted effort is appropriate and that current acquisition management organization and staffing is inadequate to undertake an active role in subcontract management. Additionally, the procedures used to achieve visibility over and leverage upon a prime contractor's subcontract management are effective. Some remedial actions are warranted, however, to achieve the benefits of the synergistic application of the procedures.

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I. Research Problem

General Issue

The magnitude and complexity of subcontracts for Department of Defense major weapon systems are increasing. The proportion of subcontracting dollars is at least as large, if not larger, than the prime contractor's in-plant cost. John Richardson, President of Hughes Aircraft Company, stated that 80% of the company's electronic component procurement dollars are attributed to subcontracts (1:34). Because of continued public concern about how we control and spend tax dollars, and because subcontract dollars are increasing as a percentage of major weapon system outlays, research on how subcontracts are managed is in order. In a letter to the Armed Services and Government Agencies on 5 April 1984, the Office of the Deputy Under Secretary of Defense (Acquisition Management) requested an assessment of DOD's entire set of subcontract management policies to include:

1. Is current DOD policy that the prime contractor is responsible for managing its own subcontracts appropriate?
2. Are DOD policies on pricing of subcontracting effort in prime contract negotiation adequate?
3. Are we concentrating on the right things?

4. Does present contractual language give us the needed visibility and leverage on subcontract surveillance?
5. Are we using the right kind of people in subcontract surveillance?
6. What role should the program office, purchasing office, contract administration office and prime contractor play in management of major high risk subcontracts?
7. What more can be done to maximize effective competition at the subcontractor level?(2:3)

With the increased number of subcontracts as well as the fact that many performance, schedule, cost, and supportability shortfalls occur at the subcontract tiers, reassessment of subcontract management procedures and organization warrants increased emphasis.

Problem Statement

The present structure of US Army management of subcontracting provides no direct relationship with the subcontractors of major weapon system prime contractors. How can or should US Army procurement activities be modified to improve the subcontracting (acquisition management) of major weapon system acquisition programs to ensure on-time delivery, maximum sustainable system performance, supportability, and minimum costs?

Background

The magnitude and complexity of subcontracts within the defense industrial base for major weapon system acquisition are increasing. The increase in subcontracting is attributed to the

unique nature of the defense market structure, described as a "bilateral monopoly" (3:275). In the bilateral monopoly, there is one seller and one buyer. The Department of Defense is a sole buyer who seeks technically sophisticated products. The sole source (seller) usually is a large firm who possesses the management capability to develop and integrate the state-of-the-art components to achieve the buyer's specification. Rand Corporation, in research on the defense industrial base, described the effects of this product specialization:

....this preference for the upper end of the technology spectrum has some clear implications for the industry. First, relatively few firms will have the necessary capabilities, and even those that do will encounter unforeseen difficulties (4:9)

Hence, a prime contractor, awarded a major weapon system contract, cannot hope to have all the capabilities to manufacture the entire weapon system in-house.

Consequently, for any one contract between a DOD procurement agency and a weapon system contractor in the defense industrial base, there can be thousands of components, parts or subsystems for which subcontracts are negotiated.

Subcontracting is defined in the Federal Acquisition Regulation as:

....any contract...entered into by a subcontractor to furnish supplies or services for performance of a prime contract or a subcontract. It includes but is not limited to purchase orders, and changes and modifications to purchase orders (5:44.101).

Within any manufacturing concern the decision to subcontract an item is dependent upon make-or-buy analysis.

Superficially, the decision to make or buy a component would appear simple; make the component if you can do so more cheaply than you can acquire it from outside sources. In actuality, many things influence a contractor's make-or-buy decisions. Make-or-buy problems generally can be categorized into two general varieties. The first category consists of parts or components for which the using firm currently possesses the necessary major production potential (6:295) In this situation only a small capital outlay for tooling is required to enable the firm to produce the part. The second category includes parts for which extensive capital outlays would be required because the firm does not currently possess the capability or capacity to manufacture them.

The factors of cost and availability of production capacity predominate among the factors which drive make-or-buy decisions. Other less tangible considerations, however, require evaluation to effect good make-or-buy decisions. Research on the defense industrial base purchasing decisions shows that facility and skill capability and capacities, time frame and reliability of cost estimates, criticality of the component to contract performance, reputation of the subcontractor to perform, regulatory requirements such as minority offsets, depressed economic areas, and financial capability to perform subcontracted work are factors of an intangible nature exerting pressure on decisions to subcontract an item (7:5-18) Research by Parr and Provenzano on factors affecting the make-or-buy decision of prime contractors listed the following:

1. Component outside the normal scope of activity.
2. Limited capacity.
3. Desired limit o capital expenditures.
4. Unwillingness to disrupt other product lines.
5. Desire to perform efficiently (8:21).

Thus decisions to subcontract are dynamic and can be characterized to be more than simple cost relationship assessments. In effect, the make or buy decisions, correctly approached, consider the probable effect of all factors on the firm's total operation.

Within the context that the make-or-buy decision results in subcontracted effort, Government policy on major programs is:

The prime contractor is responsible for managing contract performance including planning, placing, and administering subcontracts as necessary to insure the lowest overall cost and technical risk to the Government (5:para 15.702).

For the prime contractor, subcontract management includes the expenditure of the following broad categories of effort in the various subcontracting phases:

A. Quotation Phase - The tasks of locating potential sources, development of requests for proposals, performance of risk analysis, and refinement of requirements should be performed during this phase. Additional tasks include the definition of requirements and the solicitation of responsive quotations from qualified sources.

B. Evaluation and Analysis Phase - A detailed review of proposals from potential subcontractors should be performed by competent personnel to develop sufficient factual information for presentation to top management. This information is used by top management in evaluating subcontracting risks and pricing prerogatives.

C. Negotiation Phase - The prime contractor's subcontract management team should approach the prime/subcontractor negotiations with clearly defined management objectives. The agreements or understanding reached during the negotiation should be

recorded on a continuous basis to facilitate subsequent drafting of the final subcontract, and preparation of the subcontract negotiation memorandum and file.

D. Award Phase - External, as well as internal, to the prime contractor's program office, review of the documented negotiation results and draft subcontract must be accomplished to assure that the formal contract correctly reflects the agreement, that all documentation is in order, and necessary approvals or consent are obtained.

E. Administrative Phase - Liaison must be accomplished on a continuous basis. Full prime contractor internal organizational support must be provided to the prime's subcontract management personnel during this phase to insure that timely, technically adequate, and cost effective end items are obtained. For example, if the subcontract requires the subcontractor to develop a computer, the prime's subcontract management personnel must be cognizant of the problems which may develop and obtain expert computer engineering talent to assess, on a continuing basis, specifics in sensitive development parameters. Prime contractor effort in this phase should cease only when the subcontract is completed (71:22).

Though the make-or-buy situation in the defense industrial base closely parallels that of private industry, the product specialization that characterizes the defense market emphasizes the inherent risks of subcontracting. Because of the highly sophisticated technology involved, trade secrets become an important element in achieving and maintaining a competitive market position. Other factors of subcontracting which contribute to the emphasized risk include problems of harmonization of production schedule, cyclical market activities, and a degree of technical interface between components to achieve performance parameters. These subjects are examined in greater detail in Chapter II.

The economic situation and circumstances surrounding the

acquisition of complex weaponry differ significantly from those which characterize procurement of standard commercial products sold in a competitive, free market environment. The propensity for state-of-the-art technological application into the weapon system generates greater developmental risks than the routine engineering application characterizing off-the-shelf commercial end items. Uncertainty in technical features, production history, engineering feasibility, and scheduling aspects related to these areas combine to generate tremendous cost uncertainty. Even if fairly accurate costs estimates are derived in preparation of the proposal for the contract, these costs are subject to change as unknowns become realities.

Unlike the competitive free market "invisible hand" which controls price, the bilateral monopoly situation demonstrates little price competition. Virtually all weapon systems, subsystems and major components at their inception lack adequate description of the product being sought. This inability to define, with precision, the end product and subsequently, the uncertainty of its achievement, prevent the use of price competition (10:3-4).

Usually, the company whose design and development concepts are selected for, or during, full scale development will possess obvious advantages over competitors in competing for the production phase of the weapon system acquisition. The highly complex nature of the weapon system provides the developer with technical data which includes drawings and process descriptions. If the contractor possesses a design or manufacturing technique

unknown to his competitors, he may be the sole source for a product or system or may have a product/price advantage over his competitors so that he is ensured of continuous procurement (11:699). While second sourcing has and continues to be emphasized, generally the first production contract for a major weapon system or for a complex subsystem is awarded to the developer without price competition (10:3-6).

In light of these circumstances, extremely high risk and uncertainty for both DOD and contractors, as well as limited, if any, price competition, DOD cannot merely assume a "laissez faire" role in awarding contracts for major weapon systems worth billions of dollars. In executing a fiduciary responsibility to taxpayers, Government must achieve the requisite control, visibility and information to assure the system delivered meets performance parameters, cost thresholds and time schedules.

Further complicating an already complex scenario are the concept of public trust and the requirement for the judicious expenditure of taxpayer dollars. Unlike private industry where inefficiency results in lower profits or losses, Government procurement activities are not tied to a profit motive. Classic economic theory would suggest that in a capitalistic economy the allocation of scarce resources would be less efficient in the absence of this incentive. To offset this characteristic, the Government procurement process has evolved into a complex system built upon Federal statutes, regulations, executive orders, procuring agency directives and judicial and administrative rulings designed to legislate the requisite efficiency.

Established relationships between the Government and those firms charged with the overall responsibility for system design, development, and production, as well as the successful integration of all major system components, are directed and implemented through statutory, legal and regulatory processes. These processes are designed to replicate the behavioral patterns that occur in other economic market situations and to protect social values in satisfying acquisition efforts.

Statutory relationships are established by virtue of laws passed by Congress and approved by the President. The first comprehensive legislation dealing with procurement was the Purveyor of Public Supplies Act in 1795, which became the basis for procurement of supplies and equipment needed to support the military establishment of that day (12:4). The body of the law of government contracts continues to expand as the result of an evolutionary process, a process based upon the Constitution and congressional appropriations, supplemented by congressional limitations and enactments, executive branch policy determinations and decisions of the courts (13:15).

The legal relationship between a DOD procurement agency and a prime contractor awarded a major weapon system contract is established by the contractual process. Typically, regulations which outline statutory responsibilities and procedures are stated in contract clauses. These clauses, once assembled as a document stating the nature of the item to be produced and terms of compensation, combine to form the contract. By knowingly and voluntarily signing the contract, each party to the contract

enters into "privity" with the other party or parties.

Privity of contract is defined in Black's Law Dictionary as:

That connection or relationship which exists between two or more contracting parties so as to create a mutual or successive relationship to the same property (14:1079).

The notion of privity of contract is derived from the English common law recognition of the contract as a connection or mutuality of will between interfacing parties. The classical contractual relationship is one of obligation based on a promise. This obligation binds identified parties in an arrangement that is enforceable by law. A party that is not a participant in this binding legal relationship is referred to as a "third party" who lacks privity with the other two interests in the contract.

The relationship between the parties to a contract is determined by the language of the respective contract and is reserved to those parties who have knowingly and voluntarily entered into the contractual relationship. The true third party is not part of the two party contractual relationship and is thus precluded from enforcement of that two party contract.

The exclusion of third parties from enforcement of common law contracts stems from the belief that the absence of the third party under the terms of the original contract manifests the intent of the original parties and that the third party should not be able to assert himself forcibly into the original relationship (15:7). The implication of privity for DOD

procurement agencies is that there exists no sanctioned avenue to directly influence the subcontractors of a major weapon system prime contractor.

The lack of privity between government procurement agencies and defense subcontractors is significant when analyzed in terms of total government outlays. A large percentage of the total dollars expended on a major weapon system acquisition program goes to subcontractors. On some programs as much as sixty percent or more of the program dollars are provided to subcontractors for supplying key parts, materials, and/or components to the prime contractor (16:64). For example, on the M-1 Tank program, 68.6 percent of the total contract costs are attributed to purchased materials. Total dollar outlays to subcontractors and vendors on the Attack Helicopter Improvement Program, Stinger Air Defense Missile, and Patriot Air Defense System amount to \$258.9 million (67:13). Thus, greater than sixty percent of government procurement dollars as well as significant critical components which affect performance, supportability, cost and schedule thresholds are beyond the direct management efforts of government agencies.

Research Objectives

1. Outline present contractual language and acquisition procedures that provide DOD/US Army Program Management Offices (Acquisition Management) visibility and leverage on subcontracted effort of major weapon systems.
2. Determine how effective the present contractual language and

acquisition procedures are in providing DOD/US Army Program Management Offices (Acquisition Management) the necessary surveillance of subcontracted effort on major weapon systems.

Research Questions

1. What are the current relationships that exist between DOD/US Army contract management offices, prime contractors and subcontractors?
2. Is current DOD/US Army policy that the prime contractor is responsible for subcontract management appropriate in light of the fact that in excess of sixty percent of major weapon system acquisition dollars goes to subcontractors?
3. What activities exist to provide surveillance of a major weapon system prime contractor's subcontract management?
4. How effective is the use of one or more of the subcontract surveillance options/activities in identifying potential problems?
5. What changes to the existing systems are viewed by government procurement personnel as required to provide adequate visibility and control of subcontractor performance?

Research Methodology

The research design was composed of two phases. Phase I was an extensive literature review of related subject areas. The primary source materials that were used in this literature review included historical documents, legal publications, policy/regulations/procedures, and current journal articles and/or publications. Research in phase I focused on

establishing the relationships created by privity of contract doctrine, with special emphasis on the legal ramifications to government contracting personnel. Further objectives of the literature review included enumeration of the methods currently available to government contracting personnel and organizations to achieve subcontract surveillance and visibility.

Phase II of the research was the conduct of a survey to solicit the opinions of acquisition management practitioners on the effectiveness of the subcontract surveillance and visibility policies/procedures documented in Phase I literature review. Prior to full scale distribution of the survey to the field, a prototype survey was pilot tested on experienced contract administration personnel. Based upon the critique provided by the pilot population, the survey was changed and/or revised to improve the survey instrument. Distribution of the survey followed.

The target audience consisted of those personnel who were currently or had as a minimum of three years of experience in contract administration on major weapon system contracting. Current US Army procurement activities within the Program Management Offices and the Project Managers within the major commands provided the general population of respondents. Two hundred and twelve surveys were distributed with eighty three responses. In that the survey was composed of questions for which the answers were classified as qualitative data, nonparametric statistical testing was performed.

Interpretation of the statistical analysis provided the

basis for the author's recommendations/observations. Ultimately, the responses concerning the effectiveness of current subcontract policies and procedures provided some insight into the research problem.

Organization of the Material Presented

The organization of the material of this research effort is designed to logically develop the issue. Chapter II is a literature review of the major weapon system acquisition environment. The peculiarities of this environment are important to establish prior to proceeding to the presentation of the indirect measures used to achieve subcontract surveillance. Chapter III is devoted to the presentation of existing procedural methods to overcome the indirect relationship government acquisition offices share with subcontractors. The material presented in this chapter is the subject matter of the survey distributed during phase II of the research effort. Chapter IV discusses the survey. A comprehensive presentation of the survey administration and analysis provides the basis for the conclusions presented in Chapter V. Ultimately, Chapter V is an interpretation of the statistical analysis of the survey questionnaire. The conclusions and recommendations based upon the research are presented there.

II. The Major System Acquisition Environment

The acquisition of major systems within the Department of Defense is a complex activity. Prior to any meaningful examination of the measures available to gain visibility and leverage of subcontracted effort in the acquisition process, pertinent key information and concepts must be presented. First the process of major systems acquisition provides the foundation for understanding the unique characteristics of the defense industrial base. Subsequent examination of the defense industrial market environment will provide valuable insight into the factors which combine to create the circumstances characterizing the problem of this research effort. That examination will include the economic, political, social, and technological dimensions of the defense industrial market environment. Ultimately the subject matter of this chapter provides the basis for presentation of the contractual language and acquisition procedures available to DoD/US Army acquisition management agencies to gain visibility into and leverage over subcontracted effort.

The Defense Acquisition Process

The acquisition process is a major function in the DOD which has been used to facilitate achievement of various national objectives (17:81). Competing national security issues and social welfare concerns have promoted efforts to not only

satisfy necessary military needs but to do so cognizant of the impact on social interests. In that respect defense spending is a significant consideration and determinant of fiscal policy (18:233). For the fiscal year 1985, the United States Army budget contained \$26.1 billion in acquisition related appropriations (19:8). The budget, once executed, contributes significantly to the Gross National Product and general economic growth (20:1-2). It creates jobs within the DOD and the defense industry as well as stimulates technological advancement.

DOD policy for acquiring major systems is delineated in Department of Defense Directive 5000.1 (21). Under this directive, the Secretary of Defense designates systems for DOD management efforts; however, acquisition program managers are provided the latitude to impose the procedures of DODD 5000.1 to guide policy decisions in other programs as well. The decision to designate a system for major system management procedures may be based upon:

1. Development risk, urgency of need, or other items of interest to the Secretary of Defense.
2. Joint acquisition of a system by the Department of Defense and representatives of another nation, or by two or more DOD components.
3. The estimated requirement for the system's research, development, test and evaluation, procurement (production), and operation and support resources. A Justification for Major System New Start (JMSNS) is required for all acquisition for which the DOD component estimates costs to exceed \$200 million (FY 80 dollars) in RDT&E funds or \$1 billion (FY 80 dollars) in procurement (production) funds or both.
4. Significant congressional interest (21:6).

For those programs assessed to merit major system management

procedures as outlined by DODD 5000.1, the decisions of continuation are ultimately made by the Secretary of Defense assisted by the recommendations and advisement of the Defense Systems Acquisition Review Council (DSARC) (21:4). The acquisition process is divided into distinct phases from need identification through production and fielding. Progress from one phase to the next requires Secretary of Defense approval. These approval points are called milestones and are characterized by a comprehensive review both within the DOD component and an equally comprehensive review by the DSARC. The sequencing of the process, milestones, and key elements which affect systems acquisition are presented in Figure 2-1 (22:13).

The DSARC is the top level DOD corporate body for system acquisition (23:2). The procedures under which the DSARC operates and advises the Secretary of Defense at milestones are documented in Department of Defense Directive 5000.2. This directive which augments the procedures outlined in DODD 5000.1, specifies review procedures. The review conducted at the milestones essentially amounts to "go ahead" for program continuation. At each milestone, thresholds of cost, schedule and performance are reviewed. Continuation of the program at Milestone I is based on the favorable review of factors of concept, costs, schedule, readiness objectives, and affordability as well as validation of the requirement (23:4). Milestone II decisions generally scheduled between demonstration/validation and full scale development phases are based on the examination of those factors in the Milestone I

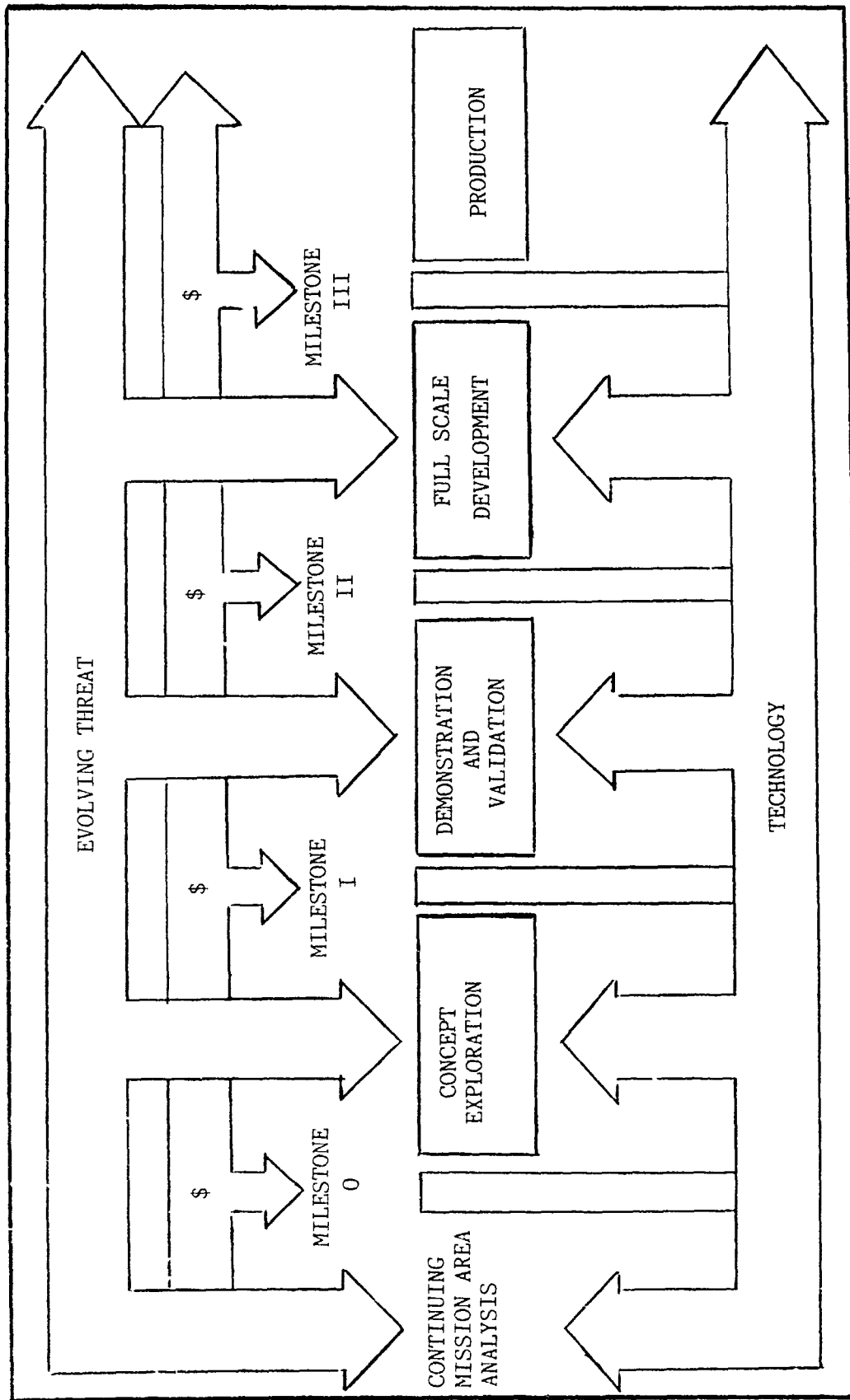


Figure 2-1. Major System Acquisition Process (22:13)

review but also the additional factors of producibility, industrial base responsiveness, supportability and testing as well (23:5). The decisions made at Milestone III occur between full scale development and production. This decision point is delegated to the lowest echelon feasible to adhere to principles of decentralization. The principal criteria for approval is that the program has met thresholds established at Milestone II review activities.

The Defense Market Environment

The significance of the major system acquisition process surfaces when the process is examined in the setting of the defense market environment. The defense market environment is impacted by many different forces. A cursory narration of four of the most significant forces will provide the necessary background for presenting the relationships that exist between government, prime contractors, and subcontractors. The forces examined are categorized as technological, political, economic, and social.

Technological Forces. The technological dimension of the DOD acquisition process impacts significantly on the defense market environment. Threat identification in the major system acquisition cycle provides the catalyst for assimilation of state-of-the-art technology. This technology provides the know-how required to develop hardware, software, and industrial processes required for defense systems and their production (24:42). Traditionally, the United States defense

establishment, in an effort to maintain a viable defense capability, has elected to pursue a strategy of weapons quality superiority vice quantitative advantage. Consequently, the production of technologically superior weapons has been pursued to accomplish that objective (25:42). The manifestation of this insatiable appetite for technology appears throughout the acquisition process but most apparently in problem identification through full scale development.

The interaction of technology and cost and schedule threshold pressures is a key control mechanism in major system acquisition. Studies have portrayed the correlation of technology, cost and schedule as depicted in Figure 2-2 (22:94). The relationship as portrayed in Figure 2-2 shows a complex interaction in which any number of potential problems can cause variance from established thresholds. One scenario that immediately arises is that technical performance parameters create technical difficulties which in turn create unfavorable schedule and costs variances. Ultimately, the implications of these variances are reduced technical performance specifications or increased costs with schedule delays. An alternative solution to such a problem would be for management visibility to identify problems as soon as possible to mitigate the synergistic effects of that problem. That alternative solution is essentially the subject of this research effort.

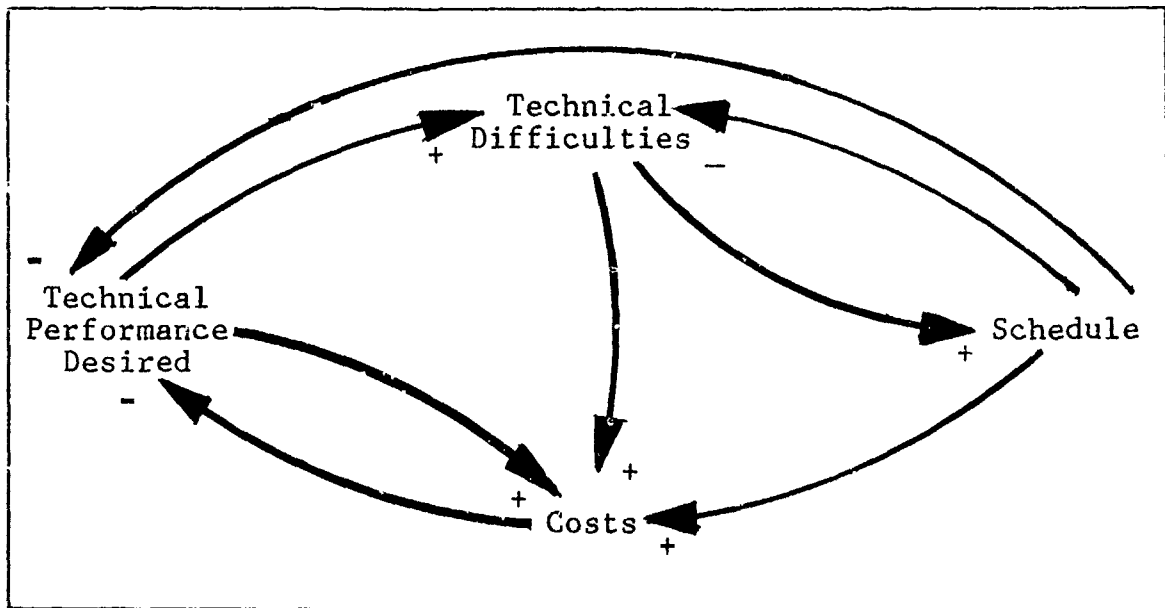


Figure 2-2. Relationship of Technology, Cost, and Schedule
(22:94)

The nature of the relationship as presented above becomes even more significant when cast in the light of the effort required of a prime contractor. The prime contractor cannot hope to have the full spectrum of technological capabilities that a major system requires. Hence the prime contractor must rely on other manufacturers as subcontractors to provide the specialized capabilities that the sophisticated technology mandates. In effect, the subcontracted effort aims at efficient distribution of functions among separate firms to take advantage of individual strengths (26:5). This delegation of the work effort serves to expand the interrelationships to additional tiers of manufacturing. It follows that the potential problems and risks are increased as well.

Political Forces. The Department of Defense, as an

executive arm of the federal government, as well as the Congress, are the regulators of the defense industry (27:76). Not only does the federal government decide what an appropriate level of profit is for its contractors (28:96-97), but it is deeply involved in the internal management of defense firms. The contractors spend a great deal of time preparing the paperwork required by DoD (29:18). Government involvement ranges from imposing extremely detailed cost accounting procedures and employment guidelines (30:57) to requiring prime contractors to develop subcontracting plans to include socially and economically disadvantaged small businesses (31:27). With the implementation of the Federal Acquisition Regulation on 1 April 1984, contractors have to work with a combination of regulations for a significant number of years. Until programs initiated under the Federal Procurement Regulation and the Defense Acquisition Regulation are phased out, defense firms will have to operate with a patchwork combination of old and new regulations (32:4-5). In addition to these complications, there are considerable discrepancies between policies stated in the regulations and actual practices (29:16).

The federal government also plays a major role in the lives of defense firms by controlling, to a large extent, their access to capital. By providing research and development funds, progress payments, and government owned facilities (depending upon contractual terms), the federal government supplies much of a firm's working capital and capital investment. Since Congress authorizes and funds programs on a year-to-year basis, while

most programs stretch over several years, there is always a degree of uncertainty for contractors (33:454, 34:283). Although Congress determines the size of the DoD budget, Congress itself is influenced by many factors: national, political, and economic issues, the international situation, and the parochial interests of Congressmen themselves (33:37). Furthermore, the national tax structure does not encourage defense industries to make capital improvements (35:8).

Political forces have a significant impact on the defense industry. With defense industries or facilities spread throughout most of the congressional districts in the country, politicians have a tremendous influence on what will and what will not be built (36:110). According to Senator William Proxmire:

The Congressional Quarterly identified some 991 major private defense plants and defense-oriented government installations in 363 of the 435 congressional districts. That means that 85 percent of all members of the House and Senate have major installations in their states or districts (36:110).

This observation by Proxmire underlies the interest that Congress has in defense and defense expenditures. Gordon Adams finds that aerospace firms contributed an average of \$55,000 to political action committees for federal elections (37:114). In addition, the Department of Defense maintains "extensive dialogue" with Congress on matters of interest to the defense community (38:81).

While politics plays a significant role in the defense market, "regulatory and review practices are a universal

concern" among firms in the defense industry(39:40). Among the restrictions that concern all levels of the defense industry are "government imposed foreign offset; reduction in on-site government personnel, reviews, and audits; and elimination of some export constraints" (39:42).

Economic Forces. The defense industry is a major factor in the national economy. On the average, defense spending represents 5 percent of the Gross National Product and 25 percent of the Federal budget. The significance of these statistics arises when acquisition related appropriations are examined. DOD budget appropriations for fiscal year 1985 for Research, Development, Testing and Evaluation when combined with procurement (production) funding totaled \$141.6 billion (40:11, 41:ii). Therefore these economic activities introduce an important dimension to the defense market environment.

The defense industry interacts with the federal government on a variety of levels. It sells its products to DOD, is regulated by the legislative and executive branches, is financed through congressional appropriations, and is influenced by politicians. As the primary, and in some cases the only, purchaser of the prime contractor's products, DOD exerts a profound degree of control over the defense industry. In order to survive economically, contractors must try to adapt to the instability created by a one-customer market (33:38).

Ultimately the implication for contractors is that they must and do compete fiercely for the big contracts since failure to get one could mean the end of the company (42:23). This

competition does not result in truly competitive prices however. Many other aspects, which will be introduced below, can overshadow proposed prices; quality, availability (production schedule), technology, the contractor's previous performance and its relationship with the military service involved are just a few (33:39). Essentially, the use of competition in initial phases of major system acquisition, to determine price, rarely occurs. According to federal and DOD contracting directives, price and profit are determined by initially planned costs (33:38). This situation essentially encourages the contractor to "buy in" by understating costs and overstating performance at little risk, since the cost overruns are almost always absorbed by future contract changes (43:127).

A key characteristic of the defense industrial economy is the labor market. The defense industry involves approximately 10 percent of the American labor force (34:247). The defense industry employs a large proportion of the nation's scientific and technical personnel and receives a significant share of the nation's research and development dollars. Defense spending has also stimulated increased scientific training (44:103). However, one of the defense industry's main problems is the "cyclical hiring and firing of thousands of defense workers" (27:76). When a program is phased out, the workers are laid off. When a new contract is received, those with seniority are the first to be recalled. The result is an aging, inefficient work force which must be retrained again and again. Because competition is usually for all or nothing on a particular market

segment, such as the M-1 tank, major defense contractors are often willing to allocate more resources to an effort to secure a contract than would their commercial counterpart (38:30, 37:10).

At the subcontractor tiers, small companies with 250 or fewer employees make up the majority of the subcontract capability (45:75). Of 6000 subcontractors in the market in 1968, only 3700 were still operating in late 1977 (45:76). Much of this decline is attributed not only to competition between subcontractors but also to the fact that many major contractors chose a vertical integration strategy. These contractors bought the firms that were supplying materials for production or began making the parts themselves (45:76).

One factor contributing to this situation is that, unlike prime contractors, subcontractors are continually evaluated against other subcontractors on cost (38:142). Whereas a prime contractor generally cannot be replaced without terminating the weapon system program, subcontractors can be replaced if they run into problems because many prime contractors have alternative sources for the materials or parts (45:76).

Given that competitive pressures permeate the various dimensions of the defense industrial market environment, and to a large degree dictate the success of one company over another, the type and occurrence of competition in major weapon system acquisition warrants examination. The economic circumstances under which major systems acquisition occurs are markedly different from the competitive free market. Unlike the

perfectly competitive market model characterized by a homogeneous product, with many buyers and sellers, ease of entry and exit to the market, and relatively perfect knowledge of the market place (47:253), the economic characteristics of major weapon system acquisition are devoid of these dimensions of price competition. Generally, the DOD acquisition of major systems, subsystems, and technologically sophisticated components, is characterized by circumstances where:

1. The final products do not exist at the time developers are selected and they usually do not exist in final form when the producers are selected.
2. There are very few buyers for these products (although it is an error to view the "marketplace" as always having one buyer).
3. The buyers have very imperfect information concerning the prices and functional specification of the product, their own need for the product (i.e. the threat is uncertain and changing) and the relevant budgetary constraints, especially in future years.
4. The entry and exit of firms in this market is often slow and costly (46:5).

As a consequence, the competitive forces of the perfectly competitive economic market are not available to determine price. Competition does occur, however, but usually is of a non-price nature.

The extent of competitive interaction in major system acquisition occurs with regard to technical feasibility and design capabilities although introduction of price competition can occur. The various types of competition and their typical appearance throughout the major system acquisition process is conceptually depicted in Figure 2-3 (46:7). The ways in which

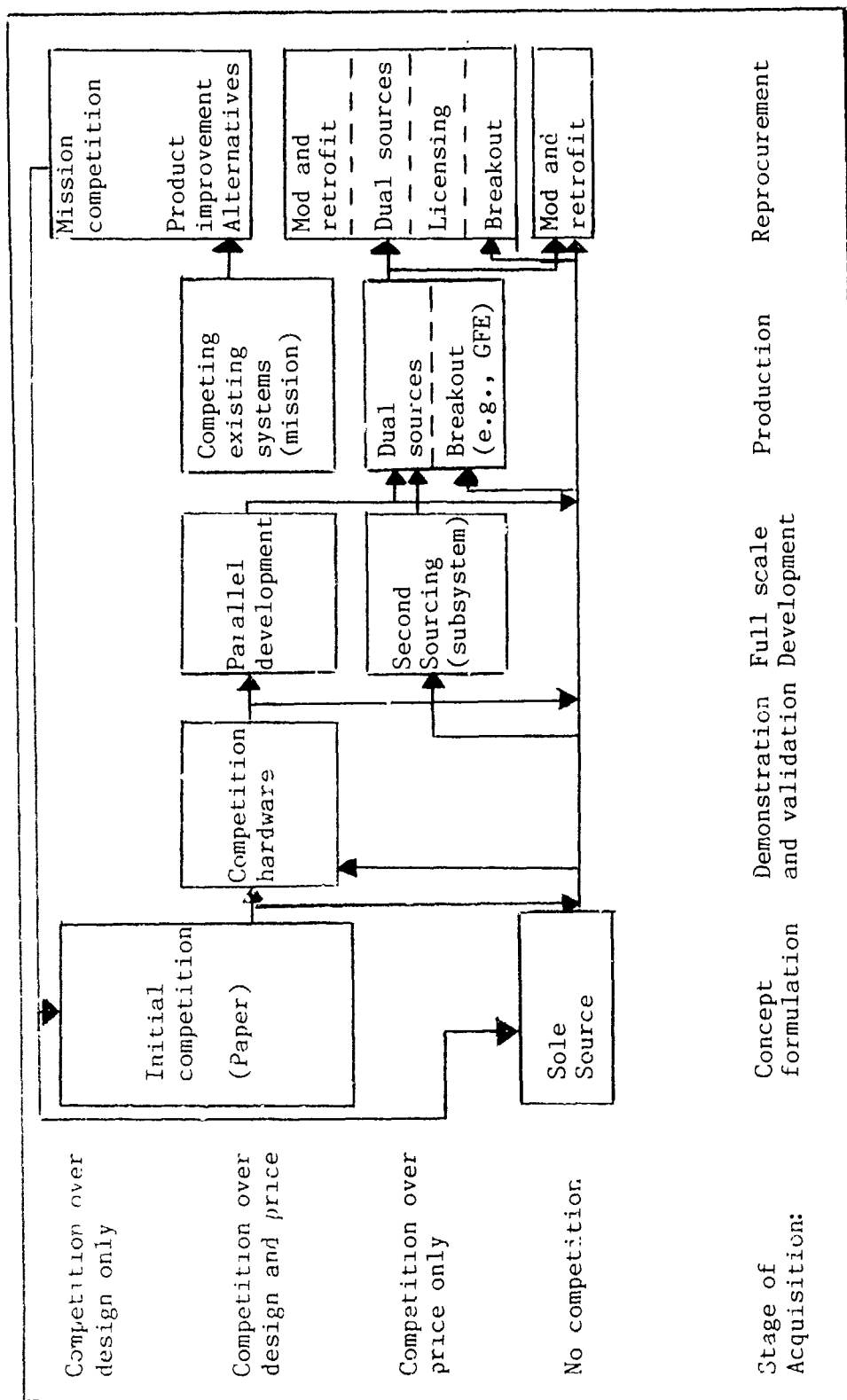


Figure 2-3. Types of Competition (46:7)

government can induce competition over design or price or both are reflected in the vertical segment representing a stage of the major system acquisition process.

This continuum of competitive alternatives through the major system acquisition cycle bears some significant implications. The most obvious characteristic is that competitive pressures and type of competition change. Initial efforts in the concept exploration phase and validation and demonstration phase are a "complex blend of desires to improve the system design concept, reduce performance and schedule risks, and minimize costs" (46:56). As the design moves through Milestone II review into full scale development, the interest is principally aimed at reducing risk and costs. Finally at the point when production begins, the management interest in introducing competition is to reducing cost to the buyer (46:56).

The effects of this change in competitive emphasis impacts upon not only prime contractors but theoretically, even more so upon subcontractors. Because prime contractors must seek the specialized capabilities of a subcontractor to produce a technologically complex component or subsystem, the subcontractor becomes an indispensable part of the prime contractor's effort. This heavy reliance and interdependence are most salient during validation and demonstration phases.

Social Forces. The use of the federal acquisition process in the implementation of socioeconomic policies has a long history. Two of the first such attempts were the Naval Service

Appropriation Act of 1865 and Army Appropriation Act of 1876 (50:78). These policies mandated the purchase of only American bunting and preferred American labor and materials for public improvement contracts. Another one of the earlier attempts to bring about social change through the procurement process was the enactment of the Eight Hour Laws, a series of statutes setting standards for hours of work. The eight-hour day was first extended to workers employed by contractors and subcontractors engaged in Federal projects in 1892. In 1905, an executive order by President Theodore Roosevelt prohibited the use of convict labor on Government contracts, thereby implementing, through the procurement process, an 1887 statute prohibiting the hiring-out of convict labor (51:112).

The federal government and its component agencies, such as the Department of Defense, are very unique "customers" when compared to private consumers in terms of the ability to control the terms of a business transaction. Unlike the individual citizen or private business, the government can not only tell the seller what it wants to buy but, it can, and will, tell the seller how to manufacture the item, where to manufacture it, and from whom the seller will buy parts, supplies, and raw materials. If the seller does not want or agree to comply with government requirements, then the contract can simply be terminated. Acting in this sovereign capacity, the federal government attempts to balance its need to procure quality items and equipment at reasonable cost with the equally demanding need to insure that all federal laws are consistently enforced;

private individuals, groups, and businesses are treated fairly; natural resources are used efficiently; and the environment is preserved and protected. As Richard J. Hampton pointed out in his doctoral dissertation:

The procurement process has been an attractive vehicle for the legislative and executive branches to implement socioeconomic programs since the latter part of the nineteenth century (48:53).

These socioeconomic programs span a wide range of diverse, sometimes conflicting, social and economic objectives. This range of objectives is best defined by the U.S. Commission on Government Procurement in their 1972 report to Congress.

According to the Commission, the broad objectives of federal socioeconomic programs include:

1. Establishment of fair wage and working conditions.
2. Promotion of domestic business and domestic economy.
3. Elimination of unemployment through provision of job and training opportunities.
4. Establishment of fair employment practices.
5. Promotion of minority business concerns.
6. Rehabilitation of prisoners/handicapped.
7. Protection of the environment.
8. Effective use of resources.
9. Humane treatment of animals (49:118).

Even a cursory review of this list leads one to wonder at the ability of the defense federal procurement process to achieve its primary goal of the economical procurement of goods and services while trying to satisfy these divergent

socioeconomic objectives. Listed in Table 2-1 is a more comprehensive list of the various socioeconomic policies affecting the acquisition process.

Table 2-1
Socio-Economic Policies Affecting the Acquisition Process

PROGRAM	PURPOSE
Buy American Act*	To provide for domestic materials. over foreign materials
Preference for United States Manufacturers	To provide preference for domestic manufacturers in construction of diplomatic and consular establishments
Preference for United States Manufacturers	To restrict US Forest Service from purchasing twine manufactured from materials of foreign origin.
Preference for United States Products (Military Assistance Programs)*	To require the purchase of US end products for the military assistance program.
Preference for United States Food, Clothing, and Fibers (Berry Amendment)*	To restrict the Department of Defense from purchasing specified classes of commodities of foreign origin.
Officials Not to Benefit*	To prohibit members of Congress from benefiting from any government contract.
Clean Air Act of 1979	To prohibit contracting with a company convicted of criminal violation of air pollution standards.
Equal Employment Opportunity	To prohibit discrimination in government contracting.
Copeland "Anti-Kickback" Act*	To prohibit kickbacks from employers on public works.

* Indicates that the program resulted in the issuance of a standard contract clause.

Table 2-1 (continued)

PROGRAM	PURPOSE
Walsh-Healy Act*	To prescribe minimum wage, hour, age, and working conditions for supply contracts.
Davis-Bacon Act*	To prescribe minimum wages, benefits, and work conditions for service contracts
Service Contract Act of 1965*	To prescribe wages, fringe benefits and work conditions for service contracts.
Contract Work Hours and Safety Standards Act*	To prescribe 8-hour day, 40 hour week, and health and safety standards for laborers and mechanics on public works.
Fair Labor Standards Act of 1938	To establish minimum wage and maximum hours standards for employees engaged in commerce or the production of goods for commerce.
Prohibition of construction of Naval Vessels in Foreign Shipyards	To prohibit use of appropriated funds for the construction of any Navy vessel in foreign shipyards.
Acquisition of Foreign Busses	To restrict use of appropriated funds to purchase, lease, rent, or otherwise acquire foreign-manufactured busses.
Release of Product Information to Consumers	To encourage dissemination of government documents containing information of possible use to the consumer.
Prohibition of Price Differential	To prohibit use of appropriated funds for payment of price differential or contracts made to relieve economic dislocation.
Required Source for Jewel Bearing*	To preserve a mobilization base for manufacturer of jewel bearings.

* Indicates that the program resulted in the issuance of a standard contract clause.

Table 2-1 (continued)

PROGRAM	PURPOSE
Employment Opening for Veterans*	To require contracts to list available employment openings with State employment system to assist veterans in obtaining jobs.
Covenant Against Contingent Fees*	To avoid contract obtained by a broker for a contingent fee.
Gratuities*	To provide government with right to terminate if gratuity is given to the government employee to obtain contract or favorable treatment.
International Balance of Payments*	To limit purchase of foreign end products and services for use abroad.
Prison-made Supplies	To require mandatory purchase of specific supplies from Federal Prison Industries, Inc.
Preference to US Vessels*	To require the shipment of all military and at least half of other goods in US vessels.
Care of Laboratory Animals*	To require humane treatment in use of experimental or laboratory animals.
Required Source for Aluminum Ingot*	To eliminate excess quantity of aluminum in the national stockpile.
Small Business Act*	To place fair portion of government purchases and contracts with small business.
Blind Made Products	To make mandatory purchase of products made by blind and other handicapped persons.
Duty-free Entry of Canadian Supplies*	To further economic cooperation with Canada and continental defense.
Use of Excess and Near-Excess Currency*	To provide preference in award to bidders willing to be paid in excess or near-excess foreign currency.

* Indicates that the program resulted in the issuance of a standard contract clause.

Table 2-1 (continued)

PROGRAM	PURPOSE
Purchases in Communist Areas*	To prohibit acquisition of supplies from sources within Communist areas.
Nonuse of Foreign Flag Vessels Engaged in Cuban and North Vietnam Trade*	To prohibit contractor from shipping any supplies on foreign flag vessel that has called on Cuban or North Vietnamese port after specific dates
Labor Surplus Area Concerns*	To provide preference to concerns performing in areas of concentrated unemployment or underemployment.
Economic Stabilization Act of 1970	To stabilize prices, rents, wages, salaries, dividends and interest.
Humane Slaughter Act*	To purchase meat only from suppliers who conform to humane slaughter standards.
Miller Act*	To require contractor to provide payment and performance bonds on government construction contracts.
Convict Labor Act*	To prohibit employment on government contracts of persons imprisoned at hard labor.
Vietnam Veterans Readjustment Act	To give employment preference to disabled veterans and veterans of the Vietnam era.

* Indicates that the program resulted in the issuance of a standard contract clause.

Source: Bureau of National Affairs, Inc., Federal Contracts Report, Washington D.C., February 19, 1979, pp F-7 and F-8.

Although controversy does exist on the use of the Federal acquisition process as a vehicle to promote socioeconomic policy, the federal procurement process continues to be the most visible and available means by which these policies are implemented. To this end, Hampton postulates:

Several factors account for this condition: the sheer

magnitude of federal spending for goods and services...; the capacity of the procurement process to respond to new programs through an established implementing mechanism; and the fact that special appropriations are not required to implement the programs...(50:53).

Defense economists seem to hold this concept of federal sovereignty responsible for placing the federal procurement process in the difficult position of trying to balance cost effectiveness with socioeconomic responsibility. This province has been described as "least cost" and "fair share and social cost". Hitch writes:

The general policy guiding defense purchases, simply stated is to obtain the most for a given budget...(however) two other policies are sometimes put forward to compete with 'least cost' policy. They are the 'fair share' and 'social cost' considerations(52:52).

Social cost, according to Hitch, is the concept by which contracts are awarded "as a means of keeping all parts of the economy in sound health"(52:53). To accomplish this goal, contracts are awarded to "economically distressed" or "labor surplus areas" with the hope that other government costs for unemployment, insurance, and welfare will be reduced. "Fair share", on the other hand, is based upon the solely political notion that legislators are generally "concerned about the heavy concentration of defense in some regions, industries, firms---usually not their own"(52:53).

In their research on the socioeconomic policies affecting federal procurement, Peggy and Richard Musgrave hypothesize that there are three distinct policy objectives for federal procurement:

1. The provision for social goods, or the process by which total resource use is divided between private and social goods.
2. Adjustment of the distribution of income and wealth to assure conformance with what society considers a 'fair' or 'just' state of distribution.
3. The use of budget policy as a means of maintaining high employment, a reasonable degree of price level stability, and an appropriate rate of economic growth(53:6-7).

Both of these explanations put forth by Hitch and the Musgraves seem to suggest that the federal procurement process is so tightly intertwined with conflicting socioeconomic objectives that the resulting losses in procurement effectiveness, cost reduction or social welfare are unavoidable.

Summary

Having described the major system acquisition cycle as well as examined the forces which impact the activities of systems acquisition, this chapter has provided the basis for presentation of the processes available to government to gain some subcontracted effort surveillance. The presentation in the next chapter necessarily builds upon the setting in which government must acquire major systems.

III. The Processes of Subcontract Surveillance

Scope

The processes by which government is able to gain visibility of a contractor's subcontract management effort and correspondingly gain leverage on contract cost, schedule and performance, are varied. The research effort of this thesis is aimed at those measures which address acquisition management methods. Cognizant that other measures such as quality assurance and manufacturing management also can provide a vehicle for achieving similar results but tailored for different ends, this narration specifically avoids these alternative techniques. The literature review that follows examines the procedures available to the acquisition management effort only.

Cost/Schedule Control Systems Criteria

The existence of what now is called Cost/Schedule Control System Criteria is traced to the Navy's use of a network scheduling technique on the Polaris submarine called Program Evaluation and Review Technique (PERT). From PERT, variations evolved which required separate costing of PERT network activities and generated detailed monthly governmental reports. These variations were called PERT COST. The technique required that a management control system responsive to the reporting requirements of the government be available within the contractor's organization. Because the control system was

solely required by government contract, the manufacturers reacted by creating PERT COST teams, simply passing on the expense of the element in contract overhead charges. This reaction caused two significant problems. First contract expenses rose and secondly, the PERT COST teams created a separate management control system within the organization to satisfy government reporting requirements. Consequently, reports rendered to the government were generally invalid because they were not derived from the contractor's actual management control system.

In answer to the inefficiencies of PERT COST, in 1963 the Air Force developed two separate approaches to performance measurement. The earned value approach, used on the Minuteman missile program, consisted of a contract performance measurement concept based on a set of management criteria to be included in the contract statement of work. Using lessons learned from PERT COST, the earned value system specified general capabilities to be provided by the contractor. The major contribution of the earned value approach was that no detailed government reporting system was superimposed over existing systems. Additionally, only an on-site "systems demonstration" to examine and validate the contractor's internal planning and control system was required.

Cost/Schedule and Control Specifications (C-SPEC), the second Air Force approach used both the elements of PERT COST and earned value in defining a set of simplified standards to validate the contractor's internal control system. C-SPEC was

published by the Air Force Systems Command in June 1966.

In December 1967, the Department of Defense published DOD Instruction 7000.2 which included the Cost/Schedule Control System Criteria (C/SCSC). Because no formal material existed that described or explained the earned value concept, DOD 7000.2 authorized the preparation of a guide for performance measurement. The guide was published in 1972 with updates in 1976 and 1980. Despite initial resistance to the criteria concept, all three services were actively implementing C/SCSC by 1972.

The C/SCSC approach to project management emphasizes that the contractor provide internal management systems that allow for control of the project by developing valid, clear standards and then managing by exception. The contractor has the latitude to organize to satisfy the requirements of his own environment and internal procedures. In specifying only reporting capabilities that the manufacturer must possess, C/SCSC avoids the imposition of expensive and duplicative reporting networks that characterized its predecessors. The basic tenet that permeates C/SCSC is that if the manufacturer operates a reliable, responsive internal control system, the government should be able to extract the summary reports to monitor project status.

The criteria established by C/SCSC requires the contractor to employ a management control system which will include policies, procedures, and methods which are designed to ensure that they will accomplish functions of organization, planning

and budgeting, accounting, analysis and revisions and access to data (60:Encl 1). A contractor's subcontract management effort is enhanced because of requirements to identify critical/major subcontractors responsible for accomplishing the authorized work.

In identifying these critical subcontractors, a prime contractor initiates the surveillance of the key components of the system to be produced. That surveillance includes measuring subcontract progress against work breakdown structure elements and schedule. Subsequent analysis of variances from targeted goals assist in achieving visibility of significant variances. The analysis capability mandated by C/SCSC must provide rationale for departure from scheduled targets. This feature of the contractor's management control system ensures that items which are critical to overall contract completion are monitored appropriately and afforded the management attention necessary for early identification and resolution of problems which would seriously impact contract performance.

The imposition of the requirements of C/SCSC, in summary, is intended to insure the government interests are protected while still allowing the contractor latitude in managing his operations as he desires. A key feature of C/SCSC in that regard is that it is a complete system which the contractor is using to keep his program within cost and schedule thresholds.

Contractor Purchasing System Review

With the expanded role of subcontracting in major weapon systems acquisition, the responsibilities of a prime contractor's purchasing system are significant. The increased responsibilities of the purchasing system impact on virtually all functions within the organization and more importantly directly influence the prime contractor's ability to meet cost, schedule and performance thresholds. Recognizing the key that a contractor's purchasing system represents, governmental review of purchasing is mandated by the Federal Acquisition Regulation (5:44.302).

A Contractor's Purchasing System Review (CPSR) is intended to evaluate the efficiency and effectiveness with which the contractor spends Governmental funds and complies with Government policy when subcontracting. Although the CPSR is intended as a comprehensive review of a contractor's purchasing operations, the review provides visibility into a contractor's subcontract management effort as well.

The CPSR is a generic review inasmuch as it is not performed for a specific contract but is conducted for each contractor whose negotiated sales are expected to exceed \$10 million during the next twelve months (5:44.302). The cognizant contract administration agency or plant representative office is responsible for conducting subsequent CPSR's at least every three years on contractors who continue to qualify. More frequent reviews may be warranted when information on the contractor's purchasing system reveals a deficiency or a major change in the contractor's purchasing system (5:44.303).

The review procedures require a complete examination of a contractor's purchasing system. As a systems review, the CPSR is not intended to narrate specific departures from contractor methods but to be an examination of procedures, policies, and performance in general. Special attention is given portions of the review. Among those significant or special concerns, with respect to gaining visibility of a contractor's subcontract management effort, are:

1. Pricing policies and techniques, including methods of obtaining accurate, complete and current cost or pricing data and certification as required.
2. Methods of evaluating subcontractor's responsibility.
3. Planning, award, and postaward management of major subcontract programs.

The prime contractor's pricing policies and procedures should provide that some form of price or cost analysis will be performed in connection with every purchasing action (54:46). The intensity of that analysis will vary with the complexity and the facts surrounding any one purchasing situation. Of particular interest is the fact that a policy is established, secondly that the policy conforms to some criteria which will represent the Government's interest and finally, that the policy or criteria are in fact applied (2:47).

Recognizing that the cost of highly complex products is difficult to analyze or estimate regardless of the experience of the price/cost analyst, the CPSR focuses on determining to what degree engineer expertise is employed in deriving internal cost estimates. The rationale supporting this is that the

contractor's own engineering personnel "may be in a better position to advise on the reasonableness of design and development hours" (54:50). It follows that complete and accurate cost estimates enable the contractor to assess competing proposals to select the bid which, at the specified performance requirements, is the lowest cost.

The contractor's evaluation methods in determining a subcontractor's responsibility are examined as well. Like cost and price analysis policy, source selection methods should be in written form. CPSR guidelines require examination of:

1. Methods of determining vendor's capability using:
 - a. Performance records.
 - b. Vendor's surveys.
 - c. Credit rating.
 - d. Technical evaluation of research and development proposals.
2. Single/sole source development.
3. Price/quality philosophy for selecting vendors (54:34).

The contractor should assess the responsibility of a subcontractor to insure that false economies due to lowest bid do not materialize. The award of an order to a vendor or subcontractor who ultimately defaults on the contract could result in additional administrative costs of surveillance or create synergistic problems in the weapon system schedule slippage.

Consequently, prior to award, a contractor should examine subcontractor responsibility to insure the vendor possesses:

1. Adequate financial resources, or the ability to acquire adequate financial resources in amounts necessary to assure timely subcontract performance.

2. Capabilities to comply with the required or proposed delivery or performance schedule, taking into consideration his other current business.

3. A satisfactory record of performance and integrity.

4. Be otherwise qualified and eligible to receive an award under applicable laws and regulations (54:45).

The contractor's procedural guidance should provide that buyers affirmatively declare that a determination has been made that a proposed vendor is responsible. A vendor rating system assists in providing a continuous record of current information.

Visibility of a contractor's subcontract management effort is achieved when, during the CPSR, the planning, award, and postaward management of subcontracts are examined. The planning efforts of a contractor should include meetings between purchasing and engineering personnel to definitize the technical specifications of the component and development of the statement of work (54:54). Among the activities included in the planning phase should be the verification that prime contract clauses and provisions have been reviewed and considered in the request for proposal. Conversely, subsequent to award, purchasing and engineering should validate all proposals to insure bids are responsive to technical specifications. Additionally, the purchase package should be routed to the appropriate review elements, complexity of the purchase considered, to ascertain that all necessary data have been included. In complex subsystem purchasing, the involvement of a special surveillance group may be warranted

(54:36).

The review of subcontract administration entails examination of the contractor's efforts to ensure:

1. Subcontract surveillance program has been properly instituted.
2. Subcontract administration and project engineering personnel work closely together in the resolution of design, production, reliability and delivery problems.
3. Subcontract administrator monitors and correlates cost and progress of the subcontracts.
4. There is an awareness of the subcontractor's problems together with effective action to resolve any problems (54:55).

Scrutiny of subcontract administration should assess the degree to which the government's interests are protected. As a minimum, procedures for prompt notification to the contracting officer of potential subcontracting problems which may impact upon delivery, quality or price of the prime contract are essential.

The review also should assess the types and frequency of reports required. Timely and accurate reporting as it impacts on cost overruns or schedule delinquencies provides the government with valuable insight into a contractor's subcontract management effort. Procedurally, the CPSR team should be able to explain all contract deficiencies in detail based upon report files. Equally important, the contractor should be capable of assessing the efficiency and effectiveness with which the subcontractors have implemented contract provisions to subtier vendors (54:56). It follows that

considerable visibility of a contractor's subcontract management effort is derived from the CPSR.

Cost and Price Analysis

Visibility of the contractor's subcontract management, as examined in this research effort, is ultimately desired to provide government with the ability to assess the efficiency with which government funds are spent. One of the key methods for assuring cost elements are accurate is cost and price analysis procedures. After first examining the procedures and circumstances under which cost and price analysis are conducted, a description of how cost and price analysis provides the DOD/US Army contract administration organizations visibility into subcontracted effort will be presented.

Because the acquisition of major weapon systems requires integration of many components, systems, and subsystems, often significantly different than commercial items and for which no price competition exists, the price of the acquisition is subject to debate. The debate of the price or cost to the government results in a "negotiated price". This function of the final pricing determination is the responsibility of the government's contracting officer (55:1A1). As such, he is required to use a combination of cost and price analysis, as appropriate, to insure that the negotiated price is fair and reasonable.

The use of price analysis is targeted on the overall price of an item. Attention is focused on the value of the item vice

on what it cost to produce the component (11:458). The procedures under which price analysis is performed require no detailed fact finding, auditing and no cost negotiation. Hence, it is a straight forward, simple and yet cost effective method which can be readily performed by an individual contracting officer independent of technical assistance.

Cost analysis, conversely, involves "an element by element review and evaluation of each component of cost and profit" (57:3-807). Unlike the simple procedures of price analysis, cost analysis focuses attention on what it should cost to produce an item rather than on the value of the item. Consequently, cost analysis is a complex and time consuming activity involving detailed cost identification and auditing. Although the contracting officer is ultimately responsible for making the final price decision, he is assisted by a group of experts (55:1A2). An important distinction between cost and price analysis is that cost analysis alone is not sufficient to determine a price to be fair and reasonable. In this case the contracting officer is not provided a good indication concerning the item's value. Thus, there is an interrelationship such that "normally a sound conclusion on value cannot be made on the basis of cost analysis alone...price arrived at by cost analysis must be corroborated by price analysis" (57:3-807.1).

Price analysis is defined as "the process of examining and evaluation a proposed price without evaluating its separate cost elements and proposed profits" (5:15-26). It should be

viewed as a "bottom line" analysis that compares the proposed 'bottom line' or total price to some other 'bottom line' price" (58:16). Price analysis may be performed through any of the following basic techniques:

1. Independent price quotations on the procurement under analysis.
2. Price quotations for similar end items.
3. Estimates developed by the Government.
4. Rough yardsticks.
5. Competitive catalogue or published price lists for items sold in substantial quantities on the open market (11:459).

The first technique involves determining that effective competition exists, then comparing the price quotations and accepting that one which is "the lowest responsible and responsive quote meeting the requirements of the solicitation" (57:3-907). Four requirements must be satisfied before the contracting officer can consider competition to be effective. There must be a minimum of two parties with each party fully capable of meeting the government's needs. Each party must independently compete for contract award with the contract being given to that party making the lowest bid or offer. Finally, each party must submit a price offer which is in keeping with the government's outlined requirements (55:3A2). If all four of the above conditions are met then price competition is considered effective, and subsequently that the resulting prices will be fair and reasonable (55:3A2).

The second technique utilizes the "comparison of prior quotations and contract prices with current quotations for the same or similar end items" (55:3A2). To employ this technique

the contracting officer must have access to complete pricing data for both the current and previous quotes. The contracting officer must analyze the historical data to validate the usefulness of this previous quoted price as a benchmark for current price comparison. The analysis must include consideration of all the circumstances surrounding the previous acquisition. Those considerations should include the type of delivery schedule, the quantities purchased, type of procurement and any start up costs involved in addition to extraordinary considerations peculiar to the acquisition. Similarly, the value of money over time as it impacts on price changes must be assessed (55:3A9).

The third technique involves "comparison of proposed prices with independent government cost estimates" (5:15-35). The government's estimate is generally based on the user's analysis of the requirement as outlined in the purchase request. In using this method, the contracting officer must consider the validity of the government estimate. He must "assure that the estimate is not based upon either funds available or a contractor's quote, but rather is based upon a thorough analysis of the effort involved" (58:26). Examination of the estimate should include what information and techniques were employed in arriving at the estimate as well as the reliability or track record of the source (55:3A10).

The fourth technique is the "application of rough yardsticks (such as dollars per pound or per horsepower or other units) to highlight significant inconsistencies that

warrant additional pricing inquiry" (5:15-35). The technique involves the use of parametric estimating procedures to develop a price based upon the prices of similar characteristics of that item purchased previously. The technique uses a cost estimating relationship (CER). The CER is "simply an expression of the relationship of cost to some characteristic such as weight, speed, volume, etc." (58:17). The method can be used only if previous application has proven to be both consistently reliable and logical (58:17).

The final technique useful in price analysis is a comparison with "prices on published price lists issued on a competitive basis, published market prices, or regulated prices" (56:459). In case of both published price list and published market prices, the contracting officer must ascertain that the published prices meet four criteria before a comparison can be performed. The criteria are:

1. There must be an established catalog or market price.
2. The price must be for a commercial item or service.
3. The item or service must be sold to the general public.
4. The item or service must be sold in substantial quantities (57:3-807).

Regulated prices are those set by the federal, state, or local governments. Here the contracting officer must verify the regulating authority and the regulated price before making any price comparisons.

Price analysis must be performed for all defense procurements (55:2B12; 56:458). The application of price

analysis alone is sufficient to determine a fair and reasonable price under certain circumstances. These circumstances are:

1. Formally advertised procurement.
2. Adequate price competition.
3. Established catalog or market prices of commercial items sold in substantial quantities to the general public.
4. Prices set by law or regulation (56:458).

Hence, price analysis alone is adequate for a determination of fairness and reasonableness in all instances of formal advertising and subsequent procurement. Additionally, price analysis alone is usually sufficient to determine fairness and reasonableness when:

1. The proposed price is under \$500,000.
2. The proposed price is over \$500,000 but the price is based upon adequate price competition or an established catalog, market, or regulated price (57:3-807).

Neither the Federal Acquisition Regulation nor public law requires submission of cost or price data under these two conditions (5:15-27).

In those instances where price analysis is insufficient to determine a fair and reasonable price, cost analysis techniques must also be used. The cost analysis, as such, will augment but not replace the requirement for price analysis (55:2B19). In situations where price competition is inadequate or lacking altogether and where price analysis as previously described, does not, by itself, insure the reasonableness of prices, contract cost analysis is used to establish the basis for negotiation of contract prices (55:2B18). The Federal Acquisition Regulation defines cost analysis as:

The review and evaluation of the separate cost elements and proposed profit of (a) an offeror's or contractor's cost or pricing data and (b) the judgmental factors applied in projecting from the data to the estimated costs, in order to form an opinion on the degree to which the proposed costs represent what the contract should cost, assuming reasonable economy and efficiency (5:15-25).

Whereas price analysis looks at the total price without regard to individual elements of cost or profit, cost analysis "is the element-by-element examination of the estimated or actual cost of contract performance" (12:249).

To perform cost analysis, the contracting officer must have available the contractor's cost and pricing data. Cost and pricing data are defined as:

Data, consisting of all facts existing up to the time of agreement on price, which prudent buyers and sellers would reasonably expect to have a significant effect on price negotiations. Being factual, these data are types of information that can be verified. They do not reflect on the accuracy of the contractor's judgement about estimated future costs or projections; they do, however, reflect on the data upon which the contractor based his judgment (55:1A-B6).

The Truth in Negotiations Act, Public Law 87-653, requires a contractor to provide the government with cost and pricing data and to certify said data's completeness, accuracy, and currentness (5:15-26). Cost and pricing data generally will be furnished in "all negotiated contracts and contract modifications expected to exceed \$500,000" (55:3B4).

Submission of cost and pricing data is not generally required when the contracting officer determines (through price analysis) that "the price negotiated is based on adequate price competition, established catalog or market prices...., or prices

set by law or regulation" (55:3B4).

The visibility into a contractor's subcontract management effort derived from cost and price analysis arises when the contractor submits his proposal including all subcontracted costs. The government can determine at that point the extent of cost and price analysis that the contractor has performed and is accorded the opportunity to verify subcontract price cost proposals. This extension of cost analysis to the subcontract tiers avails the government an opportunity to assess the subcontract risks flowed down to subtiers.

Make or Buy Program

The make-or-buy decision, within industry, refers to the analysis of the problem to manufacture an item or to purchase the same from an outside source. In essence, the make-or-buy decision process establishes the components which will be subcontracted. Government acquisition policy recognizes the contribution that make-or-buy decision procedures have on a contractor's overall performance of schedule. Prior to presenting the framework of government surveillance of a contractor's make-or-buy activities, a presentation of the factors impacting the decision process is essential.

Businesses consider the decision to make or buy for many different reasons. Perhaps the most obvious and most critical is cost. Many times a firm can make an item cheaper than they can purchase it. However, the indirect costs of equipment, research and development, facilities, and personnel, may make

the item cheaper to buy. Accurate estimates of production costs as well as purchase price are necessary to make a proper decision.

A second consideration in the make or buy process is the amount of control a firm desires to have over the particular item. Problems with product availability may result if a company is dependent on different firms for many items. Strikes, production slowdowns, and other factors effect the availability of an item. If a company makes its own items, it can control its resources and be more self sufficient (59:34). A second concern is the fear of losing trade secrets to a competitor. By making the item, all company secrets remain in control of the firm. If the decision is made to buy the item, the competitive edge may be lost (61:14, 59:33). A third area of concern about control is the principal of harmonization of interests in the production process. By making all items, coordination can be accomplished between different departments, increasing efficiency throughout the firm (59:21).

Fixed costs and workforce status is a third factor in the make or buy decision process. It may be more cost effective to use existing facilities, equipment, and personnel rather than purchase an item on the open market. Many firms are finding this to be true. Especially in periods of declining output, shifting formerly subcontracted items to "make" items becomes a method of defraying fixed expenses (61:14). However, the opposite argument is that existing facilities may be outdated and may be too expensive to maintain. It may be more efficient

to close a plant down and purchase the item from a more modern firm at an equitable price.

Specialization is a fourth factor bearing on the decision to make-or-buy. The question should be asked, "Who is best suited to do the job or perform the service?" A company may not want to expand or start a new production line with all the associated set up charges. Dale and Cunningham noted:

"a company may employ a policy of concentration which restricts its activities to those it does extremely well, with the provision that it 'jobs out' the remaining tasks to specialty suppliers" (62:11).

An example of specialized tasks is the area of research and development (R&D). A great deal of money is involved in setting up and operating laboratories with specialized equipment and personnel to perform research. Risk is also involved in operating an R&D section since the new research needed may not be developed, or it may take a long time to develop and perfect. An advantage of "buying" R&D, is the reduced risk involved in an already developed and tested technique (63:49). Frand, in his article "Make or Buy?", noted:

Buying R&D is costly and the buyer must pay for the time and effort which went to develop the technology and the marketable product. However, it is a far less expensive course when viewed in the overall efforts to develop new products (64:25).

This specialty of R&D should be a serious consideration in the overall strategy of the firm in its make or buy decisions.

A fifth consideration in the make or buy decision is the market cycle, market structure, and the company's desired place in the market. The market status is a major factor in the make

or buy decision. First, in a recession, prices go down creating a buyer's market and increasing competition. On the other hand, when business is booming, buying from subcontractors will be more expensive; however, this is when subcontracting is needed the most. Second, making an item requires a large cash outlay; therefore when interest rates are high, the tendency will be to buy rather than make the item and pay the higher interest rates on a loan to increase the manufacturing capabilities of the firm. Third, an expanding company may be more likely to buy because of its concentration on a specific area of expansion. This is especially true when the firm has a lack of liquid funds to expend on increasing the manufacturing facilities and may be forced to buy (65:214). A fourth component of the market to be considered is the degree of complexity of the transaction of the item. Generally, as the complexity of an item increases, the tendency to produce the item internally increases as well(65:216, 222).

The Federal Acquisition Regulation (FAR) outlines the make or buy program for the Department of Defense and defines three terms used in discussing this program: buy item, make item, and make or buy program.

Buy item - an item or work effort to be produced or performed by a subcontractor.

Make item - an item or work effort to be produced or performed by the prime contractor or its affiliates, subsidiaries, or divisions.

Make or buy program - that part of a contractor's written plan for a contract identifying:

a. those major items to be produced or work efforts to be performed in the prime contractor's

facilities

b. those to be subcontracted (5:15.701).

Thus, a prime contractor may either produce all components of a system, use subcontractors to supply them, or a combination of the two. The prime contractor is ultimately responsible for the performance of the contract including any subcontracting to make sure the government receives the required item or services at the lowest price and at the least risk. The government reserves the right to review a contractor's make or buy proposal to insure reasonable contract prices, satisfactory performance, and implementation of socioeconomic policies (5:15.702).

Contracting officers are required to review a contractor's make or buy proposal for all contracts over \$2 million except for research and development contracts, non-complex work, and when there is adequate competition. The contracting officer may also review the proposal when he feels it is necessary. The information given to the contracting officer in the make or buy proposal includes major items or work efforts that are "complex, costly, large quantities or require additional facilities to produce." Raw materials, commercial products, and off-the-shelf items and items less than one percent of the total contract should not be included in the review (5:15.704).

In reviewing a make or buy proposal, the contracting officer should consult specialists to compare estimated costs. Approval must also be obtained from the Small Business Administration before final approval of the suggested make or buy program. The contracting officer should be concerned with the effect of the

make or buy program on price, delivery, quality, and performance. Approval should not be given to "make" an item if:

1. The item is not normally manufactured or provided by the contractor and it is available from another firm at less than or equal cost.
2. When the item is regularly manufactured or provided by the contractor but is available from another source at lower prices. However, the contracting officer may agree to allow the contractor to make an item if it will decrease the cost to the government (5:15.706).

The make or buy plan analysis provides visibility into the prime contractor's subcontract management effort by requiring the contracting officer to consider the scope and complexity of the technical effort involved. If proposed subcontracted subsystems are complex and/or require a significant developmental effort by the subcontractor, the government is alerted to these risks. In the absence of information on the design status of the product being acquired, the contracting officer will require that a clause requiring identification of changes to the make or buy program be included in the prime contract (5:15.706(a)). The resulting management of critical or complex subcontracts adds to governmental visibility into subcontracting effort.

Consent to Subcontract

The proliferation and integration of state-of-the-art technology into major systems requires the efficient effort of many separate contractors. The prime contractor, as system integrator of these component work efforts, plays a significant role in determining which subcontractors will assist in meeting

the system requirements. Cognizant that the efforts of not only the prime contractor but the subcontractors as well influence achievement of cost, schedule and performance targets, the government requires that contractors obtain consent to enter into some subcontracts.

Consent to subcontract is required when the subcontract work is complex, the dollar value is substantial, or the Government's interest is not adequately protected by competition and the type of prime contract or subcontract (5:44.102). In cases where fixed price contracts are involved, the government's interests are protected by specific delivery and cost provisions. As a result, consent requirements are not exacted with the exception of cases where contracts are designated for special surveillance.

Procedurally, the contracting officer or the cognizant administrative contracting officer, if delegated the authority, is responsible for consent to subcontract. In his evaluation of the request to subcontract, the contracting officer will obtain the necessary assistance from subcontracting, auditing, pricing, technical, or other specialists. The evaluation of the request to subcontract entails considerations which impact on cost, schedule, and performance parameters. These considerations include:

1. Is the decision to subcontract consistent with the contractor's approved make-or-buy program, if any?
2. Was adequate price competition obtained or its absence properly justified?
3. Did the contractor adequately assess and dispose

of subcontractors' alternate proposals, if offered?

4. Does the contractor have a sound basis for selecting and determining the responsibility of the particular subcontractor?

4. Has the contractor performed adequate cost or price analysis or price comparisons and obtained accurate, complete, and current cost or pricing data, including any required certifications?

5. Is the proposed subcontract type appropriate for the risks involved and consistent with current policy?

6. Has the contractor adequately and reasonably translated prime contract technical requirements into subcontract requirements? (5:44.202-2).

These considerations enable examination of the contractor's proposed subcontracted work which bears significantly on contract success, thus providing the government visibility of the prime contractor's subcontract management.

Prime Contractor Subcontract Management Plan

Statutory requirements created by the Small Business Act of 1953 mandate that any contractor receiving a contract in excess of \$10,000 must agree to allow small business concerns to participate to the maximum practicable opportunity in the contract performance. Furthermore, in contracts which are individually expected to exceed \$500,000 and that have subcontracting responsibilities, the apparent successful offeror must submit a subcontracting plan (5:19.702). Subsequent to award of the contract, the contracting officer will determine if the plan is acceptable. A contractor who fails to submit or negotiate an acceptable subcontracting plan is considered ineligible for contract award.

The subcontracting plan is a document detailing the effort of the contractor to allow and maximize small business concerns to participate in government acquisition. The plan must include six elements. They are:

1. Separate percentage goals for using small business concerns and small disadvantaged business concerns as subcontractors;
2. The name of an individual employed by the offeror who will administer the offeror's subcontracting program, and a description of the duties of the individual;
3. A description of the efforts the offeror will make to ensure that small business concerns and small disadvantaged business concerns will have an equitable opportunity to compete for subcontracts;
4. Assurances that the offeror will include the clause at 52.219-9, Utilization of Small Business Concerns and Small Disadvantaged Business Concerns (see 19.708(b)), in all subcontracts that offer further subcontracting opportunities, and that the offeror will require all subcontractors (except small business concerns) that receive subcontracts in excess of \$500,000 (\$1,000,000 for construction) to adopt a plan similar to the plan required by the clause at 52.219-9, Small Business and Small Disadvantaged Business Subcontracting Plan (see 19.708(c));
5. Assurances that the offeror will (i) cooperate in any studies or surveys as may be required, (ii) submit periodic reports in order to allow the Government to determine the extent of compliance by the offeror with the subcontracting plan, and (iii) submit Standard Form (SF) 294, Subcontracting Report for Individual Contracts, and SF 295, Summary Subcontract Report, in accordance with the instructions on the forms;
6. A recitation of the types of records the offeror will maintain to demonstrate procedures adopted to comply with the requirements and goals in the plan, including establishing source lists; and a description of the offeror's efforts to locate small and small disadvantaged business concerns and to award subcontracts to them (5:19.702)

No specific format is required for a subcontracting plan but it

must include all six elements as specified above. Failure to do so may render the offeror nonresponsive. Government contracting officers are required to review the plan for completeness and adequacy.

The visibility of a prime contractor's subcontract management effort occurs when the provisions of the subcontracting plan are implemented in solicitations for major systems acquisitions. Due to the complexity or sensitivity of these acquisition programs, negotiation of a subcontracting plan may be required to be conducted concurrently with cost, technical and management proposals (5:19.705.2). This negotiation procedure highlights the technical risk and schedule uncertainties of subcontracted subsystems or components.

Similarly, in evaluating the acceptability of the subcontracting plan, the government contracting officer should assess the congruence of the plan with the contractor's make-or-buy program. If the contract is for a product which is specialized or not readily available in the commercial market, the contracting officer should consider the offeror's current capacity to perform the work (5:19.705-4). In making this assessment, the contracting officer is protecting the government's interests by insuring that the contractor, if capable and within capacity constraints, does not transfer work that could be performed in plant at a lower cost.

Summary

The nature of the acquisition of major systems is a complex

system of government, contractor and subcontractor interaction. The process, in and of itself, is conducted in an environment impacted by a variety of external forces, creating even greater uncertainties. The government, in an effort to achieve the prudent management visibility of the expenditure of tremendous sums of acquisition dollars, employs statutory, regulatory and legal relationships to attain this objective. Previous policy to pay the prime contractor for subcontract management continues to be the government's preference despite significantly expanded subcontracted effort. That dimension has produced a situation that places as much as fifty percent of government acquisition outlays beyond direct government influence. The measures enumerated in this chapter, however, provide the government with some leverage both in an indirect route through the prime contractor as well as in a direct fashion by virtue of the government's sovereignty. The effectiveness of those measures has recently been the point of concern. The next chapter examines the results of a survey design to gain some field perceptions on that subject.

IV. Survey Administration and Statistical Analysis

In an effort to determine the perceived effectiveness of the various processes of attaining visibility of a contractor's subcontract management effort, a survey instrument was constructed to solicit field opinion. The survey is attached as Appendix A. The survey consisted of ten questions on the effectiveness of the government surveillance techniques addressed in Chapter III. The respondents were asked to respond to each question on a five-increment Likert scale of agreement or disagreement on the effectiveness of that particular subject. Instructions on the completion of each question recognized the fact that all respondents would not necessarily be familiar with all subjects surveyed. Therefore, respondents were directed to cross out those questions with which they were unfamiliar. Additionally, respondents were provided an answer of neutrality to indicate no opinion on the effectiveness of the respective subject.

The target audience of the research effort consisted of those personnel who have experience in major systems acquisition. To reach that audience, contact was made with the Office of Project Management, Headquarters, U.S. Army Materiel Command. A comprehensive list of Program/Project/Product Managers was provided. From the consolidated list of Program/Project/Product Management Office (PMO) organizations, a

telephonic interview of the Director of Procurement and Production Directorate for each project office provided the points of contact for coordinating distribution of the survey.

Survey Validation

Prior to distribution, validation of the research instrument was conducted by field testing at Defense Contract Administration Services Management Area (DCASMA) Dayton . The survey was administered to twelve experienced contract administration personnel with follow up interviews of the respondents. During the interviews, each of the respondents was questioned on the validity of the questionnaire. Each question was individually examined to insure that it contributed to the research effort. Attention was then directed upon analyzing whether the question was proper in scope or should be broken into two or more questions. The validity of each question was then examined in terms of whether the respondents could adequately answer the question. This criteria included examination of:

1. Assumptions of prior knowledge of the subject.
2. Respondents information/expertise levels.
3. Question generality versus specificity.
4. Bias induced from inclusion or omission of words or phraseology.

Validation of the questionnaire also included examination of the wording of each question. The field test respondents were asked to evaluate each question to insure the vocabulary used would facilitate communication of the question subject.

Additionally the question's clarity was examined. Respondents were asked to examine each question in terms of the proper balance between question length and the vocabulary use. Respondents were asked to examine each question for biased wording and inappropriate personalization which might impact on the question validity.

The questionnaire field test then turned to examination of answer alternatives. Each of the field test respondents were asked to evaluate the response scale for adequacy and format. Clarity and vocabulary of answer alternatives were examined as well for adequacy in communicating the respondent's perception. Ultimately, the field test respondents concurred that the answering format was both clear and adequate. Respondents did, however, recommend that some space be provided for remarks.

Finally, the interviews of the field test respondents concluded with examination of the question sequencing. Question sequence was examined to insure that:

1. The question process adequately awakened interest and motivated the respondents to participate willingly.
2. The questioning process began with simple items and moved to more complex items.
3. The questioning process moved from general to more specific subjects.
4. Changes in frame of reference were minimized and clearly pointed out (68:238).

The result of the field test was the redesign of the survey instrument to the format as presented in Appendix A. Once validated, the survey was distributed to the addressees listed

in Appendix B. A total of two hundred and twelve surveys were distributed. Responses totaled eighty-three, for a return percentage of 39.1%.

Survey Population Analysis

Completion of Part I of the survey required annotating biographical information. Information requested included whether or not the respondent had program management experience, years of experience in contract administration, and years of experience in acquisition management. Evaluation of this data provided the basis for validating the respondent's contribution to the survey data base. The criterion of three years experience was established as a minimum amount of experience to qualify as a credible source. Of the total responses examined, eight failed to pass the minimum experience levels. Each respondent was asked also to indicate the background from which his experience was derived. Of the seventy-five validated responses, sixty-six indicated an experience level in excess of three years in contract administration. Fifty-eight of the respondents indicated experience levels in excess of three years in acquisition management duties.

A statistical analysis of the experience levels was performed. The analysis involved plotting the reported years of experience for contract administration and acquisition on a histogram to determine the shape of each distribution. Analysis of the histograms suggested that both distributions were best approximated by a Poisson probability distribution. The

calculation of the mean, variance, and standard deviation was performed. The calculation of the respective values is included in Appendix C: Statistical Analysis. The values derived are listed below in Table 4-1.

Table 4-1. Summary of Contract Administration and Acquisition Experience Statistics

Category	Mean Years of Experience	Standard Deviation

CONTRACT ADMINISTRATION	9.6983	3.1142
ACQUISITION	8.8182	2.9695

To verify the assumption that the Poisson distribution adequately approximated the real values derived from the survey, Chebyshev's theory was invoked. Under this rule, the interpretation of the standard deviation as a measure of distribution variability is acceptable if at least seventy-five percent of the measurements fall within two standard deviations of the mean (67:78). Application of this rule to both distributions under examination showed that eighty-three percent of the respondents replying who had acquisition experience were within two standard deviations of the mean. Additionally, of those respondents with contract administration experience, seventy-six percent of the responses were within two standard deviations of the mean. The analysis of the computed values therefore supports the conclusion that the data can be

approximated using a Poisson distribution.

Question Statistical Analysis Methodology

Evaluation of the survey questions involved a two step process. Initially, the distribution of responses was statistically tested to determine whether the distribution was a statistically probable distribution or conversely that an opinion or preference for a particular answer(s) existed. This statistical test involved the use of a Chi Square test for "goodness of fit". If the computed value exceeded the tabled value for four degrees of freedom at a .05 significance level, then examination of the count data followed to determine the nature and strength of the preference. If the computed value did not exceed the test statistic, then no statistical basis for further examination of the question was warranted.

Procedurally, the chi square test of one dimensional classification data requires comparison of the observed data to the expected count to make inferences about the probabilities of distribution (67:724). The test of the goodness of fit is based on the following assumptions:

1. The experiment consists of n identical trials.
2. There are K possible outcomes to each trial.
3. The probabilities of the K outcomes, denoted by $p_1, p_2, p_3, \dots, p_k$, remain the same from trial to trial.
4. The trials are independent.
5. The random variables of interest are the counts $n_1, n_2, \dots, n_k$, in each of the K cells (67:725).

Based upon these assumptions the test is performed for the

hypothesis that:

$$H_0 = p_1 = p_2 = \dots p_k \text{ (where } p_1, p_2, \dots p_k \text{ equal } np)$$

H_1 = At least one of the proportions exceeds np . (a preference exists).

The value of this technique is derived from the fact that the probability of the one dimensional classification data will be approximated by the chi square value corresponding to $K-1$ degrees of freedom. To minimize the chance of making an error in interpreting the statistical test, (i.e. a beta error), the significance level selected for this statistical analysis was .05 percent. The test statistic for the chi square is:

$$X = \sum_{i=1}^k \frac{[n_i - E(n_i)]^2}{E(n_i)}$$

Figure 4-1. Chi Square Test Statistic

where: $E(n_i) = np_{i,0}$, the expected number of outcomes of type i assuming H_0 is true.

Chi Square Testing

To test for statistical significance, the data for each of the questions was recorded. The test conducted was based upon the hypothesis that:

H_0 : The distribution of the responses on this question approximated the expected values for each of the possible answers.

H_a: The distribution of the responses on this question differed from the expected values. (An opinion or preference existed.)

The test statistic was computed for each of the questions and compared to the tabled value of four degrees of freedom at the .05 significance level (9.48773). Computation of the test statistic and histogram of the responses recorded for each question is included in Appendix C-Statistical Analysis. In all cases, the test statistic exceeded the tabled value. Therefore the data supports rejection of the null hypothesis in favor of the alternate hypothesis that an opinion of preference does exist on each of the survey questions.

Comparative Analysis Procedures

Having determined that a statistical basis for concluding that a preference existed on each question, the analysis continued with examination of the count data to determine the magnitude and nature of the opinions expressed by the survey population.

Comparative analysis of the values for each of the alternatives was used to establish the specific preference. The comparative process employed was to first examine the number of responses for each category on the continuum of five possible answer alternatives, categorizing the answers into three general classes of either agreement ("Highly Agree" and Agree"), neutral ("Neutral"), or disagreement ("Disagree" and "Highly Disagree"). In that the objective of the survey was to gain field

perspective on each of the surveyed subjects, this classification process provided the vehicle to gain that insight. From this classification schema, the values for each category were converted to percentages of the population. This conversion process facilitated the determination of the comparative values. The greatest percentage value established the nature of the preference. The magnitude of that opinion was then determined by a Bayesian analysis of the preference class. The individual elements were converted to percentages to arrive at the answer alternative which was interpreted to be representative of the survey population.

Preference Determination

Question one of the survey addressed current acquisition policy. The question posed on the survey was:

Current DOD/US Army policy is that the prime contractor on a major weapon system is responsible for subcontract management. Is this policy appropriate to insure cost, schedule, performance and supportability thresholds are met?

Examination of the count data showed that the greatest percentage of the respondents, seventy-eight percent, agreed that this policy is appropriate to insure cost, schedule, performance and supportability thresholds are met. In contrast, this preference value exceeded the number of respondents who selected the "Neutral" response, three percent, and those who were classified to disagree who represented nineteen percent of the population. Within the preference group, fifty-five percent

of the agreement group selected "Agree" versus forty-five percent who indicated "Highly Agree". Therefore the data supports the conclusion that the current policy, that the prime contractor is responsible for subcontract management to insure cost, schedule, performance and supportability thresholds are met, is appropriate.

Question two of the survey addressed use of the Contractor Purchasing System Review (CPSR) Program. Respondents were asked to indicate their agreement/disagreement with the statement:

Contract Purchasing System Review procedures provide the necessary visibility to adequately assess a prime contractor's subcontract management capability.

Examination of the count data showed that fifty-nine percent of the survey population agreed that that the procedures of the CPSR provide the necessary visibility to adequately assess a prime contractor's subcontract management capability. This value compared to only twenty-four percent of the respondents who indicated disagreement and seventeen percent who selected the neutral alternative. Of those respondents who indicated agreement, only nineteen percent "Highly Agreed" that the CPSR program procedures provided necessary visibility. Therefore, the data for question two supports the conclusion that CPSR procedures provide the necessary visibility to adequately assess a prime contractor's subcontract management capability.

Question three of the survey addressed use of the price/cost analysis. Respondents were asked to indicate their agreement/disagreement with the statement:

Price analysis provisions that allow price/cost analysis of subcontract proposals provide the necessary leverage to adequately influence a prime contractor's subcontract management effort.

Examination of the descriptive data showed that forty-seven percent of the respondents agreed that the procedures of cost/price analysis provide the necessary leverage to adequately influence a prime contractor's subcontract management effort. Of that percentage, ninety one percent "Agreed" and nine percent "Highly Agreed". The comparison of the values for each of the classes showed sixteen percent neutral and thirty-eight percent selected disagreement. Consequently, the data supports the conclusion that cost/price analysis does provide the necessary leverage to adequately influence a prime contractor's subcontract management effort.

Question four of the survey addressed analysis of a prime contractor's make or buy plan. Respondents were asked to indicate their agreement/disagreement with the statement:

The analysis of a prime contractor's "Make-or-Buy" plan provides the visibility of the prime contractor's subcontract management to favorably influence management of critical subcontracts.

Examination of the descriptive data showed that thirty-seven percent of the respondents "Agreed" and thirty-six percent "Disagreed" that analysis of the prime contractor's "Make-of-Buy" plan provided the visibility of the prime contractor's subcontract management to favorably influence management of critical subcontracts. Twenty-six percent

indicated a "Neutral" opinion. The opinion of the population can be interpreted to be in agreement with this statement but only by a one percent margin. Limitations of the methods used preclude statistically valid confidence intervals. Therefore, the data does support agreement on this statement, but only by the narrowest of margins.

Question five of the survey addressed the use of a prime contractor's subcontract management plan procedures. Respondents were asked to indicate their agreement/disagreement with the statement:

The prime contractor's subcontract management plan provides the necessary visibility of the prime contractor's subcontract management effort to favorably influence management of critical subcontracts.

Examination of the descriptive data showed that the greatest number of the respondents, fifty-one percent, agreed that the prime contractor's subcontract management plan provided the visibility of the prime contractor's subcontract management effort to favorably influence management of critical subcontracts. Of that group, eighty-six percent selected "Agree" as representative of their opinion. The respondents indicated "Disagreement" twenty-seven percent of the time and selected the "Neutral" alternative on twenty-one percent of the responses. Therefore, the data supports the conclusion that a prime contractor's subcontract management plan provides the necessary visibility of the prime contractor's subcontract management effort to favorably influence management of critical

subcontracts.

Question six of the survey addressed the use of Cost/Schedule Control Systems Criteria procedures. Respondents were asked to indicate their agreement/disagreement with the statement:

Cost Schedule Control System Criteria (C/SCSC) procedures provide the appropriate capability for Government Contract Administration personnel to monitor subcontract performance on major weapon system contracts.

Examination of the descriptive data showed that forty-one percent of the respondents indicated agreement that C/SCSC procedures provide the appropriate capability for Government Contract Administration personnel to monitor subcontract performance on major weapon system contracts. Within that group, ninety-two percent of the respondents selected the "Agree" answer alternative. The forty-one percent value of the preference group exceeds thirty-two percent of the responses which indicated "Neutral" and twenty-six percent of the population who indicated disagreement with the statement. The data therefore supports the conclusion that C/SCSC procedures provide the appropriate capability for Government Contract Administration personnel to monitor subcontract performance on major system contracts.

Question seven of the survey addressed current acquisition management organization adequacy. Respondents were asked to indicate their agreement/disagreement with the statement:

Current acquisition management organization and staffing is adequate for managing surveillance of subcontractor performance on major weapon system contracts.

Examination of the descriptive data showed that the greatest percentage of the respondents, sixty-two percent, were classified as disagreeing that current acquisition management organization and staffing is adequate for managing surveillance of subcontractor performance on major weapon system contracts. This figure compared to twenty-one percent who were "Neutral" and seventeen percent who fell into the category of "Agreement". Of the preference group of "disagreement", sixty-four percent selected the "Disagree" alternative vice thirty-six percent who indicated "Highly Disagree". The data, therefore, supports the conclusion that current acquisition management organization and staffing is not adequate for managing surveillance of subcontractor performance on major system contracts.

Question eight of the survey addressed current contract administration organization adequacy. Respondents were asked to indicate their agreement/disagreement with the statement:

Current contract administration organization and staffing is adequate for managing surveillance of subcontractor performance on major weapon system contracts.

Examination of the count data showed that the sixty-seven percent of the respondents disagreed that current contract administration organization and staffing is adequate for managing surveillance of subcontractor performance on major

weapon system contracts. Percentage values for the neutral and agreement classes were twelve and twenty percent respectively. Of the preference group, sixty-three percent of the respondents selected "Disagree" as opposed to thirty-seven percent who "Highly Disagreed". The data, therefore supports the conclusion that current contract administration organization and staffing is not adequate for managing surveillance of subcontractor performance on major weapon system contracts.

Question nine of the survey addressed current training/education of contract administration personnel. Respondents were asked to indicate their agreement/disagreement with the statement:

Current training/education of contract administration personnel is adequate to provide the knowledge necessary for managing surveillance of subcontractor performance on major weapon system contracts.

Comparative analysis of the count data revealed that the preference group was the disagreement class with forty-two percent of the population. Twenty percent of the respondents selected the "Neutral" alternative and thirty-seven percent of the population were in the agreement class. Of the disagreement group, sixty-seven percent selected "Disagree" versus thirty-three percent who responded "Highly Disagree". Therefore, the data supports the conclusion that current training/education of contract administration personnel is not adequate to provide the knowledge necessary for managing surveillance of subcontractor performance on major system contracts.

Question ten of the survey addressed a proposal for a prime liaison element located at the subcontractor plant. Respondents were asked to indicate their agreement/disagreement with the statement:

Prime contractors should be required to establish employee/liaison elements at a subcontractor's plant to provide surveillance of the subcontractor.

Comparative analysis of the count data revealed that sixty-one percent of the survey population agreed that the prime contractor should establish an employee/liaison element at a subcontractor's plant to provide surveillance of the subcontractor. This preference group exceeded the percentages of the neutral class of seventeen percent and twenty-one percent for those in disagreement. Of the preference group, those who selected "Agree" accounted for sixty-three percent and "Highly Agree" amounted to thirty-seven percent. The data, therefore, supports the conclusion that a prime contractor should be required to establish a liaison element at the subcontractor's plant to provide surveillance of the subcontractor.

Summary

The focus of this chapter has been on documenting the procedures used in collecting data addressing government's subcontract management surveillance techniques. Based upon the data furnished through the survey process, a field perspective of the utility of the surveillance techniques has been derived. Coupled with the literature review of Chapters II and III, this

presentation has provided the basis for concluding the examination of subcontract surveillance policy. The conclusions and recommendations that are based upon the previously presented material are contained in Chapter V.

V. Conclusions and Recommendations

The evolution of the role of subcontractors with respect to major system acquisition has significant implications for the Department of Defense and the US Army. With the heavy dependence on technologically superior systems as the cornerstone of the nation's defense policy, the subcontractor who possesses specialized production capabilities has become a vital factor in not only producing these major systems but doing so in an efficient and timely fashion.

No longer can the government rely on a single contractor to possess all the required capabilities to provide these complex systems. Not unexpectedly, as a consequence of displacing a greater share of the work to subcontract tiers, the flow of defense acquisition expenditures to the subcontract tiers has also increased. The requirement for financially responsible and accountable expenditure of tax dollars, however, remains unchanged. Hence, the management control of the acquisition process has had to evolve as well to meet the altered circumstances of major system acquisition.

Concern over the extent and efficiency to which DOD/US Army acquisition process has adapted to this environment has required examination of the total acquisition system. This research document has examined the acquisition management of subcontracted effort. A review of the material previously

presented will provide the basis for concluding the presentation.

Review

The nature of the relationships that exist between government and the defense industrial base represents a key dimension to the problems examined in this research effort. First, the relationship between government and prime contractors has three facets. The government, as a sovereign, is vested with statutory powers to promote the interests of the people. It is the power of the statutes created by government which provides the DOD/US Army with unique capability to control a business transaction. In deed, the government compells a contractor to do many things which differ significantly from commercial practice.

The second dimension of the government-prime contractor interface is the legal requirements established through the contractual process. In signing the contract, both parties establish "privity of contract". Privity of contract essentially eliminates any third party, who not being a member of the original agreement, from legally entering or influencing the performance of the parties to the contract. It provides a direct legal avenue to delineate the requirements of both parties as well as to determine remedies available to the parties. The importance of privity doctrine is emphasized when government acquisition policy is analyzed. Federal acquisition policy is to hold a prime contractor responsible for placement,

management and administration of subcontracts. Therefore, government has no direct legal relationship with subcontractors and must rely upon the prime contractor to "best" represent its interest at the subcontract tiers.

The final aspect contributing to the definition of government-prime contractor relationships is a regulatory interaction. Government influences defense contractors by regulating the acquisition activities. Although no legal basis exists for complying with regulating provisions, contractors are forced to comply with government regulations in order to get and maintain government business. Regulatory requirements are generated by a myriad of source documents, the most recent of which is the Federal Acquisition Regulation (FAR). The most salient examples of regulatory practices include Contractor Purchasing System Reviews and Contractor Make-or-Buy Decision procedures.

To overcome the void created by lack of privity between government and subcontractors, government acquisition has evolved several indirect measures for tracking subcontractor performance. Although a subcontractor is subject to most statutory requirements, the prime contractor, as noted above, is the government's surrogate in achieving effective and efficient performance of subcontractors. These indirect measures are designed to provide government acquisition offices the ability to examine the prime contractor's subcontract management and the leverage to influence the prime contractor to effect improvements in subcontracted effort. A summary of these

measures, as addressed in Chapter III, follows.

Prior to award, as well as after contract award, Government attempts to determine a contractor's management efficiency of subcontract effort by:

1. Make-or-Buy Plan analysis.
2. Price/cost analysis
3. Subcontract Management Plan analysis.
4. Consent to Subcontract procedures.

These processes, as presented and narrated in Chapter III, provide DOD/US Army acquisition offices with oversight and insight to the subcontract management of a prime contractor. The nature of the respective contribution of these processes to the management oversight of the subcontracted effort varies. Make-or-buy plan analysis essentially examines what systems and components will be subcontracted. Price/Cost analysis provides DOD/US Army acquisition with cost management information and lastly, to whom the subcontracted items will be awarded is gained from provisions of Consent to Subcontract and Subcontract Management Plan procedures.

The efficiency under which the prime contractor performs subcontract management is scrutinized as well. A Contractor Purchasing System Review (CPSR) provides that surveillance. The CPSR, unlike the previously listed measures, is generic in nature and routinely is not performed as a consequence of a contract award. Under CPSR procedures, extensive examination of the purchasing activities is used to determine the contractor's subcontract management system adequacy and efficiency. The combination of these measures, then, provides

DOD/US Army acquisition management offices with oversight of what will be subcontracted, at what cost, to whom the work will be awarded, and how it will be managed.

Once awarded, the efficiency of the subcontracted effort is supervised through implementation of Cost/Schedule Control Systems Criteria (C/SCSC). This tracking process involves the reporting of contract performance through a contractor's own systems. Government acquisition management is advised of work completion by comparison of actual performance to preestablished cost and schedule objectives. The contractor's analysis of variance from these goals provides DOD/US Army acquisition management organizations "efficiency" oversight of the subcontracted effort, among other information.

Conclusions

The foregoing summary of the visibility of a prime contractor's subcontract management effort establishes the context in which this research effort was undertaken. Having documented the framework in which the subcontract surveillance is achieved, this inquiry examined the processes to determine the effectiveness of their application in the major system environment. All of the programs/processes were perceived by acquisition management practitioners to be effective in achieving the necessary surveillance and leverage to influence a prime contractor's subcontract management effort.

The effectiveness of these measures, however, does not insure that the government policy of holding a prime contractor

responsible for subcontracted effort is appropriate. The results obtained from the field survey, as documented in Chapter IV, do address this issue. Overwhelming agreement was recorded that this policy is appropriate. Moreover, that agreement was corroborated by three additional questions concerning organization and staffing. Field perception is that not only is this policy appropriate but that neither acquisition management nor contract administration organizations are staffed adequately to assume any active involvement in subcontract management. Additionally, current training and education of contract administration personnel is inadequate for assuming that function.

The implications that these results hold for government acquisition policy is that current practice and policy adequately address the risks incurred with the increased subcontract base. Additional cost of assuming a direct involvement in managing subcontracted effort is not justified. This fact was supported in interviews conducted with key acquisition personnel within the United States Army Missile Command (MICOM). Major General Jerry Bunyard, Commander of MICOM, where total US Army RDT&E and Procurement expenditures exceed \$8.5 billion annually, highly indorsed the current policy. In answer to the question on the appropriateness of this policy, MG Bunyard noted that not only was this the most efficient method of producing major systems, but it also was consistent with current policy to contract out to private industry those functions which are within the capability of the

private sector to perform (69).

Reinforcing the views of MG Bunyard, Brigadier General Donald R. Infante, Air Defense Program Manager, United States Army Missile Command (MICOM), also avidly supported current acquisition policy to hold a prime contractor responsible for subcontract management. Citing the effective use of existing surveillance processes, BG Infante keyed the success of acquisition management of the subcontracted effort to rigorous adherence to the procedures (70). BG Infante indicated that to assume a direct involvement in the subcontract management effort, instead of using the prime contractor to do so, is tenuous at best. Neither does government currently possess the expertise to manage subcontracted effort, nor can that function be undertaken without significantly expanded acquisition assets. He emphasized that contractors have the necessary expertise to manage subcontracted effort and that with effective and efficient application of existing processes government interests are preserved.

Based upon the research data, the conclusion is presented that current organization and procedures for achieving subcontract management surveillance are adequate and that current policy to hold a prime contractor responsible for subcontract management is also appropriate.

Recommendations

Examination of DOD/US Army policy on the acquisition management of subcontracted effort in this research effort

specifically excluded any leverage developed as a consequence of manufacturing management or quality assurance programs.

Comments from the respondents of the survey as well as from the personnel interviewed emphasized that the effectiveness of subcontract management is impacted by these programs.

Contractual language that flows provisions of producibility and production readiness to subcontractors add an additional dimension to the oversight of a contractor's subcontract management. Research on the subject as a whole is warranted.

Although the conclusions of this report support the effectiveness of current procedures designed to survey a contractor's subcontract management, the collective application of the procedures was criticized. Respondents to the survey noted that, while a measure may be effective, the benefits of the process are not always realized because of lack of currency. The synergistic effect of the application of two or more of the surveillance techniques is lost. Thus the efficiency with which the measures are applied warrants examination. The inquiry should assess the process and the appropriateness of the thresholds established. The result from this thesis suggests that a model showing the interrelationship of the processes and optimizing the benefits of the oversight techniques would be helpful.

Appendix A: Survey Questionnaire

Air Force Institute of Technology
Wright Patterson Air Force Base, Ohio 45433

DATE: 26 APR 85

Subject: Contract Administration Questionnaire

1. The complexity and frequency of subcontracting in major weapon system acquisition is increasing. Concerned that the proliferation of subcontracting has outstripped the sophistication of a prime contractor's purchasing operations, as well as the DOD surveillance of the prime contractor's subcontract management effort, the Office of the Under Secretary of Defense - Research and Engineering requested a DOD wide assessment of current subcontract management issues.
2. In support of this assessment, the attached survey is a research instrument designed to solicit field input on the effectiveness of current subcontracting surveillance and procedures. The results obtained from the survey will be assimilated into a research report covering existing subcontract surveillance techniques and the resulting visibility of prime contractor's subcontract management effort on major weapon system acquisitions. (All questions posed in the survey are with respect to major weapon systems such as the M-1 Abrahams Tank or the Sargeant York Division Air Defense gun.)
3. To complete the survey, each respondent should first insure that the requested biographical data is provided. (Names are neither requested nor required). Having provided the biographical data, respondents should then circle the answer that as closely as possible represents his or her perception that "best" answers the question. If you are unfamiliar with the subject matter of the question, simply draw a line through the question. Once completed, insert the survey into the preaddressed envelope attached to the last page making certain the envelope is sealed. Then simply deposit the completed survey in the mail.
4. Strict anonymity will be observed. Surveys should be completed and mailed as soon as possible but not later than 30 May 1985. Your cooperation in providing candid answers to all questions posed will enable meaningful analysis of existing procedures and is sincerely appreciated.

MICHAEL L. LANDON
CPT, FA
United States Army

BIOGRAPHICAL INFORMATION

Please provide the below requested information in it's entirety.

1. Current Grade/Rank
2. Current Duty Position
3. Experience in Program Management (Y/N)
4. Years of Experience in Acquisition
5. Years of Experience in Contract Administration

QUESTIONS

1. Current DOD/US Army policy is that the prime contractor on a major weapon system is responsible for subcontract management. Is this policy appropriate to insure cost, schedule, performance and supportability thresholds are met?

1. HIGHLY AGREE
2. AGREE
3. NEUTRAL
4. DISAGREE
5. HIGHLY DISAGREE

2. Contract Purchasing Systems Review procedures provide the necessary visibility to adequately assess a prime contractor's subcontract management capability.

1. HIGHLY AGREE
2. AGREE
3. NEUTRAL
4. DISAGREE
5. HIGHLY DISAGREE

3. Price analysis provisions that allow price/cost analysis of subcontract proposals provide the necessary leverage to adequately influence a prime contractor's subcontract management effort.

1. HIGHLY AGREE
2. AGREE
3. NEUTRAL
4. DISAGREE
5. HIGHLY DISAGREE

4. The analysis of a prime contractor's "Make-or-Buy" plan provides the visibility of the prime contractor's subcontract management to favorably influence management of critical subcontracts.

1. HIGHLY AGREE
2. AGREE
3. NEUTRAL
4. DISAGREE
5. HIGHLY DISAGREE

5. The prime contractor's subcontract management plan provides the necessary visibility of the prime contractor's subcontract management effort to favorably influence management of critical subcontracts.

1. HIGHLY AGREE
2. AGREE
3. NEUTRAL
4. DISAGREE
5. HIGHLY DISAGREE

6. Cost Schedule Control System Criteria (CSCSC) procedures provide the appropriate capability for Government Contract Administration personnel to monitor subcontract performance on major weapon system contracts.

1. HIGHLY AGREE
2. AGREE
3. NEUTRAL
4. DISAGREE
5. HIGHLY DISAGREE

7. Current acquisition management organization and staffing is adequate for managing surveillance of subcontractor performance on major weapon system contracts.

1. HIGHLY AGREE
2. AGREE
3. NEUTRAL
4. DISAGREE
5. HIGHLY DISAGREE

8. Current contract administration organization and staffing is adequate for managing surveillance of subcontractor performance on major weapon system contracts.

1. HIGHLY AGREE
2. AGREE
3. NEUTRAL
4. DISAGREE
5. HIGHLY DISAGREE

9. Current training/education of contract administration personnel is adequate to provide the knowledge necessary for managing surveillance of subcontractor performance on major weapon system contracts.

1. HIGHLY AGREE
2. AGREE
3. NEUTRAL
4. DISAGREE
5. HIGHLY DISAGREE

10. Prime contractors should be required to establish employee/liaison elements at a subcontractor's plant to provide surveillance of the subcontractor.

1. HIGHLY AGREE
2. AGREE
3. NEUTRAL
4. DISAGREE
5. HIGHLY DISAGREE

REMARKS: Please provide any comments, observations, or ideas/initiatives that you consider to be important to the issue of evaluating the effectiveness of a prime contractor's subcontract management effort or establishing surveillance of critical subcontracts.

Appendix B: Survey Addressees

The survey audience was targeted by contacting the below listed addresses.

DCASPRO HUGHES
P.O. Box 3310
Mail Drop 600-E115
Fullerton, California 92634

USASC
AHPMO (Attn: W. Smith)
Building 105
4300 Goodfellow Road
St. Louis, Missouri 63120

Lima Army Tank Plant
AMCPM-GCM-UC (ATTN: L. Haas)
1155 Buckeye Road
Lima, Ohio 45802

CDR, USATACOM
DRCPM-LCV-PC
Warren, Michigan 48397-5000

DCASMA Detroit
GDLS Residency Office
ATTN: J. Long
850 Stephenson Highway
Suite 115
Troy, Michigan 48083

CDR, USATACOM
AMCPM-M113
Warren, Michigan 48397-5000.

DCASR Cleveland
DCASR-CLE-AFS (ATTN: J. Bucci)
Federal Office Building
1240 East Ninth
Cleveland, Ohio 44199

USAVSC
AMCFM-ASH-S (ATTN: R. Moore)
4300 Goodfellow Road
St. Louis, Missouri 63120-1798

CDR GECOM
AMSEL-PC (ATTN: J. Varady)
Ft. Monmouth, New Jersey 07703

DCASMA Indiannapolis
DCASR-CHI-GIA (ATTN: R. Briggs)
Building 1
Ft. Benjamin Harrison, Indiana 46249-5700

DCASPRO FMC
DCASR-LA-REA (ATTN: M. Okamoto)
P.O. Box 367
Mail Drop K-65
San Jose, California 95103

Appendix C: Statistical Analysis

Recorded Experience Values - Contract Administration.

3.0 4.5 5.5 7.0 11.0 19.0
3.0 5.0 5.5 9.0 11.0 20.0
3.0 5.0 6.0 10.0 11.0 22.0
3.0 5.0 6.0 10.0 12.0 24.0
3.0 5.0 6.0 10.0 12.0 24.0
3.0 5.0 6.0 10.0 12.0 25.0
4.0 5.0 6.0 10.0 12.0 29.0
4.0 5.0 6.0 10.0 15.0 33.0
4.5 5.0 6.0 10.0 15.0
4.5 5.5 6.5 10.5 15.0

Number of data points = 58.

Sum of all experience values = 562.5 years

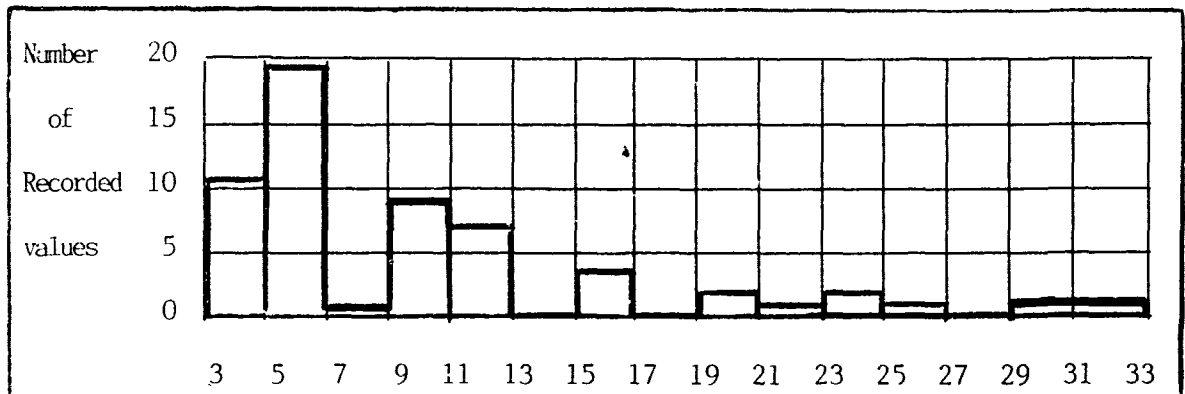


Figure C-1. Contract Administration Experience Levels

Calculation Of Statistics.

Mean Of Contract Administration Experience Levels = $562.5/58$
= 9.6983

Standard Deviation (Poisson) = $\sqrt{9.6983} = \underline{\underline{3.1142}}$.

Verification of Poisson Distribution.

To be a valid measurement of the distribution, the standard deviation must indicate the variability of the distribution. In a Poisson distribution, seventy-five percent of the values must be between two standard deviations of the mean. For the above data, the interval is $[9.6983 \pm (2 \times 3.1142)]$ or from 3.4699 to 15.9267. The values within this interval total 44. Therefore, seventy-six percent of the points (44/58) are represented by this interval.

Recorded Experience Levels - Acquisition Management.

3.0	4.5	5.0	6.0	10.0	12.5	16.5
3.0	4.5	5.0	6.0	10.0	12.5	
3.0	5.0	5.0	6.5	10.5	13.0	18.0
3.0	5.0	5.5	6.5	10.5	13.0	23.0
3.5	5.0	5.5	6.5	10.5	13.5	24.0
3.5	5.0	5.5	6.5	10.5	15.0	25.0
3.5	5.0	5.5	6.5	11.0	15.0	29.5
4.0	5.0	5.5	7.0	11.0	15.5	
4.0	5.0	5.5	7.0	12.0	16.5	
4.0	5.0	6.0	9.5	12.0	16.0	

Number of Data points = 66

Sum of all experience values = 582.0 years

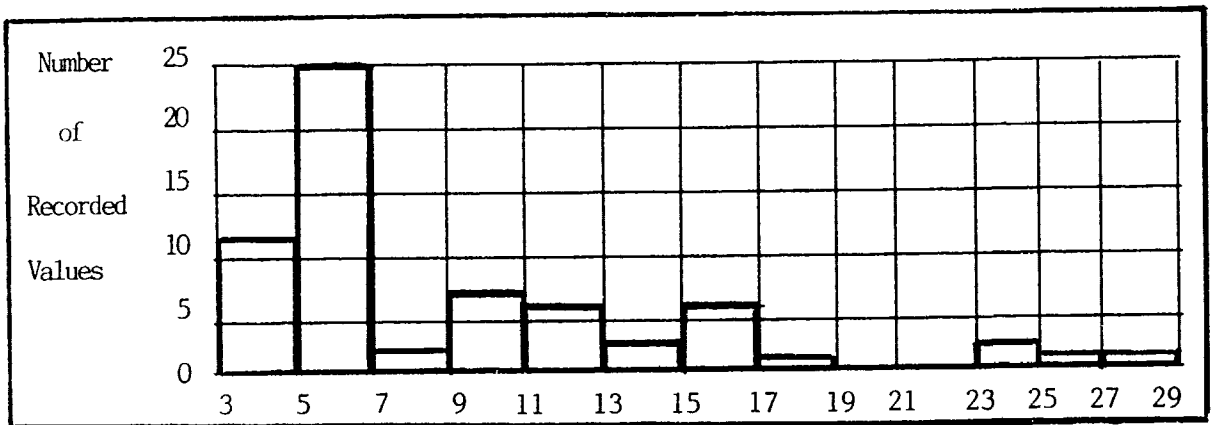


Figure C-2. Acquisition Management Experience Levels

Calculation of Statistics.

Mean of Acquisition Management Experience Levels = $582.0/66 = \underline{\underline{8.8182}}$

Standard Deviation (Poisson) = $\sqrt{8.8182} = \underline{\underline{2.9695}}$

Verification of Poisson Distribution.

In a Poisson distribution, seventy-five percent of the values must be between two standard deviations of the mean. For the above data, the interval is $[8.8182 \pm (2 \times 2.9695)]$ which computes to the interval 2.8971 to 14.7573. The values that fall within this interval total 55. Therefore, eighty-three percent (55/66) of the points are represented by this interval.

Statistical Analysis: Question # 1

Question: Current DOD/US Army policy is that the prime contractor on a major weapon system is responsible for subcontract management. Is this policy appropriate to insure cost, schedule, performance and supportability thresholds are met?

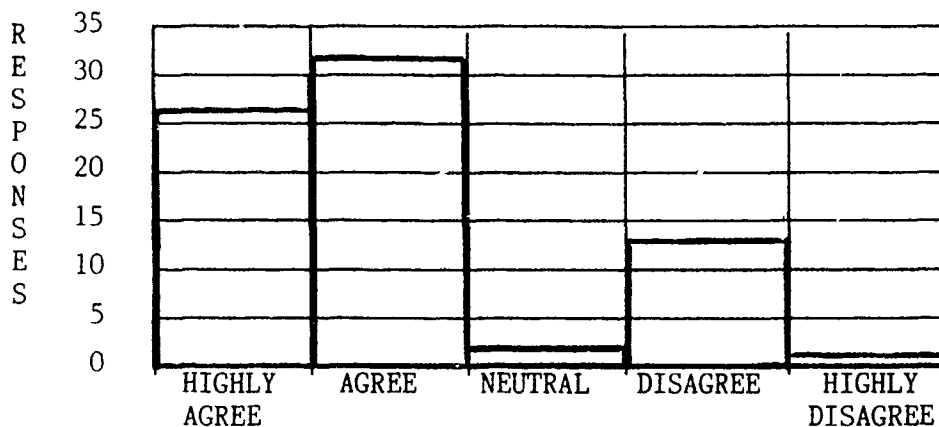


Figure C-3. Histogram of Survey Responses-Question # 1.

CHI SQUARE CALCULATION

$$\begin{aligned}
 \chi^2 &= \frac{(26-15)^2}{15} + \frac{(32-15)^2}{15} + \frac{(2-15)^2}{15} + \frac{(13-15)^2}{15} + \frac{(1-15)^2}{15} \\
 &= \frac{121}{15} + \frac{289}{15} + \frac{169}{15} + \frac{4}{15} + \frac{196}{15} \\
 &= 8.0667 + 19.2667 + 11.2667 + 0.2667 + 13.0667 \\
 &= \underline{\underline{51.9333}}
 \end{aligned}$$

CLASS	RESPONSE CATEGORY	NUMBER OF RESPONSES	NUMBER IN CLASS	PERCENT OF POPULATION	PERCENT OF CLASS
AGREE	HIGHLY AGREE	26	58	78.4	44.8
	AGREE	32			55.2
NEUTRAL	NEUTRAL	2	2	2.7	100.0
DISAGREE	DISAGREE	13	14	18.9	92.8
	HIGHLY DISAGREE	1			7.2
TOTAL		74	74	100.0	

Table C-1. Comparative Analysis-Question # 1.

Statistical Analysis: Question # 2

Question: Contract Purchasing Systems Review procedures provide the necessary visibility to adequately assess a prime contractor's subcontract management capability.

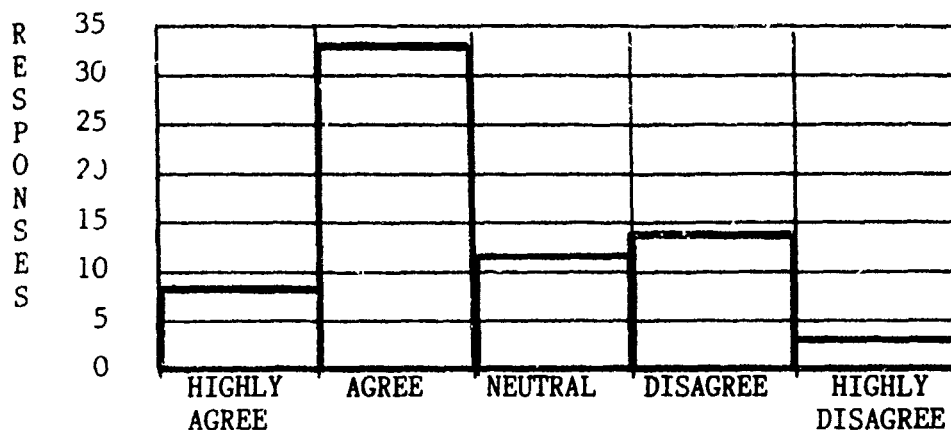


Figure C-4. Histogram of Survey Responses-Question # 2.

CHI SQUARE CALCULATION

$$\begin{aligned}
 \chi^2 &= \frac{(8-14)^2}{14} + \frac{(33-14)^2}{14} + \frac{(12-14)^2}{14} + \frac{(14-14)^2}{14} + \frac{(3-14)^2}{14} \\
 &= \frac{36}{14} + \frac{361}{14} + \frac{4}{14} + \frac{0}{14} + \frac{121}{14} \\
 &= 2.5714 + 25.7857 + 0.2857 + 0 + 8.6429 \\
 &= \underline{\underline{37.2857}}
 \end{aligned}$$

CLASS	RESPONSE CATEGORY	NUMBER OF RESPONSES	NUMBER IN CLASS	PERCENT OF POPULATION	PERCENT OF CLASS
AGREE	HIGHLY AGREE	8	41	58.6	19.5
	AGREE	33			80.5
NEUTRAL	NEUTRAL	12	12	17.1	100.0
DISAGREE	DISAGREE	14	17	24.3	82.3
	HIGHLY DISAGREE	3			17.7
TOTAL		70	70	100.0	

Table C-2. Comparative Analysis-Question # 2.

Statistical Analysis: Question #3

Question: Price analysis provisions that allow price/cost analysis of subcontract proposals provide the necessary leverage to adequately influence a prime contractor's subcontract management effort.

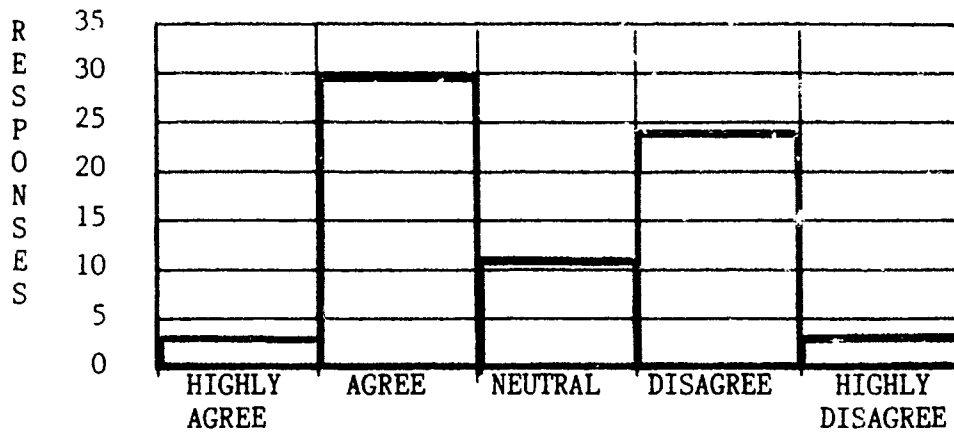


Figure C- 5. Histogram of Survey Responses-Question #3.

CHI SQUARE CALCULATION

$$\begin{aligned}
 \chi^2 &= \frac{(3-14)^2}{14} + \frac{(30-14)^2}{14} + \frac{(11-14)^2}{14} + \frac{(24-14)^2}{14} + \frac{(3-14)^2}{14} \\
 &= \frac{121}{14} + \frac{256}{14} + \frac{9}{14} + \frac{100}{14} + \frac{121}{14} \\
 &= 8.6428 + 18.2857 + 0.6429 + 7.1429 + 8.6428 \\
 &= \underline{\underline{43.3571}}
 \end{aligned}$$

CLASS	RESPONSE CATEGORY	NUMBER OF RESPONSES	NUMBER IN CLASS	PERCENT OF POPULATION	PERCENT OF CLASS
AGREE	HIGHLY AGREE	3	33	46.5	9.0
	AGREE	30			91.0
NEUTRAL	NEUTRAL	11	11	15.5	100.0
DISAGREE	DISAGREE	24	27	38.0	88.9
	HIGHLY DISAGREE	3			11.1
TOTAL		71	71	100.0	

Table C-3. Comparative Analysis-Question #3.

Statistical Analysis: Question # 4

Question: The analysis of a prime contractor's "Make-or-buy" plan provides the visibility of the prime contractor's subcontract management to favorably influence management of critical subcontracts.

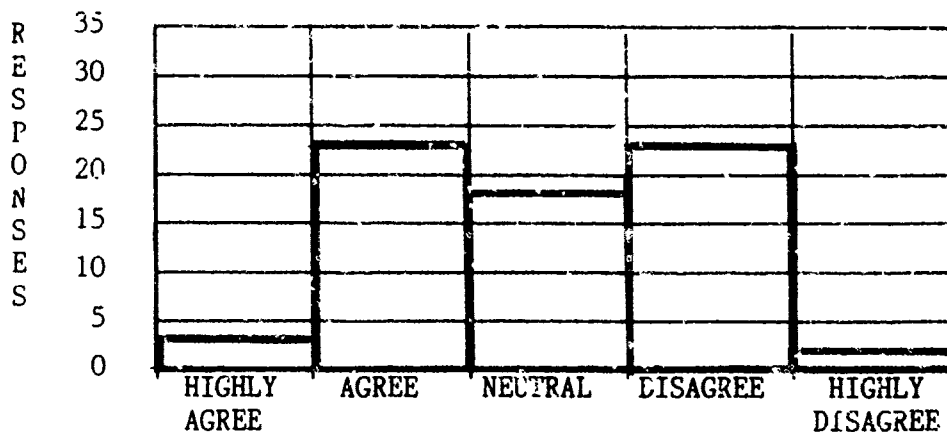


Figure C-6. Histogram of Survey Responses-Question # 4

CHI SQUARE CALCULATION

$$\begin{aligned}
 \chi^2 &= \frac{(3-14)^2}{14} + \frac{(23-14)^2}{14} + \frac{(18-14)^2}{14} + \frac{(23-14)^2}{14} + \frac{(2-14)^2}{14} \\
 &= \frac{121}{14} + \frac{81}{14} + \frac{16}{14} + \frac{81}{14} + \frac{144}{14} \\
 &= 8.6428 + 5.7857 + 1.1429 + 5.7857 + 10.2857 \\
 &= \underline{\underline{31.6428}}
 \end{aligned}$$

CLASS	RESPONSE CATEGORY	NUMBER OF RESPONSES	NUMBER IN CLASS	PERCENT OF POPULATION	PERCENT OF CLASS
AGREE	HIGHLY AGREE	3	26	37.7	11.5
	AGREE	23			88.5
NEUTRAL	NEUTRAL	18	18	26.1	100.0
DISAGREE	DISAGREE	23	25	36.2	92.0
	HIGHLY DISAGREE	2			8.0
TOTAL		69	69	100.0	

Table C-4. Comparative Analysis-Question # 4.

Statistical Analysis: Question # 5

Question: The prime contractor's subcontract management plan provides the necessary visibility of the prime contractor's subcontract management effort to favorably influence management of critical subcontracts.

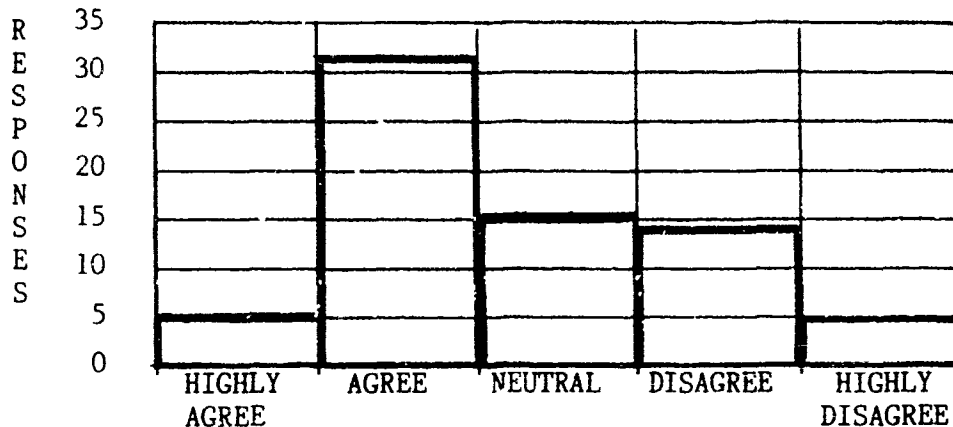


Figure C-7. Histogram of Survey Responses-Question # 5.

CHI SQUARE CALCULATION

$$\begin{aligned}
 \chi^2 &= \frac{(5-14)^2}{14} + \frac{(31-14)^2}{14} + \frac{(15-14)^2}{14} + \frac{(14-14)^2}{14} + \frac{(5-14)^2}{14} \\
 &= \frac{81}{14} + \frac{289}{14} + \frac{1}{14} + \frac{0}{14} + \frac{81}{14} \\
 &= 5.7857 + 20.6429 + 0.0714 + 0 + 5.7857 \\
 &= \underline{\underline{32.2857}}
 \end{aligned}$$

CLASS	RESPONSE CATEGORY	NUMBER OF RESPONSES	NUMBER IN CLASS	PERCENT OF POPULATION	PERCENT OF CLASS
AGREE	HIGHLY AGREE	5	36	51.5	13.9
	AGREE	31			86.1
NEUTRAL	NEUTRAL	15	15	21.4	100.0
DISAGREE	DISAGREE	14	19	27.1	73.7
	HIGHLY DISAGREE	5			26.3
TOTAL		70	70	100.0	

Table C- 5. Comparative Analysis-Question # 5.

Statistical Analysis: Question #6

Question: Cost/Schedule Control Systems Criteria (C/SCSC) procedures provide the appropriate capability for Government Contract Administration personnel to monitor subcontract performance on major weapon system contracts.

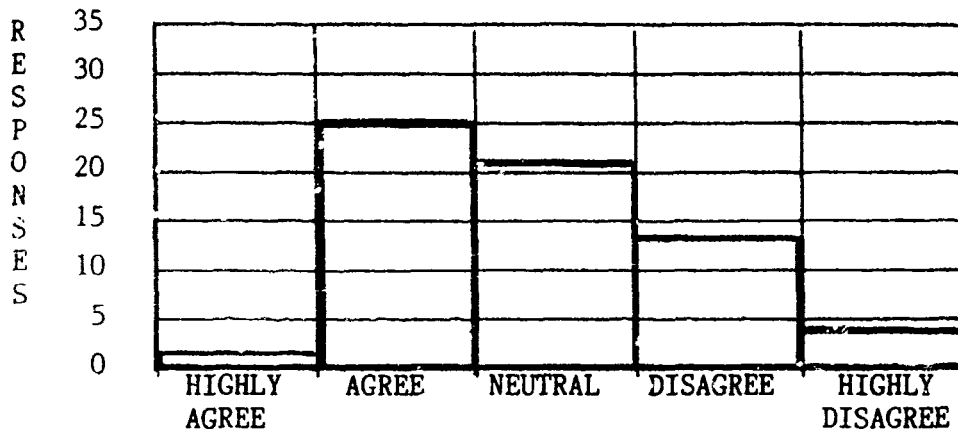


Figure C- 8. Histogram of Survey Responses-Question # 6.

CHI SQUARE CALCULATION

$$\begin{aligned}
 \chi^2 &= \frac{(2-13)^2}{13} + \frac{(25-13)^2}{13} + \frac{(21-13)^2}{13} + \frac{(13-13)^2}{13} + \frac{(4-13)^2}{13} \\
 &= \frac{121}{13} + \frac{144}{13} + \frac{64}{13} + \frac{0}{13} + \frac{81}{13} \\
 &= 9.3077 + 11.0769 + 4.9231 + 0 + 6.2308 \\
 &= \underline{\underline{31.5385}}
 \end{aligned}$$

CLASS	RESPONSE CATEGORY	NUMBER OF RESPONSES	NUMBER IN CLASS	PERCENT OF POPULATION	PERCENT OF CLASS
AGREE	HIGHLY AGREE	2	27	41.5	7.4
	AGREE	25			92.6
NEUTRAL	NEUTRAL	21	21	32.3	100.0
DISAGREE	DISAGREE	13	17	26.2	76.5
	HIGHLY DISAGREE	4			23.5
TOTAL		65	65	100.0	

Table C- 6. Comparative Analysis-Question #6.

Statistical Analysis: Question #7

Question: Current acquisition management organization and staffing is adequate for managing surveillance of subcontractor performance on major weapon system contracts.

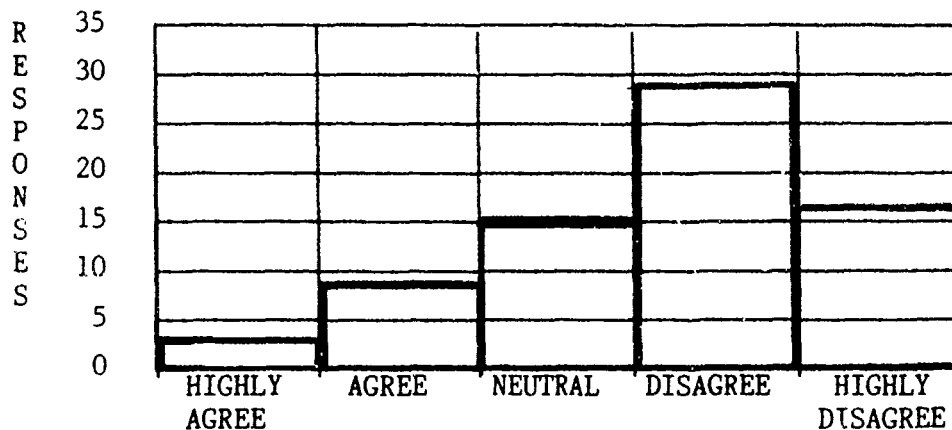


Figure C-9. Histogram of Survey Responses-Question #7.

CHI SQUARE CALCULATION

$$\begin{aligned}
 \chi^2 &= \frac{(3-14)^2}{14} + \frac{(9-14)^2}{14} + \frac{(15-14)^2}{14} + \frac{(29-14)^2}{14} + \frac{(16-14)^2}{14} \\
 &= \frac{121}{14} + \frac{25}{14} + \frac{1}{14} + \frac{225}{14} + \frac{4}{14} \\
 &= 8.6429 + 1.7857 + 0.0743 + 16.0714 + 0.2857 \\
 &= \underline{\underline{26.8571}}
 \end{aligned}$$

CLASS	RESPONSE CATEGORY	NUMBER OF RESPONSES	NUMBER IN CLASS	PERCENT OF POPULATION	PERCENT OF CLASS
AGREE	HIGHLY AGREE	3	12	16.7	25.0
	AGREE	9			75.0
NEUTRAL	NEUTRAL	15	15	20.8	100.0
DISAGREE	DISAGREE	29	45	62.5	64.4
	HIGHLY DISAGREE	16			35.6
TOTAL		72	72	100.0	

Table C-7. Comparative Analysis-Question #7.

Statistical Analysis: Question # 8

Question: Current contract administration organization and staffing is adequate for managing surveillance of subcontractor performance on major weapon system contracts.

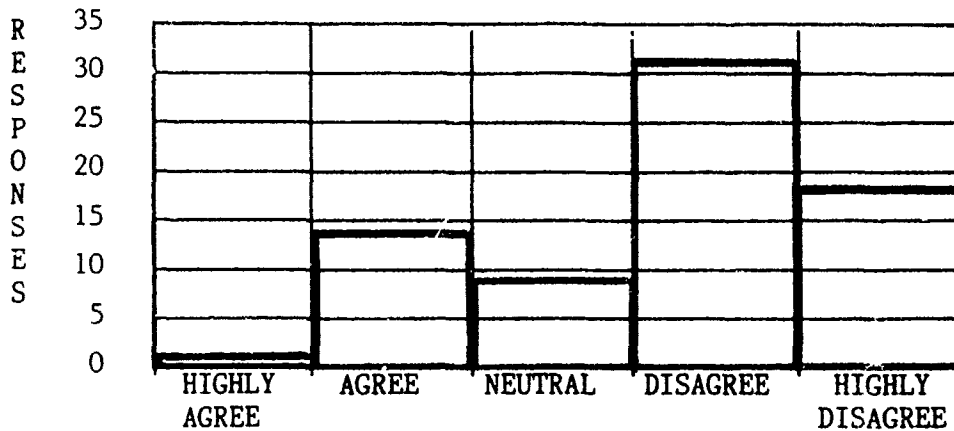


Figure C-10. Histogram of Survey Responses-Question #8 .

CHI SQUARE CALCULATION

$$\begin{aligned}
 \chi^2 &= \frac{(1-15)^2}{15} + \frac{(14-15)^2}{15} + \frac{(9-15)^2}{15} + \frac{(31-15)^2}{15} + \frac{(18-15)^2}{15} \\
 &= \frac{196}{15} + \frac{1}{15} + \frac{36}{15} + \frac{256}{15} + \frac{9}{15} \\
 &= 13.0667 + 0.0667 + 2.4000 + 17.0667 + 0.6000 \\
 &= \underline{\underline{33.2000}}
 \end{aligned}$$

CLASS	RESPONSE CATEGORY	NUMBER OF RESPONSES	NUMBER IN CLASS	PERCENT OF POPULATION	PERCENT OF CLASS
AGREE	HIGHLY AGREE	1	15	20.6	6.7
	AGREE	14			93.3
NEUTRAL	NEUTRAL	9	9	12.3	100.0
DISAGREE	DISAGREE	31	49	67.1	63.3
	HIGHLY DISAGREE	18			36.7
TOTAL		73	73	100.0	

Table C-3 . Comparative Analysis-Question # 8.

Statistical Analysis: Question #9

Question: Current training/education of contract administration personnel is adequate to provide the knowledge necessary for managing surveillance of subcontractor performance on major weapon system contracts.

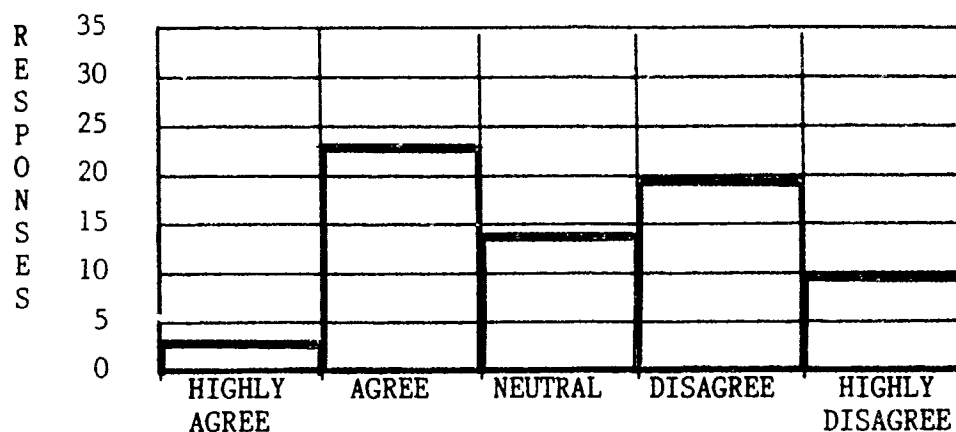


Figure C-11. Histogram of Survey Responses-Question #9.

CHI SQUARE CALCULATION

$$\begin{aligned}
 \chi^2 &= \frac{(3-14)^2}{14} + \frac{(23-14)^2}{14} + \frac{(14-14)^2}{14} + \frac{(20-14)^2}{14} + \frac{(10-14)^2}{14} \\
 &= \frac{121}{14} + \frac{81}{14} + \frac{0}{14} + \frac{36}{14} + \frac{16}{14} \\
 &= 8.6429 + 5.7857 + 0 + 2.5714 + 1.1429 \\
 &= \underline{\underline{18.1429}}
 \end{aligned}$$

CLASS	RESPONSE CATEGORY	NUMBER OF RESPONSES	NUMBER IN CLASS	PERCENT OF POPULATION	PERCENT OF CLASS
AGREE	HIGHLY AGREE	3	26	37.1	11.5
	AGREE	23			88.5
NEUTRAL	NEUTRAL	14	14	20.0	100.0
DISAGREE	DISAGREE	20	30	42.9	67.7
	HIGHLY DISAGREE	10			32.3
TOTAL		70	70	100.0	

Table C-9. Comparative Analysis-Question #9.

Statistical Analysis: Question # 10

Question: Prime contractors should be required to establish employee/ liaison elements at a subcontractor's plant to provide surveillance of the subcontractor.

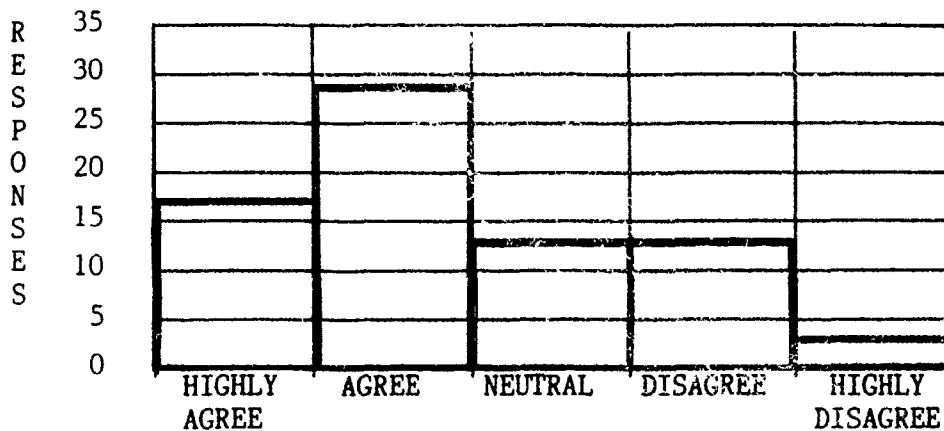


Figure C-12. Histogram of Survey Responses-Question #10.

CHI SQUARE CALCULATION

$$\begin{aligned}
 \chi^2 &= \frac{(17-15)^2}{15} + \frac{(29-15)^2}{15} + \frac{(13-15)^2}{15} + \frac{(13-15)^2}{15} + \frac{(3-15)^2}{15} \\
 &= \frac{4}{15} + \frac{196}{15} + \frac{4}{15} + \frac{4}{15} + \frac{144}{15} \\
 &= 0.2667 + 13.0667 + 0.2667 + 0.2667 + 9.6000 \\
 &= \underline{\underline{23.4567}}
 \end{aligned}$$

CLASS	RESPONSE CATEGORY	NUMBER OF RESPONSES	NUMBER IN CLASS	PERCENT OF POPULATION	PERCENT OF CLASS
AGREE	HIGHLY AGREE	17	46	61.4	37.0
	AGREE	29			63.0
NEUTRAL	NEUTRAL	13	13	17.3	100.0
DISAGREE	DISAGREE	13	16	21.3	81.2
	HIGHLY DISAGREE	3			18.8
TOTAL		75	75	100.0	

Table C-10. Comparative Analysis-Question #10.

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This study examines the appropriateness of the government's policy on subcontracting in major systems acquisition and the procedures used to achieve visibility of and leverage on a prime contractor's subcontract management. Based upon a literature review of the subject, a survey instrument was developed and distributed to gain field perspective on the issue. The survey data was analyzed using non-parametric statistical techniques and provided the basis for the study conclusions and recommendations.

The perspective expressed by acquisition management practitioners is that the current policy to rely on a prime contractor to manage subcontracted effort is appropriate and that current acquisition management organization and staffing is inadequate to undertake an active role in subcontract management. Additionally, the procedures used to achieve visibility over and leverage upon a prime contractor's subcontract management are effective. Some remedial actions are warranted, however, to achieve the benefits of the synergistic application of the procedures.