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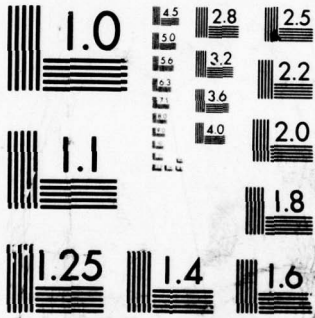
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THESIS

Decision Criteria
for Cost-Plus-Award-Fee Contracts
in Major Systems Acquisitions
by
Gwilym Howard Jenkins, Jr.
March 1979
Thesis Advisor: A. C. Crosby

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Decision Criteria for Cost-Plus-Award-Fee Contracts
in Major Systems Acquisition

by

Gwilym Howard Jenkins, Jr.
Lieutenant, Supply Corps, United States Navy
BT, The Pennsylvania State University, 1970

Submitted in partial fulfillment of the
requirements for the degree of

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from the

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Author:

Gwilym Howard Jenkins Jr.

Approved by:

W. S. Key

Thesis Advisor

Melvin B. Klein

Second Reader

Carl P. Phee
Chairman, Department of Administrative Sciences

A. Schradt
Dean of Information and Policy Sciences

ABSTRACT

The Cost-Plus-Award-Fee (CPAF) contract has useful application in Major Systems Acquisition during the full-scale development phase. This thesis examines the Cost-Plus-Award-Fee contract with Leavitt's Organizational Theory model which identifies goals, technology, people, structure, and environment as factors for analysis. It further investigates cost reimbursement contract types versus technical risk for identification of those criteria, which best accommodate application of the CPAF contract in Major Systems Acquisition. This thesis concludes that the CPAF contract can be viewed as an informal Management Information System (MIS) to enhance project control. It summarizes basic strengths and weaknesses of the Cost-Plus-Award-Fee contract in Major Systems Acquisition.

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I. SCOPE

A. HYPOTHESIS

The Cost-Plus-Award-Fee contract has useful application in Major Systems Acquisition when salient characteristics/parameters of performance are best identified in a subjective manner.

B. PURPOSE

To establish a decision aid for Project Managers utilizing organizational theory for selection of Cost-Plus-Award-Fee contracts during transition from validation to full-scale development.

ii. THESIS APPROACH

A. ASSUMPTIONS

The proposed hierarchy of "contract type" versus "technical risk" can be described as indicated by Figure #1. The Cost-Plus-Award-Fee contract fits in the spectrum of approved contract types between the CPFF and CPIF contract.

Major Systems Acquisition is a focal point for research; therefore the thresholds of \$75 million for research and development and \$300 million for production of major projects is appropriate for analysis in this study.

The primary emphasis of study will be to address those issues relevant to preparation for Milestone 2 of the Defense Systems Acquisition Review Council (DSARC) by a Project Manager.

B. USE OF ORGANIZATION THEORY

Application of the Leavitt's Organizational Theory Model, Figure #2 [1] is envisioned to evaluate system and organizational factors with respect to the interacting variables such as, goals, technology, people, structure and environment. Of significant interest are the goals, but analysis must also consider technology, human relations and structure. As shown in Figure #2, these are all interrelated and embedded in the external environment. Changes in the environment may significantly change these interrelationships.

The following discussion explains this organizational model with respect to its components: [1]

MAJOR SYSTEMS ACQUISITION MILESTONES
AND
HIERARCHY OF CONTRACTS VERSUS RISK

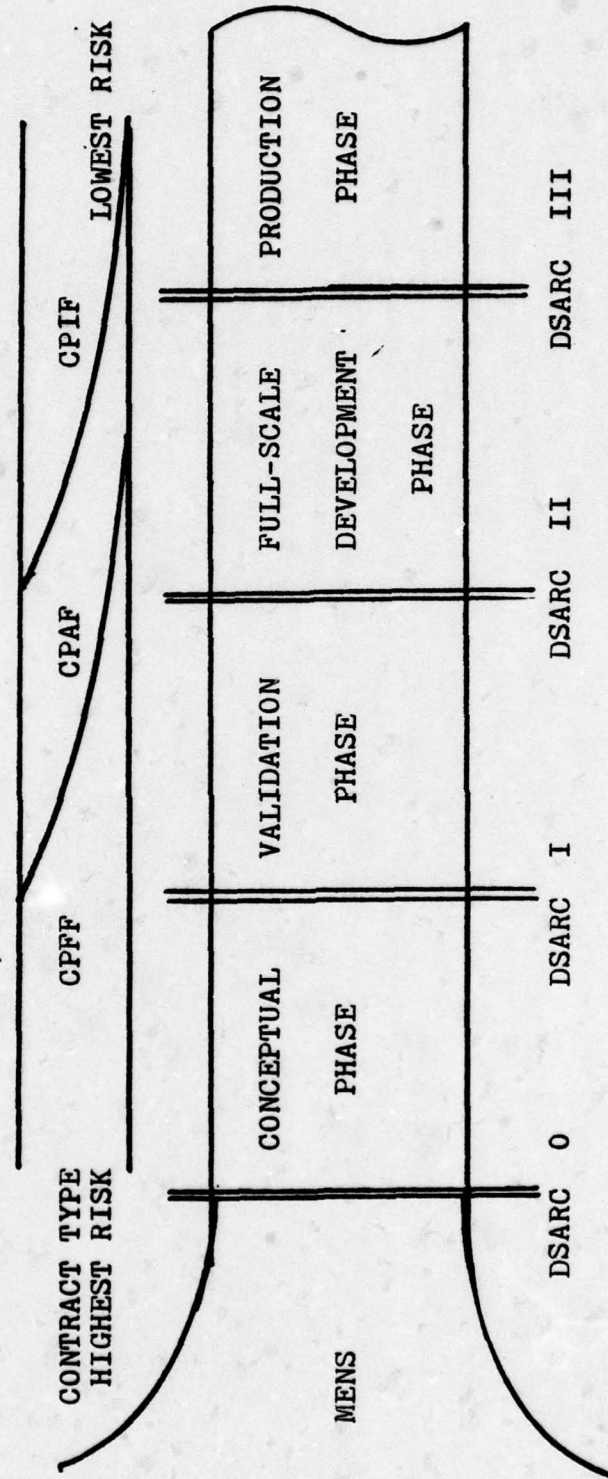


FIGURE #1

"The complex organization is more like a modern weapons system than like old fashioned fixed fortifications, more like a mobile than a static sculpture, more like a computer than an adding machine. In short, the organization is a dynamic system."

"After we get used to the noise and complexity of a large organization, we begin to break it down into at least four basic parts:

1. Tasks (goals) - the organization builds things or designs things or provides services - all with certain purposes in mind.

2. Structure - the organization has some broad, more or less permanent framework, some arrangement of processes and material resources and people in some sequence and hierarchy.

3. Tools (technology) - the organization incorporates technological advances and provides tools that enable people or other machines to perform tasks. These tools also provide the means for administrative control.

4. People - the organization is populated by these sometimes troublesome, but highly flexible, orders or work.

In view of the organization as a dynamic structure, the parts themselves are of less significance than the varied and multiple relationships among them.

This more dynamic and more humanistic view of the organization is also a more complicated view. In dealing with any particular organization one way to simplify the

ORGANIZATIONAL THEORY FOR CASE ANALYSIS

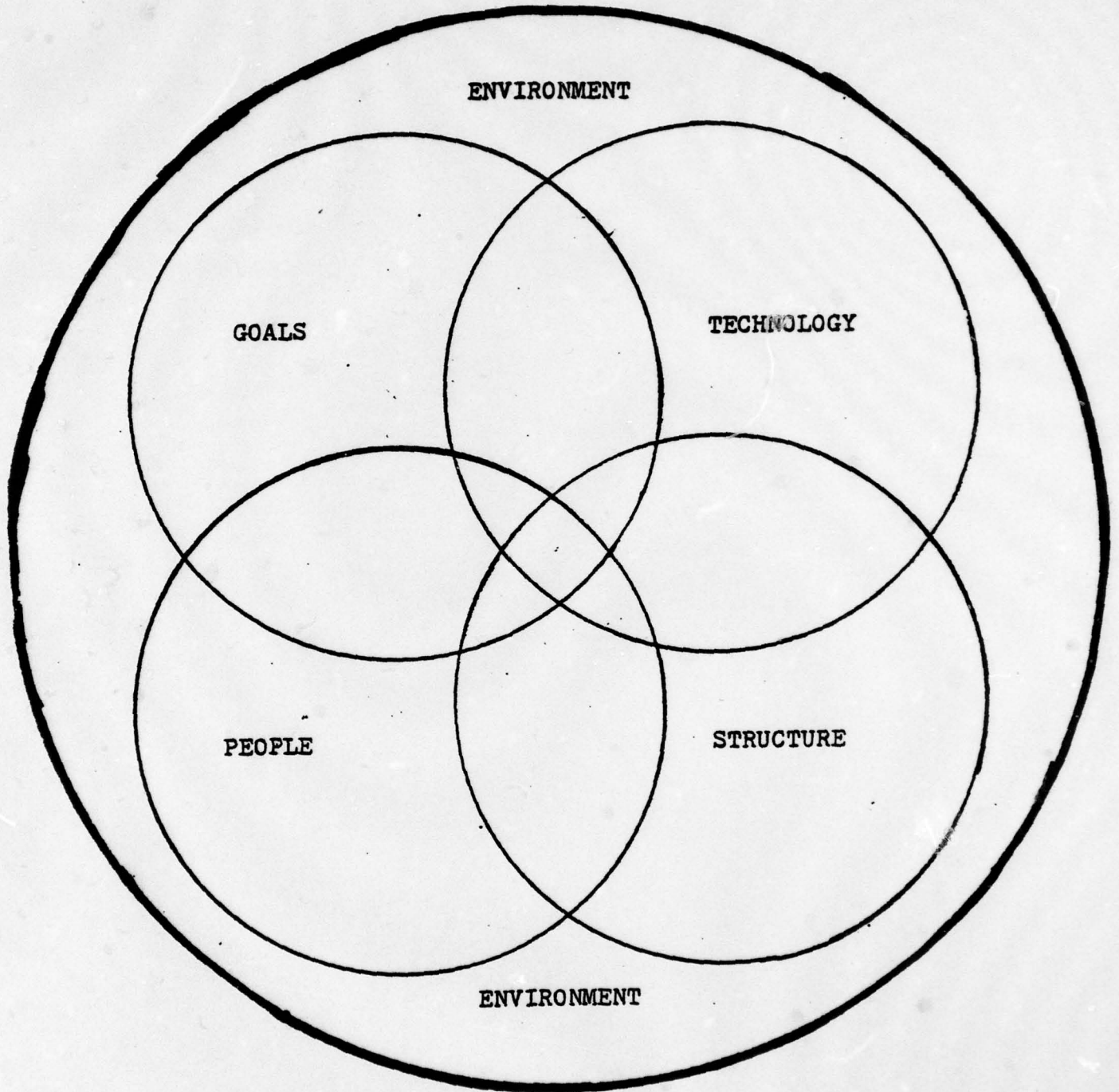


FIGURE #2

picture is to look first at the organization tasks (goals). The degree to which those tasks are programmable, and their variety, can tell us a good deal about what we should expect by way of structure, managerial technology, and human relations."

Specific identification of issues utilizes the following taxonomy:

a. Goals: Includes the analysis of the formal and informal goals of personnel, value systems, and mission identification, all in consonance with cost, schedule, and performance trade-offs.

b. Technology: This section analyzes the impact of system procedures, hardware specification limitations, and the design process in relation to the "State of the Art" and technical risk.

c. People: This section of the analysis recognizes and addresses personalities and characteristics in terms of program management; e.g., the preferences of the Procuring Contracting Officer (PCO), Administrative Contracting Officer (ACO) and Project Manager (PM) in contract formulation and administration.

d. Structure: This portion of the analysis evaluates the formal and informal power structure, possession of knowledge and decision making authority, and assessment of rewards and punishments of the organization; e.g., source selection and evaluation criteria.

e. Environment: This portion of the analysis evaluates specific attributes which best define the states of nature concerning each category above to enable possible identification of alternatives; e.g., is the environment placid or turbulent,

poor or munificent, predictable or uncertain, benevolent or hostile, simple or complex, etc.

C. ANALYSIS METHODOLOGY

A literature search was conducted to determine the characteristics of the CPAF contract and its current application in systems acquisition.

Interviews were conducted with numerous government and contractor managers of systems acquisition with both the Department of Defense (DOD) and the National Aeronautics and Space Administration (NASA). The questions rendered were directly related to the CPAF contract with respect to components of the organizational model previously described. Additionally, attendance at CPAF evaluations during program reviews of the AEGIS and TOMAHAWK Cruise Missile Projects was most beneficial in identifying critical issues related to the actual administration of the contract.

The data received from research was synthesized in the four basic categories of goals, technology, people, and structure. Environmental aspects were incorporated within each category since by the very nature of this organization model the interactive elements utilize the environment as a media. In essence, the issues addressed in the analysis are not all inclusive nor are they mutually exclusive.

III. BACKGROUND

A. MAJOR SYSTEMS ACQUISITION MILESTONES

"Major Systems Acquisition milestones and the Hierarchy of Contracts" versus "technical risk" can be identified as depicted in Figure #1, which implies a natural progression of contract type during the life cycle of major systems acquisition. It suggests that an appropriate contract type during transition from the validation phase to the full-scale development phase is the Cost-Plus-Award-Fee (CPAF) structure. As an introduction, a brief description of the acquisition process is appropriate. The Department of Defense (DOD) uses two primary directives (DOD DIRECTIVE 5000.1 and 5000.2) in the execution of general guidelines outlined by the Office of Management and Budget (OMB) Circular No. A-109. Basically, four key decision points are identified with separate phases of the program structured as follows: [2]

1. MILESTONE 0 PROGRAM INITIATION. As such time as the Secretary of Defense requests or a DOD Component Head perceives a mission need to exist and determines that a new capability is to be acquired to meet the need, the DOD activity must submit a statement of mission need to the Secretary of Defense and request approval to proceed to identify and explore alternative solutions to the mission need. The considerations to support the mission need must be documented by a Mission Element Need Statement (MENS). Once the mission need is determined to be valid, the Secretary of Defense may approve that a DOD component systematically and progressively explore and develop alternative

system concepts.

2. MILESTONE 1 DEMONSTRATION AND VALIDATION. When competitive exploration of alternative system concepts merit system demonstration, approval to proceed must be secured. Recommendations are documented in a Decision Coordinating Paper, and reviewed by the Defense System Acquisition Review Council (DSARC) and the (Service) System Acquisition Review Council prior to a Secretary of Defense decision.

3. MILESTONE 2 FULL-SCALE ENGINEERING DEVELOPMENT. When the demonstration and validation phase has been completed and the system merits full-scale engineering development, recommendations are documented by the DSARC prior to Secretary of Defense decision. If the system is approved for full-scale engineering development, long lead time production items and limited production of prototypes for test and evaluation may be authorized.

4. MILESTONE 3 PRODUCTION AND DEPLOYMENT. Upon completion of the full scale engineering development phase, which includes successful completion of Operation, Test, and Evaluation (OT&E), production for a system may then be approved by the Secretary of Defense. The Decision Coordinating Paper (DCP) is a key document in the DSARC process since it encompasses the MENS, a description of alternatives, and a summary of the program acquisition strategy [3]. This acquisition strategy should contain a contingency plan to think through the myriad of program considerations to achieve goals in an economical, effective, and efficient manner [4:10]. As stated the OFPP Pamphlet No. 1 on the application of OMB circular No. A-109;

"In developing a system acquisition strategy considerable thought should be given to specific program goals and objectives. The approach should not be reduced to fill-in-blank formats or cookbooks. The strategy should form the basis for the program manager's system acquisition plan. He should then use his plan to communicate with higher authority, his management team, interfacing government organizations, and industry. The plan should also provide the means to measure accomplishments and consider contingencies as the program progresses. At program initiation, it is neither possible nor desirable to address all considerations in detail. It is possible and desirable, however, to examine and schedule when decisions on each consideration can and must be made throughout the acquisition process and to refine the strategy and planning as the program proceeds.

The plan should encompass the entire system acquisition process with emphasis on the near term time phased actions. As the program proceeds and periodic reviews are made, the next increment of near term considerations should be emphasized. Such an approach minimizes the planning burden and provides a basis for program direction and for measurement of success against program goals and objectives."

B. COST-TYPE CONTRACTS

Since the Cost-Plus-Award-Fee (CPAF) contract is a member of the cost reimbursement family of contract types, a brief

discussion of cost-type contracts and their relationship to major systems acquisition is appropriate. The principal features of the cost-reimbursement type contract are as follows [5:16]. The government reimburses the contractor for all costs determined to be allowable and allocable by a Defense Contract Audit Agency (DCAA) performance audit; however, the contractor is permitted to voucher for payment as costs are incurred until costs are equal to the amount stipulated in the "Limitation of Costs Clause" in the contract. Because the government bears the greatest portion of cost risk, the fee which the contractor may earn is limited by statute and regulation. This law limits the fee to 10% for supplies and services and 15% for research, development, test and evaluation (RDT&E) costs. Cost reimbursement contracts are often used if the following conditions exist:

1. high technical risk (research and development),
2. undefinitized scope of work,
3. low probability of success,
4. product specifications are incomplete.

In addition to the major portion of cost risk being absorbed by the government, administrative burdens are also increased to monitor accounting practices, property settlements and overall accountability.

The following taxonomy, as described in teaching notes for the Introductory Quantitative Analysis course at the Air Force Institute of Technology, [5:17-20] depicts the characteristics of cost-type contracts and their general application:

"1. Cost Type Contract. The cost type contract is one in which the contractor receives no fee and has only costs reimbursed. This type of contract is most widely used in research and development work, generally with non-profit organizations, or in facilities contracts.

2. Cost Sharing Contract. A cost sharing contract is a cost reimbursement type of contract for use in developmental or research contracts under which the government reimburses the contractor for a portion of the allowable costs. This contract type is used only when there is a high probability that the contractor will receive substantial benefit in the commercial market.

3. Cost-Plus-Fixed-Fee (CPFF). This contract type is designed chiefly for use in research or exploratory development when the level of contractor effort cannot be accurately defined. Generally, dollars involved are significant, work specifications cannot be defined precisely, and the uncertainty of performance is so great that a firm price or an incentive arrangement cannot be set up at any time during the life of the contract. The government agrees to reimburse the contractor for all allocable, allowable, and reasonable costs which may be incurred during the performance of the contract. Moreover, the government agrees to pay the contractor a fixed number of dollars above the cost as fee for doing the work. ... The fee dollar changes only when the scope of the work changes; that is why it is referred to as a fixed-fee. It is fixed for the life of the contract;

i.e., the fee is constant.

4. Cost-Plus-Incentive-Fee (CPIF). Procurement for advanced system development and first production runs may be such that the contractor's risk is still too high to transition to a fixed price type of contract, but the risk might not be sufficient to warrant the use of a CPFF contract. The CPIF contract may then be appropriate. This particular contract incorporates an incentive share ratio with a cost plus fixed fee arrangement. The incentive is effective in the most likely area of cost underrun to over-run; however, on either end of this range, the contract reverts to a CPFF structure. ... The hope is that the contractor will be motivated to reduce costs (the independent variable), thereby increasing fee (the dependent variable) in the range where the incentive is effective."

C. WHAT IS THE COST-PLUS-AWARD-FEE (CPAF) CONTRACT?

The CPAF contract is a member of the family of cost reimbursable contracts. The cost portion of the contract is determined by an audit to account for those costs which are considered allowable and allocable. The evolution of the CPAF contract resulted from the need to subjectively evaluate a contractor's performance in incentive contracts, where definitization of evaluation parameters is not feasible using objective techniques. In the early 1960's, DOD and NASA postulated the feasibility of CPAF contracts, and in 1961, Professor Fredric M. Scherer of Harvard University considered an "after-the-fact" evaluation

incentive system in a report resulting from a Harvard University Acquisition Research Project. [6:327] Due to the strong interest and motivation of top management in DOD and NASA, the first generation of CPAF contracts emerged in 1962 [7:5-6]. In 1963, the Armed Services Procurement Regulation Committee approved the use of CPAF contracts for primary use in level of effort contracts to procure engineering and support services [8:6]

In recent years, use of the CPAF contract has been expanded to include research and development efforts, architectural design, and construction. Since the scope of this thesis is primarily oriented toward Major Systems Acquisition, an attempt to identify the optimum contract type during full-scale development will be forthcoming with respect to the organization model. Within these guidelines, the CPAF contract fits in the spectrum of approved contract types between the CPFF and CPIF contracts [9].

The basic elements of the CPAF contract are:

1. estimated cost
2. base fee
3. award fee
4. performance criteria.

As stated, the estimated cost for a CPAF contract is in consonance with established constraints for cost reimbursable type contracts. The amount of base fee shall not exceed three (3) percent, which shall be earned by the contractor regardless of performance evaluation results. The award fee is the available fee pool which can be earned in part or in total by

by the contractor as an incentive for best efforts. Weighted guidelines to determine profit are not utilized in this process; however, past performance, complexity of the task, resources required, and organization are relevant issues in the determination of fee objectives. These issues and the subjective plan to measure achievement should be developed and disclosed to the contractor prior to commencement of performance.

A major difference of the CPAF contract is the inability of the contractor to seek remedy under the "Disputes Clause", except for factors related to the base fee or other contractual conditions not related to the Award (variable) Fee.

Timely, effective evaluation of the contractor's performance is of the paramount importance. Immediate feedback permits maximum flexibility both in terms of desired results and the contractor's ability to make optimal trade-offs. More important, the CPAF contract can be effective only if strong personal credibility and integrity is perceived by both parties from the inception of project requirements.

D. TECHNICAL RISK

The hierarchy of contract type versus technical risk is exhibited in Figure #3 as directly portrayed in teaching notes used by the Air Force Institute of Technology. Additional comments from these notes follow: [5:3]

"Technical Risk Related to Type of Contract

In order to realistically choose a type of contract that meets a specific situation, an effective appraisal

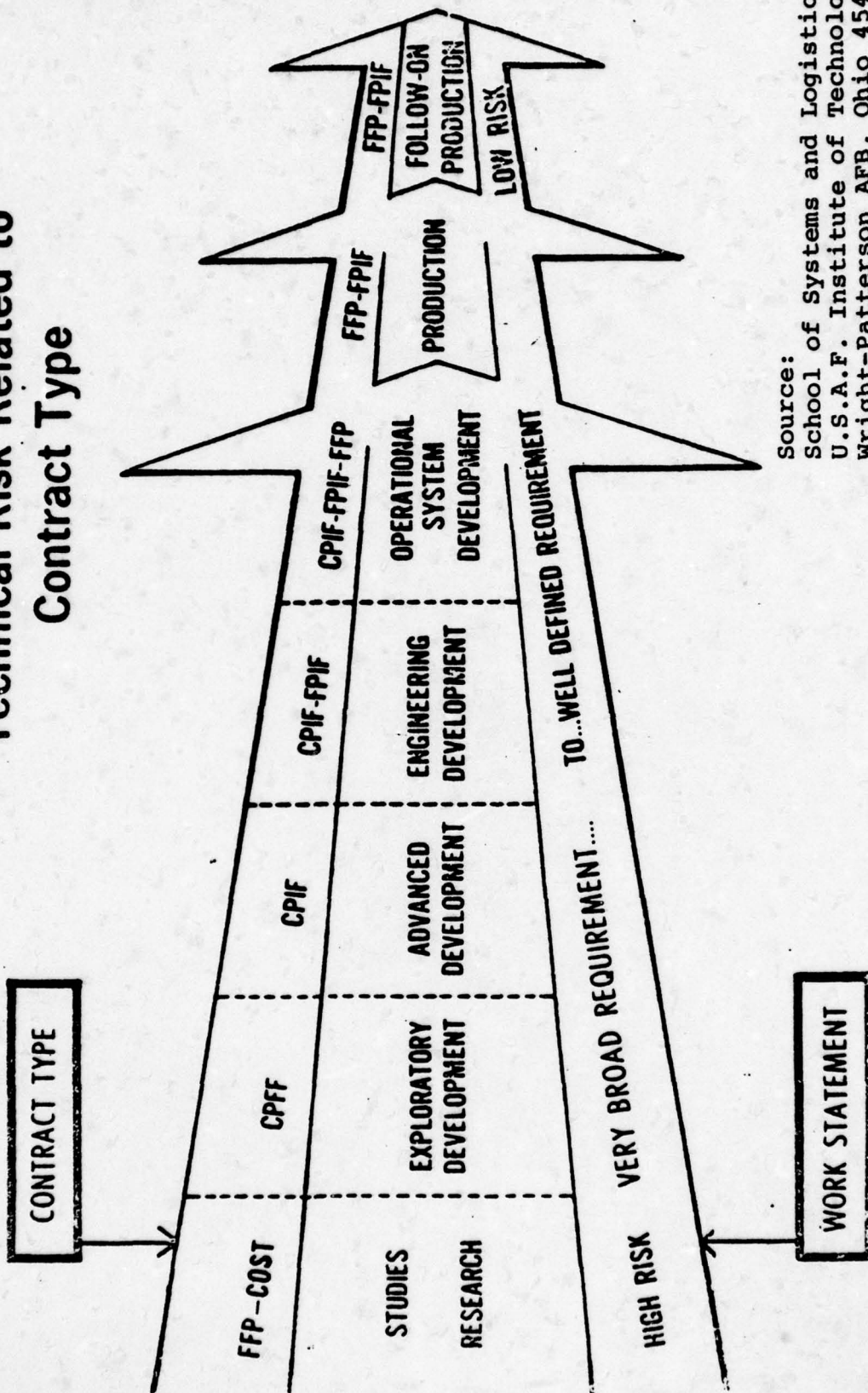
of technical risk must be undertaken. This analysis of risk for a complete system must include appraisals by a team of technical experts which will include personnel from Engineering, Requirements and Procurement. After review of technical risk and quantification of risk factors in dollars, the buyer will have an approximation of the dollar risk involved. This will provide a starting point for determining the proper type of contract.

Figure #3, Technical Risk Related to Contract Type, is a visual presentation of how the adequacy of the requirement definition generally related to technical risk and the type of contract. The type of contract shown for any specific condition is not necessarily the best for an actual situation. Each case must stand on its own. The essential differences between a fixed price type of contract and a cost reimbursement contract are the conditions, i.e., in a fixed price contract the specified product must be delivered, whereas in the normal cost reimbursable contract, costs will be reimbursed regardless of product delivery if they are allocable, allowable and reasonable."

The incorporation of the CPAF contract in Figure #3 would occur in the block entitled "Engineering Development", and would, under appropriate conditions replace the Cost-Plus-Incentive-Fee or Fixed-Price-Plus-Incentive-Fee contract.

As implied by Figure #1, the Cost-Plus-Award-Fee structure is appropriate when high technical risk and uncertainty exist. This

Technical Risk Related to Contract Type



Source:
 School of Systems and Logistics
 U.S.A.F. Institute of Technology
 Wright-Patterson AFB, Ohio 45433

FIGURE #3

conclusion is a logical extension of research conducted by Mr. Hudson B. Drake and summarized in an article entitled "Major DOD Procurements at War with Reality". This article, written in 1967, addressed procurement issues related to that period; i.e., total package procurement and fixed price contracting. The following discussion summarizes basic issues and findings of Mr. Drake's research: [10]

Competition has proven to be effective in controlling costs and increasing efficiency. Since the defense market is a one buyer market in weapon systems (monopsony), the issues of profit and related risk are of much concern. Congress has criticized the alleged excessive use of Cost-Plus-Fixed-Fee (CPFF) contracts; and has recommended increased use of Firm-Fixed-Price (FFP) contracts based upon the premise that: (1) CPFF contracts foreshorten competition, and (2) increased contractor's risk would promote competition among contractors. Consequently, FFP contracts have been the common method for procuring highly sophisticated weapons systems. In addition, other policy innovations include the Truth in Negotiations Act, use of severe warranty clauses, and implementation of total package procurement.

Prime contractors at times were adversely impacted by the heavy burden of technical and cost risk and restraint due to contingencies. The opportunity for profit and threat of loss do not ensure the viability of major program requirements, since the emergence of unanticipated unknowns can severely hamper program progress. A primary finding was that DOD policies were not compatible with inherent technical uncertainties; and that industry

handled anticipated unknowns well, but unanticipated unknowns were another factor. Mr. Drake focus . on the inconsistencies between the natural flow of uncertainties in the development process; and the procurement phasing imposed by DOD.

Mr. Drake's fundamental model depicts a "real life" picture of interrelationships among the individual steps in systems acquisition development. As the project moves into full-scale development, the previously planned work progressively reduces the number of anticipated unknowns; however, he notes that unanticipated unknowns start to appear with increasing frequency. The conversion of anticipated unknowns to knowns is an evolutionary process in which the flow tends to blend from one type to the other with considerable overlapping at any given cross section in time. System design must be an iterative process to take into account unexpected occurrences in system integration and testing, which reflect the need for significant changes. The problem lies in the fact that the fixed-price contract for the full-scale development and operation phases must be signed half-way through the validation phase. As a consequence of Congressional and DOD policy, competitive pressure, and negotiation practice, a mismatch between contract type and degree of technical certainty depressed contractual cost estimates. These effects impose acute financial risk resulting in occasional crushing fiscal losses among prime and sub-contractors. The net outcome was to limit the application of the latest and best technology to changing mission needs.

As Mr. Drake outlines a new approach, he identifies the problem in major systems acquisition to be the basic and

irreconcilable mismatch between the nature of the development process and the government's phasing and contracting policy. The contractor tries to excuse his original cost estimates by pointing at the overly definitive specifications, and the government defends its original cost estimates by flourishing the exact and inaccurate specifications industry provided. The full-scale development phase is certain to include surprises and changes that fatally dilute the usefulness of the FFP/FPI modes. Mr. Drake indicates that the total uncertainty envelope makes the choice of a flexible cost-reimbursement mode the natural one in the pre-production phases, and that negotiated cost incentive contracts should be employed in the full-scale development phase. In consonance with this finding, this thesis addresses use of the CPAF contract during the full-scale development phase.

IV. THE AEGIS COST-PLUS-AWARD-FEE PROCEEDINGS

The following is a synopsis of the procedural process utilized by RADM W. E. Meyer, AEGIS Project Manager, during a recent "Award-Fee" evaluation of two contracts with General Dynamics Corporation, Pomona Division, for the Standard Missile, on 7 December 1978. The "Award-Fee" evaluation followed a detailed program review as stipulated in the contract. RADM Meyer took this opportunity to communicate trends of systems acquisition and the macro goals of DOD in a meeting of middle and upper management from both the government and the contractor. Such issues as shipbuilding claims, the Vinson-Trammell Act, minorities programs, urban development, and Washington environmental changes were addressed.

The evaluation board then convened with General Dynamics' General Manager present. At this time RADM Meyer brought the board to order, announced the proposed attendance of the author for the purposes of thesis research, and solicited objections. No objections were voiced and the author was permitted to observe the board's proceedings with the caveat that specific remarks were proprietary in nature, and therefore not subject to publication since "Integrity of the Board is most important".

RADM Meyer, the board chairman, stated the the "Award-Fee" panel is not a program review tribunal. At this time statements were rendered by contractor personnel on issues regarding proprietary information not presented in the program review. The chairman reviewed the fee allocation available, the evaluation

criteria, and corresponding weights with board members. Specific hand-outs of written inputs from field activities were provided and reviewed. Statements by government personnel were then heard with both good and bad comments about specific details of contractor performance. Each member, including the contractor's General Manager, was given the opportunity to question and assess these comments in accordance with the contract's rating structure. Statements were then solicited from associate contractors (RCA) concerning inter-business relations and fulfillment of responsibilities.

After this fact finding procedure was concluded, the board proceeded with a verbal vote on the corresponding percentage of recommended fee. Interestingly, the General Manager was permitted to vote; however, his vote did not count in the actual score. On occasion, it was noted that his evaluation was lower than a specific board member's evaluation, but it was never less than the overall average score. The final score and agreed dollar value were determined in session. The board formally adjourned. In summary, the "Award-Fee" determination board was a very formal process with designated functions such as the chairman, secretary, and sergeant at arms.

V. ANALYSIS AND EVALUATION

A. GOALS

As shown by introduction of the Mission Element Need Statement (Milestone 0) in the Weapons Systems Acquisition process, it is evident that top DOD management has placed heavy emphasis on identification of goals. This analysis therefore properly evaluates goals as integral and fundamental elements in the selection of contract type. Two basic viewpoints will be adopted for analysis: organizational goals and program goals.

Organizational goals are established by the organization hierarchy above the program office; therefore, they often have only indirect impact upon the project manager. These goals are environmental factors external to the project office, which therefore increase uncertainty and decrease ability to predict final outcomes.

In his research of the Polaris System Development, Mr. Harvey M. Sapolsky stated: [11]

"The Polaris experience reveals still another serious problem in incentive contracts. Unlike cost-plus contracts, the targets and their rankings in incentive contracts are supposedly fixed for the length of contract and thus, can reflect only the conditions that exist at the beginning of the development effort or that can be then anticipated. Unpredictable changes in political conditions affecting major weapons acquisitions seem to require constant alterations in project targets and their rankings. It seems unrealistic

to expect the development and procurement targets of major weapons systems such as the Poseidon will remain fixed. Therefore, it seems wasteful to impose upon them an elaborate contracting system whose effectiveness depends upon the validity of fixed targets. Although conceived as a device to improve management performance in major projects, incentive contracts cannot possibly fulfill their promise, ignoring as they do the bureaucratic and political conditions affecting such projects."

Perhaps the greatest advantage to the government of the CPAF contract is the inherent ability to make changes to contract goals without going through a formal change process. To understand better the impact of the bureaucratic and political ramifications on organizational goals, the recognition of these goals and of their significance requires further analysis. One of the most important policy goals is to maintain the integrity of the procurement system, which is a fundamental aim of policy decisions in all branches of the government. Previous attempts at fulfilling this aim include former DOD policies regarding "total package procurement" and fixed price contracting. These policies enslaved the procurement system with inflexible contractual instruments, and thus restricted the governments ability to adjust goals. Incentive contracts were consequently introduced to increase efficiency with respect to cost, schedule, and performance criteria. Therefore, implementation of new procurement policies such as incentive contracts requires the full understanding of contractors and government agencies alike. In this regard,

interviews with government contracting officers indicated that contractors often do not understand government motives in incentive contracts. However, the CPAF contract provides for enhanced communication of dynamic goals at regular intervals; therefore, organization desires for effective utilization of manpower requires intensive management efforts because of the participative roles required for effective contract administration. For example, it is feasible to incorporate the newest procurement policies, such as requirements for new executive orders, merely by incorporating new evaluation criteria at the beginning of the next "Award-Fee" time interval. This precludes the need for time consuming contract modifications.

Although it is impossible to divorce organizational goals from program goals, a more micro-view of the goals of a weapons system acquisition project is necessary. Perhaps one of the most significant objectives of the Project Manager is the ability to reset goals - FLEXIBILITY! Since the ability to predict outcomes is severely constrained, the need to provide after-the-fact adjustment (feedback) becomes paramount for project control. Contingency planning is possible because evaluation criteria can be tailored to specific design trade-offs in a timely manner. Therefore, Design to Cost and Life Cycle Cost objectives can be expressed and monitored with both short and long term parameters, and can be adjusted according to basic alternatives outlined in the contingency plan. These alternative strategies may reduce acquisition time if adjustment of criteria does not evolve from a lengthy change process, notwithstanding possible undefinitized

change orders. The CPAF contract evaluates contractor performance in a subjective manner; consequently, the ability to change evaluation criteria at specific intervals provides a method of adjusting program goals and insuring that contractor economic motivations remain undamaged. It is vital for the Project Manager (PM) to know the basic goals of the contractor.

Since the PM usually is the "Award-Fee" determining official, by altering the "Award-Fee" objectives he has direct impact upon the contractors motivations. While reviewing various CPAF contracts within the Naval Material Command, it was interesting to note that even though some contractors had various fees reduced for perceived deficiencies, corresponding resolution of such deficiencies was not always forthcoming. It appeared that the contractors had made specific trade-offs with respect to expected value to optimize profit. For example, "good management of cash flow" and "return on assets employed" are significant factors for corporate survival; consequently, the weighting of various "Award-Fee" criteria in the available fee pool will guide contractor trade-off analysis. Since capital has an inherent time value, timeliness of fee evaluation and payment becomes an essential goal for the contractor and government alike; that is, the contractor receives immediate rewards or punishments for recent efforts, and the government establishes a feedback conduit for program status. The timeliness aspect of the CPAF contract cannot be over emphasized because program milestones alone are difficult to establish without infringement of inaccurate or aged information. Many defense contractors exhibit other

motivations coincident to economic considerations. These include: [9]

- "1. Contribute to and improve the nation's international reputation.
2. Gain prestige and good will.
3. Retain and maintain an engineering and/or production capability.
4. Excel for the sake of excellence."

It was noted in many interviews that the CPAF contract promotes pride in performance because managers and co-workers must get involved with goals. Properly administered, the CPAF contract instills a stronger link for communication of corporate goals within the contractor's organization. Specifically, the amount of "Award-Fee" received can be used as a barometer of performance within corporate divisions, thereby, an attempt to match goals and incentives can be an ongoing process congruent to the dynamic states-of-nature imposed by the environment.

Overall, the project office and the contractor must identify the three basic program goals of cost, schedule, and performance in some measureable manner. Both environmental and self-imposed operating constraints require that long and short term goals be tailored to individual system needs and peculiarities.

One of the major disadvantages of the CPAF contract is its complexity with regard to administration. It requires adequate resources because timely administration mandates very close monitoring and professional execution. If performed correctly,

the "Award-Fee" determination is a time consuming process that demands expert evaluation and analysis. If these resources are not available, either internally or via consultants, avoidance of any incentive arrangement would be prudent; i.e., the CPAF contract would be more appropriate. According to various interviews, it is believed that the CPAF contract is more costly because of the greater demand upon resources, however, some argued that this alleged additional cost is more than off set by added project control. On the other hand, if the program goals are sufficiently stable over time and can be assessed in an objective, measurable fashion, then utilization of the more structured CPIF contract would be more suitable.

B. TECHNOLOGY

During an interview with Mr. David Boyer, a Contracting Officer for the Naval Sea Systems Command, he defined contractor performance in the early phases of a Major Systems Acquisition to be categorized as either advancements in the state-of-the-art or the state-of-the-technology. A subtle, but perhaps significant, differentiation in the selection of contract type. It was Mr. Boyer's observation that a Project Office rarely deals with procurements that truly push the state-of-the-art by the time full-scale development is conducted; rather the weapons system has experienced many iterative tests of conceptual design, and the system is engulfed with advancement of the technology after the conceptual and validation phases are completed. This observation has numerous ramifications in consideration of the CPAF

contract. This type of contract may be used to transition from CPFF contract to more sophisticated incentive arrangements. Specifically, performance requirements often cannot be definitized in an objective manner, but a level of effort (CPFF) contract does not provide adequate incentive when the state-of-the-technology is somewhat measurable.

The ability to definitize requirements in advance of actual performance was the predominant motivation for all Contracting Officers interviewed for selection of a contract type other than the CPAF or CPFF. The specific identification of baselines with objective parameters which are measurable is the greatest inhibiting factor of "Incentive Fee" arrangements. Again, Mr. Sapolsky identifies some common beliefs which prevailed when incentive contracts were introduced to the Polaris System Development: [11]

"You can't specify enough in advance in a development project especially one which requires system integration. Incentives will cost more, involve more paper work, and give the contractors more profit."

Since the CPAF contract is oriented toward subjective "after the fact" evaluation with respect to established goals, it serves as a flexible instrument to accomodate the inability to identify objective performance incentives. However, evaluation criteria must still be firm enough to depict some tangible elements; i.e., define standards with reasonable goals. The performance requirements must be well enough advanced in the acquisition cycle to sight intermediate goals, where specifications for procurement

are best defined by performance specifications. They must be congruent with these intermediate goals and established criteria for "after the fact" evaluation. When design goals are subject to significant change, specifications often lack quantitative measure; therefore, the CPAF contract provides a conduit to impose meaningful incentives utilizing qualitative techniques.

In this regard, the CPAF contract permits the Project Manager to mold performance by flexible orientation of design trade-offs. The CPAF contract enhances contractor participation in design trade-offs in accordance with OMB A-109 principles. It provides for timely changes which may prove to be cost effective. The trade-off analysis and subsequent realignment of performance requirements provide greater flexibility to integrate technical improvements in a timely manner. Additionally, the CPAF contract provides an economic means to incorporate design trade-offs that enhance performance when current results are mediocre even though contract requirements are satisfied. Contractors have long maintained that they did not need close technical supervision and have been confident in their trade-off decisions [10]. The CPAF contract promotes a good working relationship and communication of trade-off considerations. It is recognized that the CPAF contract need not be hardware oriented, but trade-off analysis and implementation of desired actions in full-scale development can be results oriented, thereby reducing contractor risk in the incentive arrangement.

The National Aeronautics and Space Administration (NASA) has successfully employed the CPAF contract since the early 1960's.

The degree of technical risk for NASA contracts exhibits significant uncertainty, which is commonly referred to as unknown-unknowns. A closer look at NASA contracts indicates a very narrow band in objectives; that is, their prime purpose is performance oriented toward exploration of space technology. (Interview with RADM Evans.) Each space craft is different and are basically a one of a kind design, where follow on production contracts do not exist. As such, each procurement advances the state-of-the-art and the state-of-the-technology. It has been noted that technological "break throughs" have been experienced sooner and with less expense. It is necessary to point out that NASA enjoys a different environment with contractors due to the nature of public information as required by law, and its result upon protection of technical data by contractor's as proprietary information. Many parallels can be made between NASA and DOD procurements in the full-scale development phase; i.e., degree of technical and cost risk, need for flexibility, complexity of systems and prototype construction. Since the full-scale development is a demonstration of performance of a proposed system, the contract often allows for the procurement of an "objective" for which the probability of success may be low. Again, the CPAF contract creates a mechanism to change emphasis of performance criteria with respect to technical risk. It further provides for recognition of early achievements thus creating a strong motivator for best efforts, or conversely, a means to penalize poor performance. Therefore, the CPAF contract is believed to provide the contractor with a potentially higher reward (greater fee)

with less technical risk with respect to more structured incentive arrangements. The fear of unrealistic performance parameters for very dynamic standards causes risk adverse positions among contractors in the negotiation of contract type; consequently a candidate procurement for the CPAF contract should exhibit substantial technical risk where performance characteristics cannot be objectively or accurately definitized.

During the forementioned interviews, an interesting distinction between incentives of the CPAF and CPIF contract was repeatedly indentified. It was emphatically noted that the perceived benefit of the CPIF contract was strongly oriented to incentives of cost control/reduction only; whereas, the CPAF contract was believed to enhance incentives for performance and schedule at the sacrifice of cost minimization. Further analysis of various CPAF contracts within the Naval Material Command tended to bear out this assumption because criteria were heavily performance weighted even though design to cost criteria were present. This tends to substantiate Mr. Sapolsky's assertion:

[11]

"To the military a late or inoperable weapon is considerably less satisfactory than a costly weapon."

It is logical that the CPIF contract would become driven primarily by cost considerations. Theoretically, performance and schedule parameters have reasonable objective functions which can be attained by optimizing constraints to maximize profits, which requires reduction of cost. Trade-off curves should depict combinations of cost and performance achievements, however, the

overall factor in negotiation for CPIF arrangements is the cost share ratio. Again, it is reasonable to assume that if the contractor controls the trade-off decisions, as is the case with the CPIF contract, the contractor will elect to minimize overall cost rather than attain marginal increases in performance.

On the other side of the contract spectrum, the CPFF contract provides no incentive to minimize cost, but is appropriate when conceptual effort is required. This minimizes administration expense when the end product is for research and identification of alternatives. In essence, the expenditure of resources for purely research ventures does not warrant the complexity of the CPAF contract.

C. PEOPLE

The Project Manager requires maximum flexibility in the management of a major weapons system acquisition. Notwithstanding good management ability, he must possess a sound knowledge of technical aspects of the project. Due to the dynamic environment, contingency planning becomes a must for survival. This planning is inherent in the Acquisition Strategy outlined by DOD Directive 5000.1. The CPAF contract provides for maximum flexibility for "after the fact" adjustment by the Project Manager.

Since in most cases the project manager is the fee determination officer, he commands both formal and informal power to control the direction and magnitude of contractor efforts. This ability to motivate the contractor requires a fundamental trust

in which no room for conflict management exists. The CPAF contract requires candor to be effective since rewards and punishments of the contract are subjectively applied. The success or failure of the CPAF contract depends upon the individual strength of the Project Manager to promote credibility among government and contractor participants alike. This is not an easy task when one considers the vast number of participants within the government alone. Non-belief from key personnel truly becomes a self-fulfilling prophecy and dooms the contract because the contract mandates maximum management attention.

Sometimes the Project Manager's staff is not adequate to administer the contract; however, some Project Managers have elected to bring in consultants to account for staff deficiencies or merely to augment with a given expertise. In any regard, the project office personnel must do more than an adequate job in the evaluation of contractor performance. During the forementioned interviews, a consensus opinion expressed was that Navy in-house ability with respect to technical expertise has diminished within the past decade. The Strategic Systems Project Office was cited as an exception, and as previously indicated NASA enjoys a different environment, which is more of a partnership with industry. Moreover, industry tends to seek out technical expertise within the NASA organization. The CPAF contract in major systems acquisition requires the utmost professional evaluation if credibility is to be established. Because "Award-Fee" proceedings are subject to contractor rebuttal, project office personnel are required to substantiate appraisals of contractor performance with greater attention to detail. Since these

appraisals have direct impact upon the "Award-Fee" (profit) personal integrity becomes an issue, therefore, intensified efforts result in a better identification of problem areas. These efforts enhance communication among project and contractor personnel. Enhanced management of the technology becomes a necessity.

The Armed Services Procurement Regulations clearly place the formal decision for contract type upon the Procuring Contracting Officer (PCO), however, it becomes very apparent that the informal decision of the Project Manager is truly the governing position. Most Contracting Officers interviewed indicated this to be the case because of the need for the PCO to be program oriented. Selection of contract type is often a function of the disposition and personality of the decision maker. Since contract decisions are not made in a vacuum, the PCO becomes a business consultant because the Contracts Directorate is to be a support group for the project office.

A strong interface between the PM and the PCO is required since they must provide a single "face" to industry. The PCO must be persuasive if the CPAF contract type is to be successful. Again, personal integrity becomes a very relevant issue. The CPAF contract will not correct already strained relationships unless bona fide "intent" for fair and reasonable evaluation is perceived by the contractor. This persuasive ability becomes particularly important in the single or sole source environment, however, a different mental attitude prevails when competition is present. This is evidenced by the recent award of a CPAF

contract under a competitive environment for the DDG-47 to Litton Industries, particularly in light of past shipbuilding claims.

The PCO is also a member of the "Award-Fee" determination board, and as such, can make significant contribution to its results. The PCO is in the pivotal position where he is required to protect contractually the interests of the government and the contractor. In a major system acquisition, keeping track of voluminous changes can be extremely difficult and time consuming; i.e., high level concern for undefinitized change orders. As a member of the "Award-Fee" determination board, the PCO is privy to changes required as they occur, and more importantly, is involved in the contingency plan of the program. This promotes his ability to respond and adapt to current problems and monitor interactions of different levels within the acquisition hierarchy. The closer involvement of contracting and project office personnel yields a greater appreciation of problems to protect all parties. The ability to assess these problems with better communications is exhibited by a cohesive balance and judgement during evaluation, which enhances credibility.

The most significant factor in the CPAF contract is the perceived credibility and integrity of the system. Direction from the corporate hierarchy will impact contractor personnel motivations regarding contract type. Some contractors will strictly avoid any overture of the CPAF arrangement. On the other hand, corporate giants such as General Dynamics and TRW seem to welcome the CPAF contract, provided perceived credibility and integrity

are present.

In consonance with OMB circular A-109, the CPAF contract provides a good conduit to communicate the "threat to national defense" to industry. Communications between contractor personnel and the government are enhanced simply by incorporating a portion of the "Award-Fee" toward the personnel interface with the project office. This has been particularly successful in CPAF contracts for the AEGIS Project. Specifically, a category for "recognition of people" enables the contractor to earn a portion of the fee for appropriate individual awards or for training of contractor personnel. This innovative technique enhances the user/producer dialogue not only in upper echelons of the organization but provides recognition for effort in lower tiers as well. This type of action clearly identifies the versatility of the CPAF contract to motivate personnel at all levels in the organization. With proper response, the contractor has the ability to earn the maximum fee allocated in this area. The benefit to the government most likely cannot be measured in a tangible sense, but the evaluation of such intangibles is the purpose of the CPAF contract. Additionally, the project office can easily change the motives should the perceived benefit become marginal.

Another innovative technique used by the AEGIS Project is to have the corporate general manager sit in on the "Award-Fee" determination board proceedings as a non voting member. Moreover, actual voting members included non-program personnel, thus promoting objectivity. The proceedings were conducted in the presence of the contractor, and government personnel presented

relevant facts concerning evaluation issues. This environment mandates accuracy and professionalism, thereby, instilling a strong sense of credibility and integrity. This openness tends to reduce overly optimistic salesmanship since the "airing" of facts requires investigation and supportive documentation. Notwithstanding, a success orientation remains and the contractor is rewarded where outstanding effort has been rendered.

As can be deduced from the foregoing, the CPAF contract requires extensive resources to properly administer, and therefore is not appropriate for all major system acquisition procurements. If the project office is not sufficiently staffed and/or consultants are not available, the CPAF is not appropriate and attempts to use it would be costly with significant reductions in effectiveness. Unless the salient characteristics can be objectively definitized, use of any other incentive contract would also be inappropriate. Thus the CPFF contract would, by default, receive primary consideration.

D. STRUCTURE

The acquisition strategy development, via the Decision Coordinating Paper (DCP), is the formal charter under which the project office directs program operations. The formal structure of the DCP actually duplicates the informal structure utilized by the Project Manager for decision making. The Acquisition Strategy must meet the needs and peculiarities of the system under development. An integrated process is used to tailor this strategy to the systems acquisition [12]. The heart of the

tailored acquisition process lies in the full-scale development phase. During this phase sole source/competitive and/or fly-before-buy/parallel developments are initiated. The contract becomes an important tool and not a substitute for management. Selection of the contract type must be in consonance with a choice in strategy by experienced personnel, who are responsible for integrating technical and business management into a unified strategy within DOD guidelines. The project office has the responsibility to plan the development program thoroughly with a strategy that accounts for the unique characteristics. In this regard this plan must address the technical, budgetary, political, economic, and operational challenges over the expected life cycle of the proposed system. This strategy must be flexible enough to meet the dynamic environment, yet firm enough to establish concise goals and objectives. H.M. Sapolsky gives a few recommendations to enhance flexibility as follows: [11]

"1. The system development plan should be defined such that an evolutionary development is employed in the full-scale development phase, along the lines of successive block changes to the systems design. By employing this evolutionary design approach a system development can take maximum advantage of the test results from early operations; continuous re-evaluation of that threat; updating of performance specifications; and technological developments.

2. The evolutionary design approach is but one aspect of a system acquisition process tailored to meet the needs and peculiarities. This tailoring should also place emphasis

on competition by industry in the earlier phases of the development, transitioning to single source contracting in the production and deployment phases."

The CPAF contract provides great flexibility to employ the systems design approach, since goals and objectives are relatively easy to change in a timely manner. Furthermore, the CPAF contract is ideal for transition from a competitive environment to that of single source. For example, in the early conceptual and validation phases, the competitive environment promotes contractor efficiency, thus incentive contracts may not be necessary. The CPAF contract during full-scale development can be administered with little hindrance from either the competitive or single source environment. As evidenced by current contracts within the Naval Material Command, the hybrid CPAF-IF is a logical progression in the acquisition process when requirements become more defined. To exhibit the versatility of the CPAF, it is noted that the Naval Sea Systems Command has even used the CPAF contract for pilot run production efforts.

Evaluation criteria is the method with which the Project Manager communicates project goals. Specifically, interactions between cost, schedule, and performance are indicated by relative weights assigned or merely by indicating an order of precedence. However, the CPAF contract permits the Project Manager to introduce factors which transcend the formal structure. For instance, overall management can be delineated as a criteria where subjective evaluation includes "how well" the contractor has interfaced with the Navy overall or "how well" he has incorporated

training and manpower requirements. Subjective evaluation of schedule milestones could include efforts to identify problem areas, budget constraints, or production forecasts, which are not feasible in objective oriented CPIF contracts. Evaluation criteria of the CPAF contract are more adaptable to specific needs and peculiarities; i.e., how does one objectively incentivize a maintainability demonstration? Since criteria communicate goals, evaluation criteria become measures of how well these goals are translated into results.

In the CPIF contract, these criteria are not easily changed because the contractor makes early trade-off decisions, which directly affect his ability to meet certain objectives and the government has little influence once the original parameters are established. However, the CPAF contract provides great latitude in setting objectives since subjective assessment ideally should account for trade-off decisions made early in the program to meet previous government desires. (Under CPFF contracts the government makes most trade-off decisions.) As is the case in any incentive contract, the CPAF contract is most sensitive to inappropriate or mis-application of evaluation criteria. Quite different from the more structured CPIF contract, the CPAF contract resists cost reduction mechanisms because it is so performance oriented. The DOD and NASA "Incentive Contracting Guide" readily points out that the incentive contract is not a substitute for sound pricing techniques [9]. The contractual structure, through systems development, must access the probability of occurrence within the cost range to

limit inappropriate constraints and their adverse impact.

Again, the flexibility of the CPAF contract can be shown in the selection of evaluation criteria. The ability to change this criteria enhances the contingency plan with respect to changes in the environment. Of prime importance within environmental factors is the formal and informal power structure -- who are the Decision Makers? Within the project office, the Project Manager, the Assistant Project Manager, the PCO and the Project Engineer are the most influential decision makers. Generally, these are the primary members of the "Award-Fee" determination board. Informal power surges in the form of "who possesses the Knowledge"! This can be manifested by possession of information, which requires investigation of the facts. To some extent this is a function of timeliness. For example, records of performance after a year become vague or even non-existent because of personnel transfers, dynamic environmental factors, or forgetfulness. When ascertaining the facts becomes difficult or even impossible, the contractor may benefit from the government's inability to "document the file".

As indicated previously, the Project Manager directly influences the selection of contract type, but this selection requires organizational commitments at all levels. The selection of contract type may or may not be ratified by higher authority. Policy and precedence established by decision makers above the Project Manager has direct, significant impact. For example, the type of dollars (appropriated) can significantly impact selection of contract type; e.g., 6.1 or 6.2 money connotes a

CPFF contract for pure research. Additionally, personnel changes may significantly impact the power structure. Some Project Managers are technically and managerially stronger than others, which may be perceived as a risk by the contractor for acceptance of a CPAF contract. The "Award-Fee" determination and payment exhibit formal power, particularly since they impact the contractor's cash flow! The rewards and punishments of the contractor's organization are very relevant factors in his acceptance or non-acceptance of the CPAF contract. If the contractor has a strong record of performance, he will most likely favor the CPAF contract, on the other hand, if his performance has been marginal the government should avoid a CPAF contract. A prevailing theme ascertained from interviews was that the CPAF contract is not effective when conflict management is required to overcome adversary relationships. To provide timely communication of goals and resultant facts to reassess these goals, the CPAF contract requires highly motivated people who are adept in maneuvering within the organizational structure found in systems acquisition.

VI. CAN THE COST-PLUS-AWARD-FEE CONTRACT BE VIEWED AS AN INFORMAL MANAGEMENT INFORMATION SYSTEM?

The CPAF contract is a viable instrument for project control because of its flexibility, however, it does have a high cost in terms of resources required. An important side benefit of the CPAF contract is the inherent quality that the contract itself can be utilized as an informal management information system (MIS). Two extreme positions concerning management information systems are identified as follows [13:147]:

"First, the data processing expert might say that models, aside from simple model accounting procedures, have little or no role in an MIS. Their role is in using MIS-generated information to analyze decisions...."

The other extreme is the position of the analyst who might hold that mathematical models are an intrinsic part of any modern MIS Linear programming oil refinery models illustrate a situation in which a manager would find it impossible to consider each of the myraid of alternative plans for the refinery without the aid of the model."

"The resolution of these extreme positions is really very simple. If one accepts the premise of a decision-oriented MIS, both of these positions are correct. A modern sophisticated MIS should allow for all varieties of model utilization from the most formal to the most subjective and informal."

CLELAND & KING

This discussion shall address the latter segment of a modern MIS described above which is identified as subjective and informal. Clearly, the CPAF contract is predicated upon subjective evaluation of after-the-fact events, however, it can be debated whether this process is formal in context with management information systems. Since most large defense contractors have independent MIS controls as well as the government, the CPAF contractual instrument shall be evaluated as an informal control mechanism. To illustrate, the following comparisons with excerpts from MANAGEMENT, by Peter Drucker, will exhibit some strong parallels/characteristics of the CPAF contract:

A. "CHARACTERISTICS OF CONTROLS"

1. "Controls can be neither objective or neutral."
2. "Controls need focus on results."
3. "Controls are needed for measurable and non-measurable events."

Since the CPAF contract is by structure subjective in nature, it provides a means of evaluating contractor performance against criteria which cannot be objectively assessed. The project manager designates events perceived to be most important in the future or near term. The formal process of contract evaluation promotes communication of goals thereby increasing control.

The CPAF contract requires "after-the-fact" evaluation and is therefore results oriented. This gives the project manager control of contractor efforts by directly controlling profit.

The ability to reward or withhold reward is perhaps the most significant single factor of the CPAF contract. Control by economic incentive in a business institution yields a powerful tool. Coupled with the inherent flexibility, which permits the project manager to adjust for the "outside", the CPAF contract enables a subjective common sense approach to project control.

A prominent feature of the CPAF contract is the ability to transcend quantitative limitations and subjectively evaluate criteria that is not measurable. It enables the project manager to incorporate the many intangibles which cannot be quantified. It is recognized that the CPFF contract may indirectly account for these intangibles, but contractor performance cannot readily be incentivized. The CPAF contract permits incentives to be placed on these non-measurable events which can directly contribute to success or failure of the project. The CPIF contract has the danger of being so measurement oriented that other relevant criteria may be deemed of lesser importance. This is not to imply that the CPIF contract is inferior, but merely to highlight possible circumstances where the CPAF arrangement is better suited for non-measurable events. More importantly, the need for appropriate evaluation criteria becomes the central issue. If quantitative, objective criteria are possible, the CPIF contract is well suited, but should non-measurable, subjective events impact significantly upon program success, then the CPAF contract should receive strong consideration.

Mr. Peter Drucker further enumerates seven specifications

to give the manager control;

B. "SPECIFICATIONS FOR CONTROLS"

"To give the manager control, controls must satisfy seven specifications: they must be economical; meaningful; appropriate; congruent; timely; simple; and operational."

Although most contracts could be viewed as an instrument for control, the CPAF contract again enhances this control via communication. What information is needed for control? In general, the contract will require minimum essentials to promote adequate evaluation; thereby, providing the minimum information required by the project manager. Economy is realized in that the contract itself is the instrument for control. Elaborate management information systems can be pared to include only those requirements not met by the contract, if any.

The CPAF contract is tailored to major milestones/objectives which are fundamental to program success. The identification of these elemental events are by definition meaningful. Generally, the CPAF contract does not proliferate evaluation criteria because it is costly and time consuming to administer. Therefore, only those events which are essential to the program are evaluated, thus only a few significant developments are monitored/controlled.

The CPAF contract can easily fall victim to the pitfall of inappropriate evaluation criteria as well as any other contract type. Such inappropriate evaluation criteria greatly reduce the effectiveness of the contract. A saving attribute is the flexibility to change evaluation criteria when intuitive judgement

indicates incongruence. Frequent evaluation during program review may stimulate the communications feedback required to adjust criteria to appropriate events.

The CPAF contract yields great benefit with the ability to match evaluation criteria with congruent events. These criteria are subjectively derived by the project manager to address important issues. The importance of risk evaluation and its impact upon program development can be appropriately addressed via subjective evaluation incentives. This permits the project manager to reward and therefore direct contractor efforts with respect to risk. This very element (risk) often prohibits use of the more objective structured CPIF contract, which does attempt to use a range of values rather than a discrete number (figure).

Timeliness is one of the most critical requirements for successful utilization of the CPAF contract. The frequent evaluation and re-establishment criteria in CPAF contracts provides for increased surveillance during development efforts. The CPFF arrangement during development does not provide the same opportunity for feedback unless it is administered/like a CPAF contract. Regardless of administration, the CPFF contract does not provide the incentives found in the CPAF arrangement. Timeliness in the CPIF arrangement is often considered less critical, since the contractor's efforts are rewarded on final results. Thus, adjustment for a critical issue may not occur during the course of the contract. Again, this is a function of contract administration efforts and vigilance, but the CPAF contract demands timely adjustment (administration).

Although the CPAF contract is time consuming to administer, it is simplistic in nature. Enhanced communications, which result from frequent evaluation enable the project manager to reduce redundancy of other control systems. Most major defense contractors have corporate management information systems that function to monitor cost, schedule, and performance parameters. Regardless of contract type, the project manager endeavors to utilize existing systems rather than establish new government controls. Often times, however, new controls must be tailored to meet specific project requirements. Information under any contract type may be obtained via the Contract Data Requirements List (CDRL). The CPAF contract does improve or at least attempts to improve the informal transfer of communication as well. This simple, yet effective, strategy enhances the user/producer dialogue which aids project control. Since the method for measurement of contractor performance is a subjectively structured process, project control is simply received by management flexibility with respect to program direction.

The CPAF contract is an "after the fact" results oriented arrangement, where the project manager has direct control. This is not to imply that decisions are made "after the fact"; rather, results of interim tasks are used to determine action for the future. Of course, most programs monitor results for effective contract administration. The benefit of the CPAF contract is that the program control is an integral part of the contract, and incentives are applied to encourage participative involvement of the contractor. The contract is tailored to the needs of the

program and is directly administered by the decision makers. This involvement of the decision makers with specific problems in detail is the reason for improved project control. The contract does not control, but merely provides a vehicle for participative management, which enhances project control.

VII. SUMMARY

The Cost-Plus-Award-Fee (CPAF) contract is no panacea. The following discussion is a synopsis of major strengths and weaknesses of the CPAF arrangement. Its greatest strength is FLEXIBILITY, which aids project control. Enhanced communications coupled with timely information enables the project manager to use a contingency plan to meet program objectives. Environmental constraints make the establishment of contract milestones difficult. The CPAF contract affords the project manager the ability to make changes without major detriment to the contractor's economic motivations. This is not to say that acquisition lead time is unaffected. In contrast, the project manager could possibly extend schedule dates to obtain marginal gains in performance. The CPAF incentive arrangement uses participative management (Government and Contractor) to manipulate design trade-offs, which may promote integrity of the acquisition system. Conversely, a poorly administered CPAF contract not only becomes a CPFF contract with a very high fee, but also detracts from this system integrity.

The CPAF contract is strongly performance oriented which can be at the sacrifice of cost. During Full-Scale Development incentives are structured such that the government is buying an objective for which the probability of success may be low. Requirements must be well enough defined to cite intermediate goals, and they must be somewhat measurable. One of the greatest fears of contractors is unrealistic evaluation parameters. When the

CPAF contract is used during Full-Scale Development, intrinsically technical risk is present, thus performance parameters often lack quantitative measure. Performance specifications are not required to be firm. For less definitized complex systems, the CPAF contract provides a method to incentivize contractor performance based upon subjective "after the fact" evaluation. This feedback process permits the project manager to take corrective action when required.

Another great attribute of the CPAF contract is that it recognizes the need for communication at all levels of the organization. Further, it provides a means to recognize people within government and contractor organizations alike. At times, the CPAF arrangement creates a conduit for the transfer of information to decision makers that may not be forthcoming from within formal channels. It enables the government to communicate through informal channels the "Threat to National Defense", which promotes ownership and teamwork within the project. The enhancement of the user (government) producer (contractor) dialogue makes the systems approach more effective. This interaction at all levels instills a strong success orientation. However, zealous salesmanship is reduced because participants must be able to factually defend evaluation critiques (comments). This requires thorough and current investigation of program progress with respect to the technology (homework). The CPAF contract demands teamwork. Therefore, it is very sensitive to the capacities and management strength of the decision makers. First, the contracting officer must be persuasive to obtain the subjectively structured CPAF

arrangement, and the project manager must be willing to commit resources to its administration. Properly administered, the CPAF contract will build the confidence of the people involved, which promotes professionalism.

The structure of the CPAF contract often will enable the decision makers to evaluate interactions between major project parameters of cost, schedule and performance. Subjectively applied evaluation criteria introduce factors which transcend objective, quantitative events. This ability to apply subjective, intuitive management attention to the "soft" issues permits the project manager to adjust for environmental conditions (risk). These criteria can be tailored to program needs, and they serve to communicate both short and long term goals. The result of direct communications is closer program review, which provides more accurate and timely rewards. However, the CPAF contract is not without cost. It is very sensitive to organizational commitment. A mere change in command may have severe ramifications. It demands top management support and a high level of talent for proper administration.

In conclusion, the CPAF contract requires arduous attention to details for effective administration. The "after the fact" subjective evaluation permits the project manager to reward or withhold reward from the contractor for efforts during a short term evaluation period. Evaluation criteria can be tailored to needs (flexibility) when directing contractor efforts. The contract is only effective when the contractor perceives creditability, reasonableness, and integrity in the "Award-Fee"

Determination Board. Pressures to provide good performance and schedule results are tied to the ability to earn fee (profit). Cost reduction is not a by-product of the CPAF arrangement because incentives are usually performance and schedule vice cost oriented. Administratively, the CPAF contract requires greater personnel resources. Some contracting officers believe these additional costs receive adequate consideration in the form of increased vigilance, reduced structural changes, and enhanced management capacity. A major weakness is that the CPAF contract cannot function well when conflict resolution is required either within the government or with contractors. However, to some extent this is a major weakness of any contract type. The CPAF contract requires the complete cooperation of all parties. Without unreserved commitment of resources to administrate common sense of objectives, the overall program goals cannot be effectively realized. Due to the communications required to administer the CPAF contract, it creates an informal management information system. The control received from additional management flexibility makes the CPAF arrangement attractive during the Full-Scale Development phase. Properly administered, the CPAF contract becomes a "real-time" instrument for project control. It can only be effective when it is applied discriminately with regard to resources and technology.

Finally, the following comments by RADM W. E. Meyer describes basic advantages of the Cost-Plus-Award-Fee contract and some of its limitations.

"Planning is required for more than two months at a time..

Top management must have assistance from laboratories and contractors... Some have been rushing to use the "Award-Fee" to solve management's problems - it will not! ... The CPAF contract can serve as a stimulant to instill a sense of pride for achievement. It provides flexibility and adaptability to use common sense. The CPAF contract works because it requires the attention of top management."

RADM W. E. MEYER, USN

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Washington, D. C. 20360
13. Mr. George Baird 1
General Dynamics, Pomona Division
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