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SAFEGUARD Data-Processing System:

A Cost-Plus-Award-Fee Contract for a Large Software Development Program

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This paper describes the Cost-Plus-Award-Fee (CPAF) contract that has been used to control a major software development effort, amounting to approximately $30 million annually. The amount of the award fee is determined periodically, based on a unilateral judgment of supplier performance. The lessons learned in handling a contract of this type and magnitude are summarized. The CPAF contract has proven to be a good means of ensuring the continued attention of supplier management that is necessary for obtaining high performance on time.

I. INTRODUCTION

Put very simply, the Cost-Plus-*Award*-Fee (CPAF) contract is a cost-reimbursable level-of-effort arrangement in which the fee to be paid for each (predetermined) period is based on the customer's unilateral, subjective judgment of the supplier's performance during that period, measured against previously-agreed-upon performance criteria. The fee awarded is not subject to change. The award-fee contract differs from other types of cost-reimbursable contracts such as (*i*) the Cost-Plus-*Fixed*-Fee (CPFF) contract where the fee is fixed at the outset of work, and (*ii*) the Cost-Plus-*Incentive*-Fee (CPIF) contract, in which the fee is determined by applying a previously-agreed-upon formula to objective measurements of cost and/or performance and schedule events upon completion of the work.

The key words in award-fee are "unilateral" and "subjective." This type of contract is a complete departure from convention and one not eagerly sought by suppliers unless they have enough self-confidence to take some very real monetary risks. The motivating factor for the supplier is to maximize the profit—the all-important "bottom line"—by high performance, and the award-fee contract is a vehicle for doing so if the supplier is willing to take the risk of realizing a very small profit or none at all if he does a poor job.

In the past, CPFF contracts had often been chosen for both hardware and software development programs. The principal technical difficulties lay in communications and motivation: in getting requirements changes implemented, getting feedback on current progress and problems, and getting appropriate attention by supplier management.

Software development is characterized by many requirements changes and many complex interfaces, and one must ensure close and continued communication if a software development contract is to be successful. Furthermore, software development is a process of evolution, and it is very difficult to set up predetermined performance goals against which the final product could be measured; hence, a software objective-incentive contract is frequently not desirable.

To get the good communications and motivation that are essential in the development of software, we decided to use the Cost-Plus-*Award*-Fee method. At the time of this decision, the CPAF form of contract was relatively new, and had not even been recognized in the Armed Services Procurement Regulations (ASPR). It was being used principally by NASA and the Navy, for various kinds of work including software development, and had been well regarded by them. The concept appeared to be suitable for our major software development extending over several years, since it provided a financial incentive for good performance, and this periodic pressure of profit determination offered the best promise of continued attention by the contractor management.

Accordingly, a specific award-fee approach was devised, and proposals based on this approach were invited. A contract format was devised specifying a periodic award of fee money based on a quantitative scoring of supplier performance, using stipulated subjective criteria. Its provisions included developing a curve that would give profit in terms of score and establishing an effective procedure that would ensure prompt and continuous feedback. A selection procedure was devised, and the supplier was chosen with the knowledge that this was to be an award-fee contract.

The contract was signed on January 14, 1969 and with some modifications has been used steadily since then.

II. DETAILS

The contract has covered up to about 800 people. At the time, the work was divided for control purposes into 16 mission orders (missions) covering broad areas such as MSR tactical data processing and computing facilities. In turn, the missions were divided into some 70 tasks, with titles like "Software Quality Improvement" and "PAR Installation and Test System Development." Each mission can be viewed as an individual contract since it contains a scope of work, designates a representative for evaluating performance, sets forth the planned hours and dollars estimated to do the work, assigns a base fixed fee, and establishes an award-fee pool that can be earned in whole or in part depending on the evaluated performance. Thus, the entire contract is essentially a collection of mission orders handled within a common procedural framework.

2.1 Evaluation

Evaluation of the tasks and missions is a key part of the administration of the contract and, accordingly, it has been structured carefully. For convenience, the several steps in the evaluation procedure are summarized in Table I.

Each task is defined by a specific task plan, and is monitored by a designated Bell Laboratories member of technical staff, usually a first-line supervisor. Once each month, this task monitor evaluates the performance of the supplier on his task by means of a formal set of scores, supplemented by a written commentary that notes prominent strengths and weaknesses observed during the month. The monitor, based on his subjective judgment, assigns a score between a minimum of 59 (a failure) and a maximum of 100, about the interval of a typical school report card. A score of 80 will return to the supplier a fee commensurate with what would be expected for a good-quality job on a CPFF basis. The technical evaluation form is shown in Fig. 1, and the definitions of the categories in Fig. 2. Each technical evaluation is reviewed and approved (possibly with changes based on mutual discussion) by the project manager, who is the task monitor's supervisor.

Table I — Summary of evaluation procedure for CPAF contract

Frequency	By Whom	Functions
Monthly	Bell Laboratories Task Monitors	Technical evaluation of tasks.
Monthly	Bell Laboratories Project Managers	Management evaluation of tasks in a mission. Due the 5th of the month.
Monthly	DPS Control Department	Calculates scores for all tasks. Sends preliminary evaluations to supplier as of the 12th of the month.
Quarterly	Performance Evaluation Board	Reviews evaluations. May make score adjustments. Recommends scores to fee-determining officer.
Quarterly	DPS Control Department	Adjusts scores as recommended. Makes errata sheets.
Quarterly	Fee-Determining Officer	Reviews recommended scores. Makes final decision on scores. Determines fee. Sends official evaluation to supplier.
Quarterly	Management Review Board	Discusses evaluations (and reviews contract work generally).

MISSION TASK NO	TASK TITLE	TASK MONITOR	FROM	TO
DEPT		PROJECT MANAGER	MANPOWER	
			REQUIRED	ASSIGNED

CATEGORY	TASK MONITOR'S REMARKS	WT.	SCORE
ADEQUACY OF PLANNING AND SCHEDULING			
CONFORMANCE TO REQUIREMENTS AND RESPONSIVENESS TO CHANGE			
COOPERATION			
QUALITY OF TECHNICAL ACHIEVEMENT			
QUANTITY OF TECHNICAL ACHIEVEMENT			

CONTRACTOR REVIEW	DATE	ADMINISTRATIVE USE	DATE	TASK MONITOR	DATE	PROJECT MANAGER	DATE	TOTAL SCORE

TECHNICAL EVALUATION	TASK	PERIOD COVERED	

(6/73)

Fig. 1—Technical evaluation form.

THE BASIC REFERENCE IS THE TASK PLAN.

PLANNING AND SCHEDULING – QUALITY OF PLANNING AND REPLANNING, MEASURING AND PROJECTING PROGRESS, SCHEDULING, AND ALLOCATING RESOURCES DURING THE REPORT PERIOD (NOT NECESSARILY HOW WELL THEY ADHERED TO PREVIOUSLY ESTABLISHED SCHEDULES).

CONFORMANCE TO REQUIREMENTS AND RESPONSIVENESS TO CHANGE – DEMONSTRATED ABILITY TO MEET DESIGN REQUIREMENTS AND KEEP WORK IN LINE WITH PROJECT GOALS, EVEN IF CHANGING.

COOPERATION – IN ADDITION TO THE USUAL MEANING, PROMPT FURNISHING OF ALL DATA ON ANY PROBLEM AREAS THAT COULD IMPAIR PERFORMANCE OR OTHERWISE AFFECT TASK PERFORMANCE.

QUALITY OF TECHNICAL ACHIEVEMENT – IMAGINATIVENESS, ACCURACY, COMPLETENESS, RELIABILITY, AND APPROPRIATE OPTIMIZATION OF DESIGN AND IMPLEMENTATION. FOR EXAMPLE, EFFICIENCY OF CODE IN REGARD TO THE USE OF TIME AND SPACE, COMPLETENESS AND TECHNICAL AND EDITORIAL QUALITY OF REQUIRED DOCUMENTATION, INITIATIVE, IDEA GENERATION, AND GENERAL APPROACH TO THE JOB.

QUANTITY OF TECHNICAL ACHIEVEMENT – PRODUCTIVITY IN DESIGN AND IMPLEMENTATION OF PROGRAMS AND PRODUCTION OF DOCUMENTS. OVERALL AMOUNT OF USEFUL WORK ACCOMPLISHED DURING THE PERIOD.

MANPOWER:

REQUIRED – THIS NUMBER IS TAKEN DIRECTLY FROM THE TASK PLAN AND REPRESENTS THE MANPOWER PLANNED FOR THE MONTH SPECIFIED, IN EQUIVALENT FULL-TIME PEOPLE.

ASSIGNED – THIS NUMBER IS DERIVED FROM TOTAL MAN-HOURS (INCLUDING OVERTIME) REPORTED DIVIDED BY THE NUMBER OF HOURS IN THE ACCOUNTING MONTH. HENCE, THIS NUMBER REPRESENTS EQUIVALENT FULL-TIME PEOPLE.

Fig. 2—Definition of technical evaluation categories.

PROJECT MANAGER		FROM	TO

CRITERIA	PROJECT MANAGER'S REMARKS	WT.	SCORE
COOPERATION AND RESPONSIVE MANAGEMENT			
ORGANIZATION, MANNING, AND QUALITY OF PERSONNEL			
MANAGEMENT ACHIEVEMENT			

ADMINISTRATIVE USE		PROJECT MANAGER	DATE	TOTAL SCORE
MANAGEMENT EVALUATION	TASKS	PERIOD COVERED		

(6/73)

Fig. 3—Management evaluation form.

Separately, each project manager evaluates the tasks for which he is responsible within a given mission by means of a management evaluation (see Figs. 3 and 4). Technical scores are calculated, based on a weighting of the categories that varies with the individual tasks. Management scores are also calculated, but with a uniform weighting that is the same for all missions. The entire body of monthly evaluations is sent to the supplier soon after the start of the succeeding month, and face-to-face discussions ensue shortly thereafter.

COOPERATION AND RESPONSIVE MANAGEMENT – QUALITY OF ACCURATE AND OBJECTIVE EVALUATION OF THE IMPACT OF REQUIREMENTS AND CHANGES. FURNISHING DATA, INFORMATION, AND ADVICE ON KEY PROBLEMS, AND MAKING TECHNICAL AND ADMINISTRATIVE CHANGES AS REQUIRED.

ORGANIZATION, MANNING, AND QUALITY OF PERSONNEL – ESTABLISHING AND MAINTAINING HIGH QUALITY PERSONNEL AND A USEFUL ORGANIZATION WHICH INTERFACES CONVENIENTLY WITH THE LABORATORIES, AND MEETING CONTRACT MANPOWER REQUIREMENTS.

MANAGEMENT ACHIEVEMENT – QUALITY AND QUANTITY OF USEFUL OUTPUT. MAKING EFFECTIVE USE OF PERSONNEL, CONTROLLING THE USE OF RESOURCES, FILTERING OUT INESSENTIAL WORK, AND PROPERLY USING AND CARING FOR FACILITIES AND EQUIPMENT.

Fig. 4—Definition of management evaluation categories.

2.2 Review

Once a quarter, the evaluations for the entire three months are reviewed by the performance evaluation board, which consists of the project managers, the senior management of the division, and the head of the local contracting (purchasing) department [who enters into the scoring equation his own evaluation of cost and contract administration (see Fig. 5)]. All evaluations are scrutinized and reviewed for fairness and appropriateness of category. The project managers are permitted to change the evaluation scores if they consider it necessary, based on subsequent information of events during the quarter that had not been available at the time of the evaluation, provided they can justify the changes to the board's satisfaction. The board is permitted to change scores to reflect a broader view, and comments are frequently made in the minutes of the review meeting that draw attention to a strength or weakness or emphasize a particular problem. Normally, the changes in scores are few, and are made only for a specifically explained reason. The board then recommends, to the fee-determining officer, a set of scores by mission for the quarter.

2.3 Fee determination

The mission scores are converted to mission fees according to an essentially linear algorithm, with 59 corresponding to the base fixed fee (if any) or 0 percent award and 100 corresponding to the maximum

P E BOARD MEMBER		FROM	TO

CRITERIA	PURCHASING DEPARTMENT'S REMARKS	WT.	SCORE
CONTRACT ADMINISTRATION			
COST CONTROL ACCURACY OF RESOURCE ESTIMATES FOR EACH TASK PLAN			
COST REDUCTION, EFFECTIVE REDUCTION IN DIRECT OPERATING COSTS, AND INDIRECT BURDEN RATES			

ADM USE	DATE	ADMINISTRATIVE EVALUATOR	DATE	TOTAL SCORE
COST AND CONTRACT ADMINISTRATION EVALUATION			PERIOD COVERED	

Fig. 5—Cost and contract administration evaluation.

fee of 15 percent which would include the base fixed fee. In military work, the base fixed fee cannot exceed 3 percent nor can the maximum fee exceed 15 percent for R&D work (including the base fixed fee, if any). The fee-determining officer (the local director of purchasing) then reviews the scores from the purchasing point of view; he is empowered to change the fees if in his sole judgment it is appropriate. He then forwards the official copy of the quarterly evaluations to the supplier, together with any score changes and performance evaluation board minutes, and with the fees for the quarter.

2.4 Supplier review

A contractor/supplier review is normally held quarterly, at the supplier's request, by the management review board, which consists of officials of the supplier, technical contractor personnel, and the fee officer, to discuss the evaluations and pertinent technical and management questions. This review may be waived by the supplier.

III. DISCUSSION

Experience has shown that firm customer management support must be given to the process of evaluating the work and reviewing the evaluations. This involves many people; for example, in July 1971, when the job stood at 14 missions and 54 tasks, the customer monitoring involved (part-time) 44 task monitors and 17 project managers. These numbers may suggest an inordinate amount of monitoring; however, this is not the case, since in a program of this magnitude one would expect to have roughly this number of customer technical people involved to ensure a good product. The distinctive feature is the coordinated evaluation effort of these people. There is a tendency for the evaluation process to become routine and thus to lose its incisiveness. This must be guarded against continuously, by vigorous top-management interest, principally at the quarterly performance evaluation board meetings. Not only must the evaluations be incisive, they must also be timely. In any busy organization, there is a tendency for paperwork such as these evaluations to lag. This must be prevented, since prompt feedback with the supplier is essential.

The evaluations must be carefully and thoughtfully done. In the course of reviewing a great many evaluations, some DOs and DON'Ts have been formulated. Since these have come from hard experience, it is appropriate to include them here.

(*i*) Make the task plans clear and concise.
(*ii*) Encourage initiative.
(*iii*) Ensure that the score represents the exact evaluation of the supplier for the period.

(*iv*) Say *why* you thought the work was good or bad. If the score is very high or very low, always include an explanation. Make the remarks constructive, so that they may be used to maximize supplier performance.

(*v*) Task monitors should discuss evaluations face-to-face with supplier counterparts.

(*vi*) Jot down comments as the month proceeds.

(*vii*) Get completed forms in on time, to permit quick feedback to the supplier.

(*viii*) Don't use an unsupported adjective:
NOT "Good"
BUT "Good replanning to accomodate a peak work load."

Some problems were observed from the supplier's point of view. Some supplier managers felt that task monitors were arbitrary in their scoring, and sometimes they tended to please the task monitors rather than exerting their own judgment on how best to do their jobs. At times, requirements changes made supplier managers uncertain as to the customer's needs and made them regard evaluations as unfair. In the main, these problems were growing pains, and disappeared as higher management review was applied to the evaluations.

A frequent question is "Are you paying a proper fee for the work?" The answer is that, if you need high performance on time, then the value of a high-quality job more than compensates for a higher fee. If the proper evaluation of the supplier's performance results in a high fee, then by definition you must be receiving the kind of product you desire. And such is the case with the contract under discussion.

IV. CONCLUSIONS

The award-fee contract discussed here has been in operation for more than four years and has covered, as of October 1974, over $130 million of effort. The gaps in communication have been few, and by and large they have been spotted and corrected promptly.

In summary, the award-fee contract is a good vehicle for dealing with a large, complex, dynamic problem, where the customer needs as good a job as he can get and on time. This type of contract requires good faith between customer and supplier and a substantial monitoring and evaluation effort. The format encourages good customer-supplier communications and the active management involvement that is, in fact, necessary to successful performance. The improved visibility of problems makes it possible to address them quickly and solve them. The CPAF contract format has played a very important role in getting high-quality software on schedule in a major software development.