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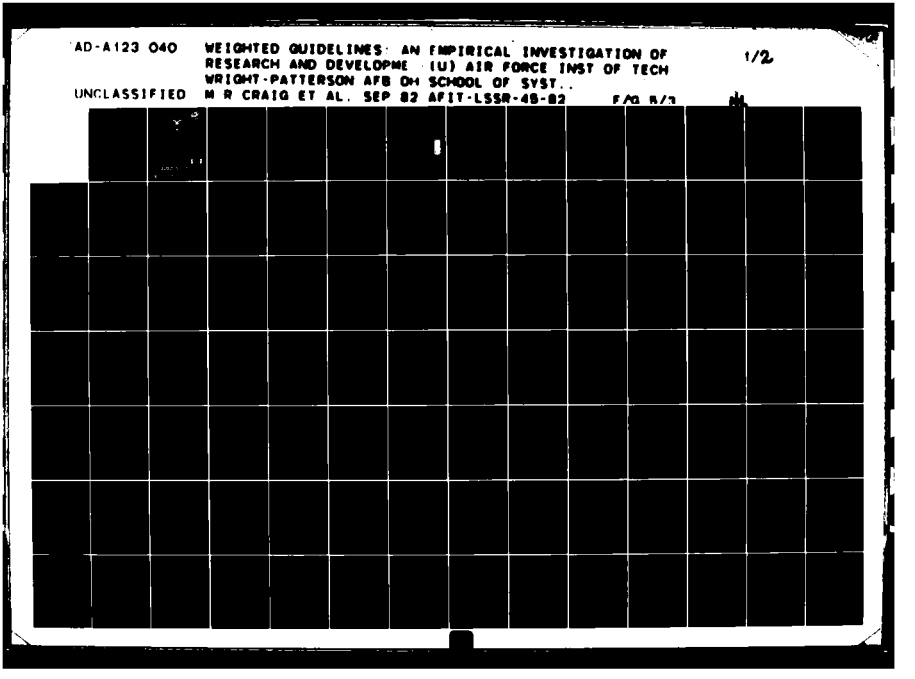

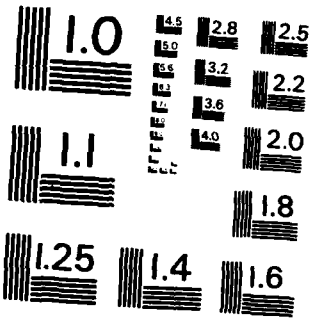

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WEIGHTED GUIDELINES: AN EMPIRICAL INVESTIGATION OF RESEARCH AND DEVELOPMENT ACQUISITIONS

Michael R. Craig, Captain, USAF
Henri J. Pousardien, Captain, USAF

LSSR 45-82

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Recent changes to DOD profit policy modified the weighted guidelines method of determining prenegotiation profit objectives. One Research and Development (R&D) contracting organization expected that this modified weighted guidelines method provided prenegotiation profit objectives that were too low to be consistent with the economic realities associated with the R&D marketplace. Two research objectives were employed in this study to compare the difference between prenegotiation profit objectives and final negotiated profits for R&D contracts categorized in two groups: (1) the R&D contracts in accordance with Defense Acquisition Circular (DAC) 76-23 and (2) those R&D contracts in accordance with Defense Procurement Circular 76-3. The research plan was to determine if recent changes to DOD profit policy had inadvertently resulted in unrealistically low prenegotiation profit objectives. The study revealed unexpected results. The random sample of R&D contracts indicated no significant difference between the prenegotiation profit objectives and final negotiated profits using the DAC 76-23 method of computing weighted guidelines. Based on the results of this study, no recommended changes are suggested for the present DOD profit policy. However, a post hoc analysis of why the research results were not as expected and recommendations for further research are included.

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WEIGHTED GUIDELINES:
AN EMPIRICAL INVESTIGATION OF
RESEARCH AND DEVELOPMENT ACQUISITIONS

A Thesis

Presented to the Faculty of the School of Systems and Logistics

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In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Logistics Management

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has been accepted by the undersigned on behalf of the faculty of the School of Systems and Logistics in partial fulfillment of the requirements for the degree of

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CHAPTER 1

INTRODUCTION

Overview

The Department of Defense (DOD) uses the profit motive to stimulate effective and efficient contract performance from contractors (22:3-808.1). However, the methods used to create prenegotiation profit objectives encourage profit levels which are too low considering the economic realities associated with the Research and Development (R&D) contracting environment (see Appendix A for a copy of the "Research Needs Statement" on which this research was based). Therefore, the objective of this research was to examine the policies and methods used to compute prenegotiation profit objectives on R&D efforts.

This chapter provides an introduction to the research problem and a brief discussion of concepts and procedures necessary to understand the final research results. The reasons for using the profit motive are examined with respect to the DOD R&D marketplace. The two contracting methods used in purchasing DOD goods and services--formal advertising and negotiation--are briefly described along with the concepts behind the financial analysis approaches--cost analysis and price analysis--used to determine price

reasonableness under each contracting method. Finally, a brief discussion of the weighted guidelines (WGL) method for developing prenegotiation profit objectives is provided. The foregoing subjects are covered to outline the background, terms, concepts, and procedures applicable to this research effort.

Problem Statement

Aeronautical Systems Division (ASD) data indicated that the average profit objectives developed in accordance with the R&D WGL method reflected prenegotiation profit percentages of 6 percent to 7 percent. However, the R&D profits finally negotiated at ASD usually exceeded 8.4 percent (see Appendix A). This discrepancy between the prenegotiation profit objectives and the final negotiated results was the basis for this research effort. The WGL procedures were designed to provide an objective method for determining a fair and reasonable profit for a particular contract (22: 3-808). However, the present WGL procedures develop profit objectives that appear to be too low with respect to the R&D marketplace. The ASD Directorate of R&D Contracting stated that the current R&D WGL method does not provide realistic profit objectives.

The problem of concern in this research project was the apparent difference between the prenegotiation profit

objectives and the final negotiated profits on most R&D contracts within ASD. ASD feels the difference is significant and causes substantial problems in negotiating R&D contracts. The significance of the research problem is discussed in the next section.

Justification for Research

Justification for examining the WGL method for R&D activities stems from the wide utilization of the WGL method, the potential for "waste" the public sees in paying profits to Government contractors, and the difficulty of attempting to negotiate contracts with low profit objectives.

The WGL method is the technique generally utilized for determining acceptable profits for negotiated acquisitions. Other methods for determining profits may be used (22:3-808(b)). However, the selected procedure and the reasons for deviating from the WGL method must be fully explained and substantiated by the responsible Government contracting officer (22:3-808(b)).

The WGL method only applies to negotiated acquisitions where cost analysis is used to determine the reasonableness of the final price. Most R&D contracts are negotiated and involve the use of the WGL method. Therefore, an objective of the R&D WGL method is to accurately produce fair and reasonable profits in order to keep companies in the R&D marketplace and to attract new companies into the R&D industry (22:3-808.1(a)).

In addition, a main area in which the public sees the potential for waste in Government contracting is the payment of profits to contractors (16:181). Therefore, the Government developed the WGL procedures to prevent potential waste. If the Government's method of determining and justifying profit does not produce fair profits for contractors, then the negotiation process and the contracting officer's actions in the negotiation process become questionable. Therefore, a sound objective method for determining a fair profit for defense contracts is clearly needed. Based on the claims made by ASD, the R&D WGL procedures apparently do not provide reasonable prenegotiation profit objectives.

The present WGL procedure is a method which the Government uses to justify the profit rate agreed upon in the contract. The WGL method is used to create "going-in" profit objectives from which the contract negotiator develops a fair and reasonable price for the contracted effort. However, if the "going-in" profit objectives are truly too low, then the negotiator's job is much more difficult.

The intent of the WGL method of prenegotiation profit calculation was to provide a reasonable profit objective for use by the contract negotiator in entering and documenting negotiations (22:3-808.2(a)). The intent of this research project was to examine the difference between the prenegotiation profit objectives and the final negotiated profit results when the WGL method for R&D contracts was employed

at ASD. This research project was also designed to determine if that difference was significant enough to warrant the revision of the existing WGL method for R&D efforts.

Background

Profit Defined

There are many definitions of profit.[1] However, the relationships among total revenue (TR), total cost (TC), and profit (P) serve as the basis for the definition used in this research. The formula, TR = TC + P, means total revenue equals total cost plus profit. This description of profit uses the accounting concept in which profit is the revenue remaining after costs owed to others are paid (17: 58). This concept of profit is different from "economic profit" which is the revenue of a business in excess of the opportunity costs (highest alternative incomes) of the productive resources employed by the business (17:58). Opportunity costs include the implicit costs of the income foregone from using the resources of the firm in a different manner (17:58).

The importance of profit can be understood best by its function within a firm. It is generally accepted that profit has three basic functions: (1) to reward a contractor for the risk assumed in undertaking the productive effort,

---

[1]In this research, the terms profit and fee are used interchangeably.

(2) to reward a contractor for organizing and managing resources, and (3) to cover the costs of capital employed (both facilities capital and operating capital)(12:I-4).

Other functions of profit specifically cited in doing business with the Government were (1) to absorb the costs of deviations from planned to actual effort and to compensate the firm for delayed or cancelled programs, (2) to keep the firm's capability intact and maintain more capacity than required (for a mobilization reserve), (3) to fund independent research and development, (4) to establish capabilities in different but related fields, and (5) to meet unanticipated inflation or costs (12:I-5).

The Government benefits directly from the profit-related activities of business firms. Therefore, it is in the Government's best interest to pay reasonable profits to keep firms active and interested in conducting business with the Government (24:II-2).

Contracting Methods: Formal Advertising and Negotiation

When the Government purchases standard commercial items or items sold in substantial quantities to the general public, then the problem of determining profit levels mutually acceptable to the Government and its contractors is much simpler. In this marketplace, the market forces interact to establish prices for items (17:15). The Government often buys such standard items utilizing a process called

formal advertising (17:15; 22:1-300).

Formal advertising involves the solicitation of bids on the premise that contract award will be made to the responsible bidder offering the lowest price. Awards are made quickly, and profit is determined by the competitive marketplace. Formal advertising is the preferred method of Government contracting (22:1-300). However, the formal advertising procedure is limited to those items meeting certain criteria. The most important of the criteria is that the item must have firm specifications. Because of this limitation, formal advertising is usually not appropriate for R&D programs (22:4-104).

The Government recognizes the limitations of such procedures and allows exceptions to the preferred policy of contracting based on formal advertising. There are seventeen exceptions listed in the Defense Acquisition Regulation (DAR) for which negotiation is allowed instead of formal advertising. One of the seventeen exceptions is for the acquisition of R&D efforts, because it is generally not possible to formulate precise specifications for R&D work (22: 3-211). Hence, negotiation is the usual contracting methodology for purchasing R&D efforts (22:4-104).

Since negotiation can be a long and involved process, much contract planning must be accomplished before discussions with contractors begin (7:150-151). Every facet of the acquisition must be examined (7:150-151). In actual

negotiations, each element of proposed cost may be discussed separately (22:3-808.2(a)(3)). Therefore, the Government must establish what it feels is fair and reasonable for each cost element (22:4-106(c)). This includes the establishment of a profit objective. Objectives should be established before negotiations begin through either cost analysis or price analysis (22:3-807).

Price Analysis/Cost Analysis

The Government's procedures to establish prenegotiation profit objectives fall into two categories: price analysis and cost analysis. Price analysis is a process of examining the proposed price without regard to evaluating the individual elements of cost (22:3-807.1(a)(1-5)). Price analysis is also a technique which compares the price offered to some other standard. As specified in the Defense Acquisition Regulation, the standard may take many forms. For example, price analysis may involve (1) the comparison of the price quotations submitted, (2) the comparison of prior quotations for the same or similar items, (3) the use of a parametric relationship, (4) the use of published price lists, and (5) the comparison of proposed prices with estimates of cost independently developed by the Government (22:3-807.2(a)(1-5)).

On the other hand, cost analysis is the review and evaluation of every individual element in a contractor's

proposed price in an attempt to reasonably form an opinion on what the contract should cost (22:3-807.1). Cost analysis includes an evaluation of profit. The method used to evaluate profit in cost analysis is called the weighted guidelines method.

Weighted Guidelines Method

The weighted guidelines method (WGL) of profit analysis is designed to provide contracting officers:

> (i) a technique that will insure consideration of the relative value of the appropriate profit factors . . . in the establishment of a profit objective and the conduct of negotiations; and
>
> (ii) a basis for documentation of this objective, including an explanation of any significant departure from it in reaching a final agreement [22:3-808.2(a)(1)].

The weighted guidelines method is designed to provide reasonably precise guidance in applying the DAR prescribed guidelines for negotiating profit. The WGL method tailors profit to the circumstances of each contract action such that DOD's long range profit policy will be fostered. The WGL technique provides profit commensurate with varying circumstances in a contract (22:3-808.1(b)).

The DAR states that the Government should establish a profit objective for contract negotiations which will:

> (i) motivate contractors to undertake more difficult work requiring higher skills and reward those who do so;
>
> (ii) allow the contractors an opportunity to earn profits commensurate with the extent of the cost risk they are willing to assume;

(iii) motivate contractors to provide their own facilities and financing to establish their competence through development work undertaken at their own risk and reward those who do so; and

(iv) reward contractors for productivity increases [22:3-808.1(b)].

The WGL method is used to analyze the cost structure of the individual contract as proposed by the contractor and to allow a certain percentage of each cost element for profit. The WGL method divides profit into major areas and requires the Government contracting officer to measure the effort expended by the contractor in each area. Weights assigned to profit factors are based on the judgment of the contracting officer considering DAR guidance.

Although profit analysis contains areas of subjective evaluation, the WGL method was designed to prevent the practice of providing profit based upon unclear guidance and historical profit levels. Prior to the WGL method, the contracting officer considered a number of relevant factors and chose a level of profit that was based on a percentage of the total contract cost. This earlier method of developing profit objectives was totally subjective and required only a narrative write-up as justification (17:57). The WGL method is more objective and allows application of the profit principles specified in DAR 3-808.1(b).

Scope

This research project was limited to R&D acquisitions purchased through the Directorate of R&D Contracting

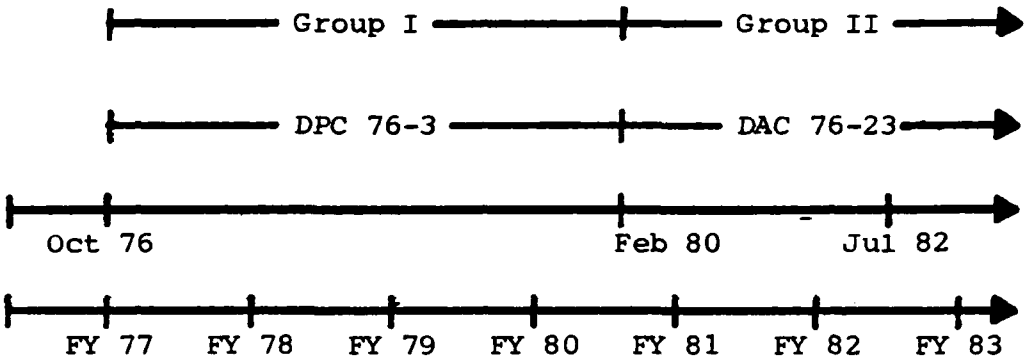
at the Aeronautical Systems Division (ASD) of the Air Force Systems Command (AFSC). The WGL method is also applicable to other types of purchasing--manufacturing and services (22:3-808.2). However, this research project specifically addressed the WGL method for R&D acquisitions. The profit determination features relating to the application of the WGL method to the other two types of purchasing were beyond the scope of this research effort.

General Research Plan

Before the general research plan can be effectively understood, one needs to become familiar with the two WGL methods used from fiscal year (FY) 1977 to the present (July 1982). Figure 1 provides a time line depicting the two WGL methods, the fiscal years affected by each WGL method, the issue dates for each change to the WGL method, and the associated data collection groups (i.e., Group I and Group II).

The researchers addressed the stated research problem (i.e., the present WGL method of producing low prenegotiation profit objectives) by comparing the prenegotiation profit objectives developed under the present WGL method with the final negotiated profit results.

Two research objectives guided the authors' research effort. The first research objective was to determine the severity of the perceived problem by determining if the difference between the WGL prenegotiation profit objectives and



WGL Procedures Under DPC 76-3 (Group I)	WGL Procedures Under DAC 76-23 (Group II)
(1) One WGL method applied to R&D, Services, and Manufacturing.	(1) Separate WGL methods for R&D, Services, and Manufacturing.
(2) Small emphasis placed on facilities investment.	(2) More emphasis placed on facilities investment for Manufacturing only.
(3) Factor of .7 applied to deflate the contractor's effort.	(3) The .7 factor was no longer applied to R&D or Services contracts.
(4) Facilities Capital Cost of Money allowed as a cost and not subtracted from the profit objective.	(4) Facilities Capital Cost of Money allowed as a cost, but the amount is subtracted from the basic profit objective.

Fig. 1. A time line showing DPC 76-3, DAC 76-23, and associated changes made to the weighted guidelines method.

the final negotiated profit results was as great as stated in the "Research Needs Statement" (see Appendix A for a copy of the "Research Needs Statement"). The second research objective was to determine if the WGL method under Defense Acquisition Circular (DAC)[2] 76-23 created the perceived problem. Group I data were used to address the second research objective. The researchers anticipated that the difference between the prenegotiation profit objectives and the final negotiated profits would be large for the group of contracts affected by DAC 76-23.

The general research plan consisted of a series of hypothesis tests to determine the severity of the perceived problem and to determine if the latest change to WGL policy promulgated under DAC 76-23 caused the problem. Figure 2 presents a decision tree delineating the research objectives and the hypothesis tests. Chapter 3 details the specific hypotheses that were tested in this research project.

Summary List of Assumptions

1. The final negotiated profits were fair and reasonable and determined by market forces independent of the use of the R&D WGL method.

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[2]The Defense Acquisition Circular (DAC), previously called the Defense Procurement Circular (DPC), is used to revise or supplement the DAR or to disseminate applicable procurement material (22:1-106.2).

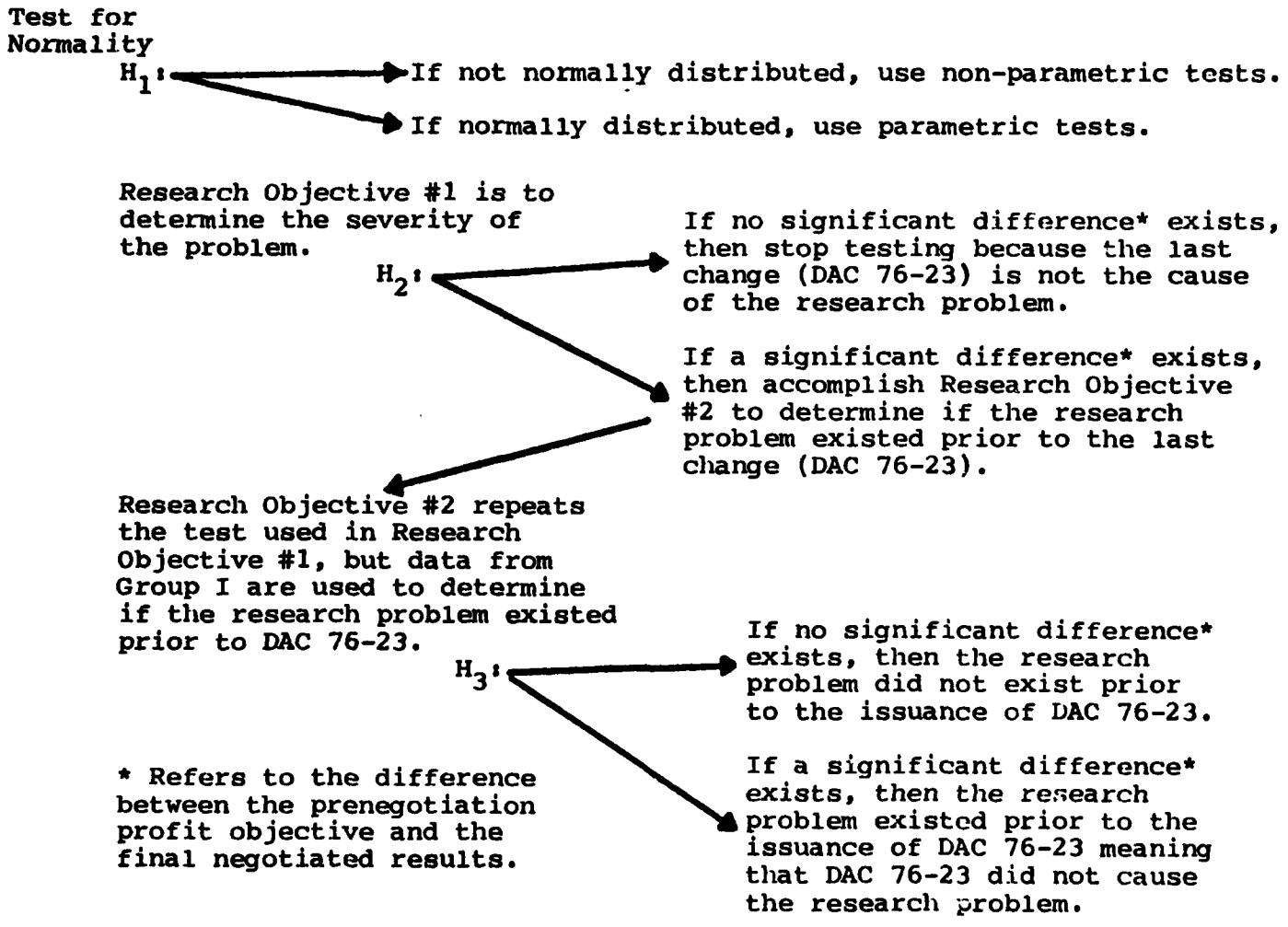


Fig. 2. Decision tree depicting the general research plan.

2. Any variables omitted in data collection and analysis had no significant impact on the research results.

3. There were no errors in the recording of the profit figures in the contract files.

4. Prenegotiation profit objectives were developed prior to the negotiation process.

Summary List of Limitations

1. Only one purchasing activity was studied.

2. The researchers studied only the differences between the prenegotiation profit objectives and the final negotiated profit results and not the effects that changes in profit would have on the total price of the contract.

3. Some aspects of data collection and analysis were limited by the researchers' experience.

4. Some variables may have been omitted from data collection and analysis.

5. Any political, economic, technological, and social influences beyond the control of the ASD Directorate of R&D Contracting were omitted from the research.

Summary

In summary, the ASD Directorate of R&D Contracting initiated a research project through the USAF Business Research Management Center to study the problem of the R&D weighted guidelines (WGL) method in use. The R&D WGL method was claimed to have produced low prenegotiation profit

objectives that were unattainable in today's marketplace. Therefore, this research project delved into the problem by examining the prenegotiation profit objectives produced under the present R&D WGL procedures and the final negotiated profit results to determine the severity of the problem. The research project was designed to identify shortcomings in the R&D WGL method which could have caused the problem.

To serve as a general framework for this research project, Chapter 2 provides a review of the history, policies, procedures, changes, and relevant literature pertaining to the DOD R&D WGL method of determining prenegotiation profit objectives.

CHAPTER 2

REVIEW OF LITERATURE

Introduction

Most studies on the Department of Defense (DOD) profit policy have occurred since the inception of the Armed Services Procurement Act of 1947. The Act consolidated the plethora of directives, statutes, and regulations that had previously governed the acquisition process into one manageable package (1:29). To implement the Act, DOD established the Armed Services Procurement Regulation (ASPR), now called the Defense Acquisition Regulation (DAR). The DOD profit policy, although rooted in the original ASPR, has been gradually revised and refined by an evolution of policy changes. Therefore, a model of the acquisition policy process will serve as a framework for this literature review.

The model, developed by Gerald A. Klopp, shows how DOD acquisition policies, such as profit objectives, are developed and implemented through a feedback control system (6:Ch.II). After discussing the acquisition policy model, a review of significant studies and policy changes shows how DOD profit policy has evolved to that currently used by Research and Development (R & D) contracting officers.

Acquisition Policy Model

The acquisition policy model has four stages: goals (external and internal), policy, implementation plan, and implementation. Each stage is the result of the integration of three attributes: inputs, feedback, and output (see Figure 3). The output of one stage becomes the input to the next, while the feedback provides the impetus for changes throughout the system.

> Thus, policy, for example, incorporates various goals which are external to the organization, feedback from other parts of the process, and various organizational or internal goals (e.g., directives and higher policy)[6:5].

Each circle represents the integration of all inputs that formulate the resulting output for each stage. The following explanation of each stage of the policy model shows how the process works.

External Goals

Although the original source of external goals was the Armed Services Procurement Act of 1947, there are various other sources of external goals. Some sources are:

1. Proposed legislation, Congressional committee hearings, and other indications of Congressional interest;

2. General Accounting Office (GAO) reports, opinions, and decisions;

3. Decisions by courts and boards (e.g., the Armed Services Board of Contract Appeals), particularly those which point up ambiguities in existing regulations;

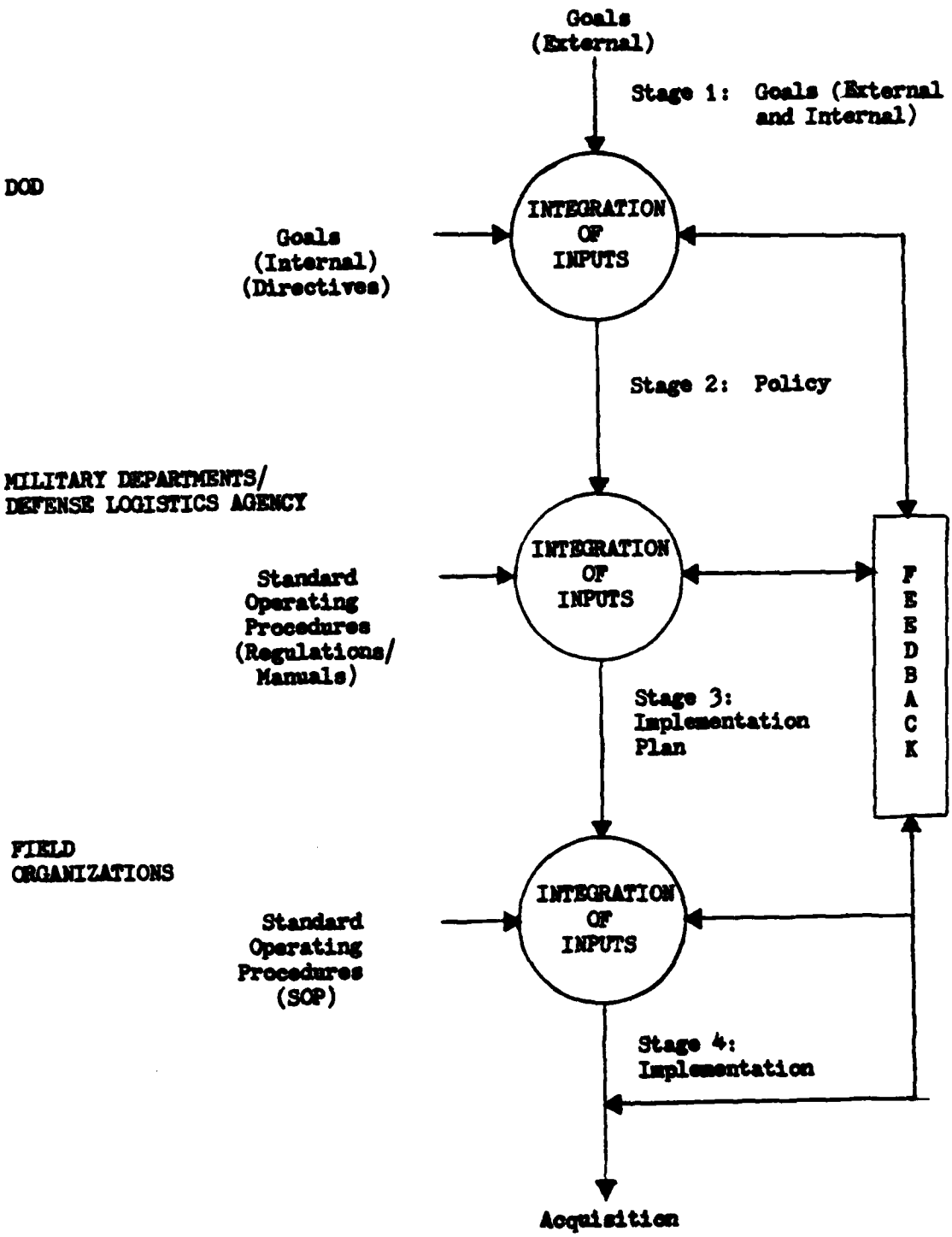


Fig. 3. Acquisition policy model.

4. Executive orders and other statements of national policy, such as those dealing with "Buy American" and "Equal Employment Opportunity";

5. Regulations issued by other agencies, which have an impact on procurement, such as Labor Department determinations with respect to wages and workman's compensation [2:3-4].

In addition to external goals, the internal goals are necessary to insure that DOD policies are in line with overall national policy.

Internal Goals

The internal goals originate from within the DOD organization itself starting, of course, with the Secretary of Defense. The Secretary of Defense issues directives with procurement implications necessary to carry out the objectives of the DOD (2:3). A current example of internal goal inputs are the initiatives of the Assistant Secretary of Defense Frank A. Carlucci to improve the systems acquisition process (13:51). Of course, any internal goal input should be developed in consideration of the external goals already established (6:7).

Feedback

Feedback is the third input into the acquisition process and comes from various sources within the procurement community (Figure 3).

Deficiencies in the regulations which are noted by contracting officers, contractors, or other users . . . [are] called to the attention of those responsible for maintaining the regulations [2:3].

The feedback is also used to monitor compliance with directives and implementation of policies.

One technique used to collect feedback information is the DD Form 1499--Report of Individual Contract Profit Plan--used to report data on all contracts over $500,000 (6:8). Other feedback information comes from internal reviews, such as GAO audits of contract files, studies (solicited and unsolicited by DOD), and inputs from the field organizations within each military service. The feedback loop helps DOD monitor how well acquisition policies are being implemented.

Formulation of Policy

The three circles in the model (Figure 3) represent three levels of policy formulation: DOD, military departments/Defense Logistics Agency, and field organizations. Each circle integrates the three sources of inputs--external goals, internal goals, and feedback--into the policy-making process.

The highest level of integration is accomplished by the Defense Acquisition Regulation (DAR) Council. The output is the formulation of DOD acquisition policy or, in the case of this research project, DOD profit policy. The DAR Council has the "primary function of establishing and promulgating policies and procedures in the ASPR [DAR] and keeping it up to date [2:7]." The DAR provides direction

and guidance for complying with other pertinent statutes and executive orders as well as areas not covered by statute (2:7). Each military service and field organization has its own regulations and policy directives that interpret and supplement higher policy directives but cannot restrict or change the policies of the DAR (6:8).

> DOD's policy, insofar as developing procurement policy is concerned, is to provide reasonable guidance to contracting personnel, allow sufficient flexibility in the regulations to accommodate a variety of procurement situations, and avoid minutiae which would unnecessarily restrict the judgment of contracting personnel [2:4].

The resulting policy from the DAR becomes the input to the next stage of the acquisition model--implementation plan.

Implementation Plan

The output of the second stage of the model is the implementation plan. As mentioned, policy starts with DOD but flows down to each military service and field organization. The regulations, policy directives, specific goals, and circumstances within each organization become Standard Operating Procedures (SOP) which are used internally within the organization to implement acquisition policy (6:8). As in the previous stage (policy), the feedback mechanism provides an information input, combined with the organizational structure and internal policies, that culminates into the implementation plan. The implementation plan is the organization's plan to carry out the policies in the DAR (6:8-9).

To insure conformity of policy implementation, the plan stipulates the use of such things as military specifications, military standards, and standard contract clauses (6:9). The implementation plan becomes the input to the next stage of the acquisition policy model, the actual implementation of the plan (Figure 3).

Implementation

The implementation is performed by the buying activity and includes the contracting officer's immediate organization. As described in previous stages, the inputs include the implementation plan, the Standard Operating Procedures (SOP), and feedback. The SOP is a guideline to the contracting officer that describes the specific goals, directives, and policies to use in performing the contracting job (6:9). Feedback includes audits from higher headquarters, GAO reports, and feedback from contractors. The contracting officer uses a team of experts to analyze price, cost, and technical proposals and, within the framework of the acquisition policy process, determines the profit objectives and awards contracts.

"It is important to note that this model is a dynamic model, changing as circumstances [or perception of circumstances] change [6:9]." When attention is drawn to a difference between the expected outcome and the actual implementation of DOD profit policy, changes to the policy are

often made. However, such policy changes develop slowly, resulting in a time lag (6:11). The result of the acquisition process is a series of evolutionary changes that over time self-correct problems in the acquisition process (6:10).

The acquisition policy model can be viewed from two vantage points for this research project. First, the model explains the evolutionary changes that have occurred in DOD profit policy since 1947. To understand how the present DOD profit policy developed, a description of the evolutionary phases is provided in the next section of this chapter.

Second, the acquisition policy model can help identify where a breakdown in policy occurs, i.e., when the results of the implementation is different than expected. The source of a policy problem must be identified to determine if the problem occurred in policy making, implementation planning, or the actual implementation. In this study, the problem statement formulated in Chapter 1 was researched at the implementation level to determine the severity of the perceived problem and to determine if the problem existed within a field organization. To serve as a foundation for this research project, the evolution of DOD profit policy to the present is described in the next section.

Evolution of DOD Profit Policy

Armed Services Procurement Regulation--1947

A key objective of the DOD profit policy is to reduce the cost of defense preparedness by incentivizing

> defense contractors' investment in modern cost-reducing facilities and other improvements in efficiency [22: 3-808.8(a)(1)].

This statement taken from the current Defense Acquisition Regulation (DAR) is similar to a statement of the Armed Services Procurement Regulation (ASPR) in 1947.

> The Department of Defense must apply contracting policies and methods designed to create an environment in which industry can realize profits on defense business which are high enough to give reasonable assurance of long term availability to DOD industrial support by the best companies and to enable those defense contractors to attract sufficient equity and borrowed capital [11:3].

As indicated in the above DAR/ASPR sections, the objectives of DOD profit policy have remained essentially the same since 1947, but the methods used by contracting officers to implement DOD profit policy have changed. The weighted guidelines (WGL) method was introduced in 1964 but was revised in 1972, 1976, and 1980 (Figure 4). Although the emphasis today is on "incentivizing defense contractors' investment," as stated in DAR 3-808.8, this was not considered a problem in 1964 (1:34).

Prior to 1964, contractor's investment was one of nine profit policy factors (1:30): effect of competition, degree of risk, nature of work to be performed, extent of Government assistance, extent of contractor's investments, character of contractor's business, contractor performances, subcontracting, and unrealistic estimates. However, the ASPR did not give any guidance to Government contracting

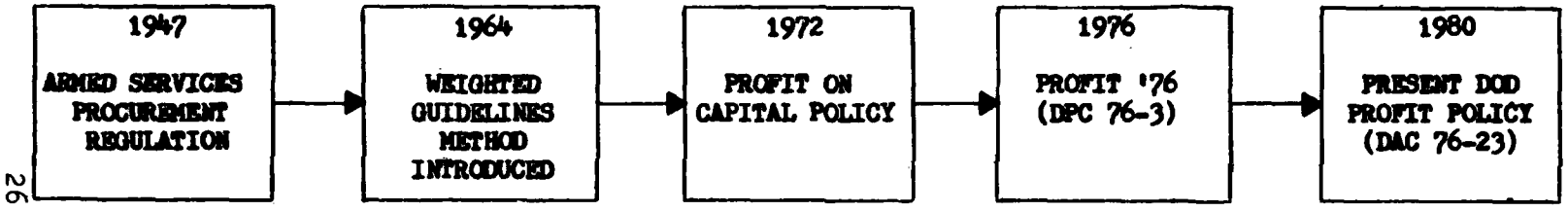


Fig. 4. Evolution of DOD profit policy.

officers on the specific relationships among the nine profit factors (1:30). The predominant factor used by contracting officers to determine profit was the established "historical rate" which had been used on previous contracts (8:44). The contracting officers only used the nine profit factors to adjust for specific procurement situations (8:44).

Weighted Guidelines Introduced--1964

The study that led to the WGL approach was conducted by the Logistics Management Institute (LMI) in 1963. On the issue of contractors' investment, LMI found that Government contracting officers did not use the investment to determine profit (8:31). However, contractors' investment was a factor used for source selection. LMI concluded that the plentiful number of contractors competing for defense contracts indicated that there was not any problem in attracting capital to defense business (8:59). Therefore, LMI did not feel that contractors' investment required any more emphasis than in the past. The WGL approach used the aforementioned nine profit factors and also utilized an analytical method to arrive at appropriate profit ratios (8:62). Appendix B describes LMI's WGL proposal which was incorporated into the ASPR.

In 1967, LMI found that their earlier conclusions were incorrect. The 1967 study showed that the WGL method had a negative investment incentive for contractors (1:34).

Since profits were a direct result of cost, there was no real incentive for the employment of new technology for cost reduction. Further LMI studies in 1969 and 1970 concluded that the same incentive deficiencies remained (11:6).

Profit on Capital Policy--1972

DOD profit policy was modified in 1972 and called "Profit on Capital Policy" (1:36). The negotiated profit objectives under "Profit on Capital Policy" were based half on cost and the other half on risk and investment (11:6). However, the policy never worked, because the policy was implemented on a voluntary basis and found to be too complex (3:45).

Profit '76 (DPC 76-3)--1976

The current system of determining profit objectives is based on a study called "Profit '76." The "Profit '76" study group was formed by the Assistant Secretary of Defense for Installations (OASD, I&L), William P. Clements and headed by Brigadier General James W. Stansberry (20:iii). "The goal was to develop policy revisions needed to motivate defense contractors to make investments which would reduce Defense Department acquisition costs [9:11]." There was a need to conduct an in-depth study to determine contractors' profitability in both defense and non-defense industries, to analyze earnings and capital investments, and to analyze motivations leading to investments designed to increase

productivity and lower costs. From these studies, DOD hoped to develop profit objectives to stop the apparent erosion of the defense industrial base.

Profit was analyzed several different ways. When profitability was based on a return on sales (ROS), the defense industry showed a rate of 4.7 percent, while commercial business showed a rate of 6.7 percent (Figure 5). However, when measured on a return on investment (ROI) basis, profit for defense contractors was slightly higher than the profit for commercial firms (Figure 6). The defense industry had a 13.5 percent ROI, while the comparable commercial industry had only 10.7 percent ROI (Figure 6). DOD believed that there was a correlation between the relatively low profit on sales and the low level of investment.

The "Profit '76" study group identified several reasons why defense contractors were reluctant to invest in modern machinery and equipment. Much was blamed on the DOD procurement policy that failed to recognize the contractor's cost of facility investment that is required for efficient operations as an allowable cost or profit factor (20:ix). The feedback from "Profit '76" was an input to the acquisition policy process described in Figure 1 and became the basis for Defense Procurement Circular (DPC) 76-3 (now called Defense Acquisition Circular (DAC)) (1:4).

DPC 76-3 made two major changes to DOD profit policy. The first change allowed the level of facility investment to

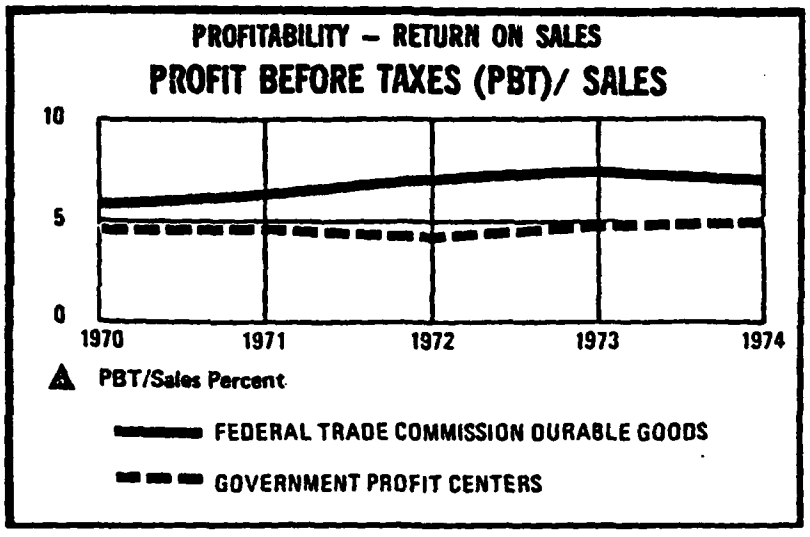


Fig. 5. Profitability - return on sales (ROS)(3:Fig. 2).

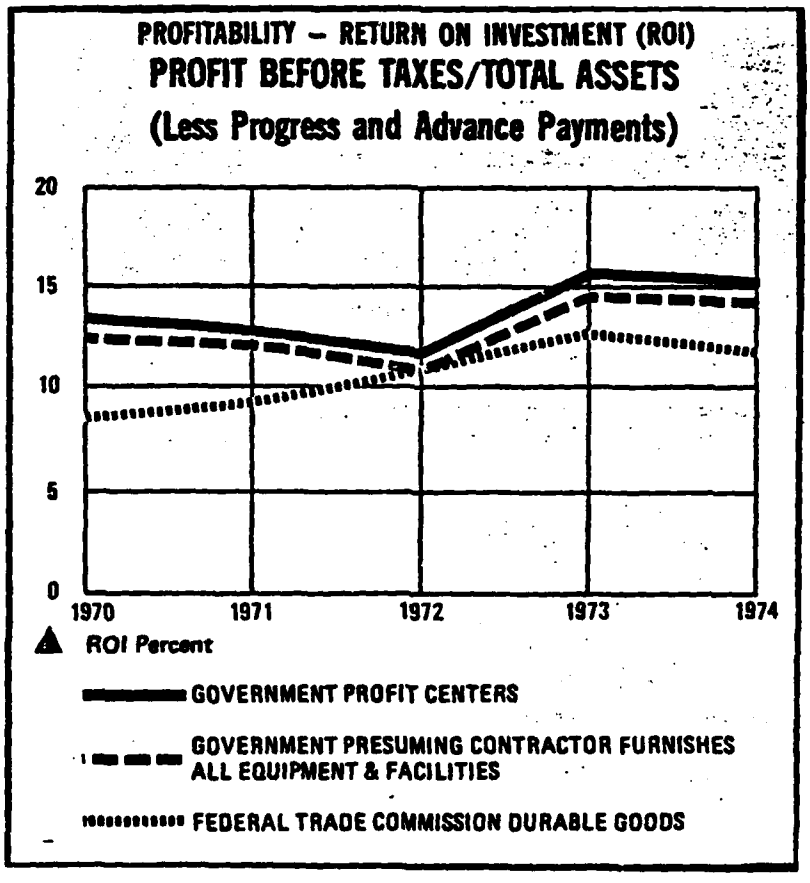


Fig. 6. Profitability - return on investment (ROI)(3:Fig. 1).

be recognized by the Government contracting officer in reaching a prenegotiation profit objective (20:ix). The relative weight of facility investment was set at a modest range of 6-10 percent, but plans were to increase the weight in the future after industry had adjusted its investment patterns (20:ix). The second change in DPC 76-3 permitted the imputed interest cost of the contractor's facility capital investment, as measured in accordance with Cost Accounting Standard (CAS) 414, as an allowable cost on most negotiated DOD contracts (20:ix). Procedures were established for the Government contracting officer to develop a prenegotiation profit objective to offset the average cost increase attributed to the imputed cost of facilities capital (20:x). The DD Form 1547, Weighted Guidelines Profit/Fee Objective, was revised to incorporate DPC 76-3 changes (see Appendix B).

The new WGL policy promulgated by DPC 76-3 was not a panacea for the defense industry's problems. Jacque S. Gansler in 1977 stated that the

> DOD has taken some steps in the right direction. . . . However, the fluctuating defense market (representing high risk) and the existing heavy debt structure of defense contractors . . . are discouraging to industrial decision makers when they consider long-term capital investment [4:113].

As a follow-up to analyze the effects of DPC 76-3, two studies in 1979 recommended additional changes in DOD profit policy to motivate contractors to invest in facilities (5:10).

The first of the two studies was by the General Accounting Office (GAO). The GAO study findings were:

1. The new profit policy has, contrary to intent, resulted in higher profits overall.

2. These higher profits were not offset by lower costs to the Government.

3. No additional contractor plan and equipment investments have resulted from the new policy (based on interview data).

4. The interest (cost of money) allowed as a cost has not been fully offset from profit [5:11].

The second study was conducted by DOD in comparing fiscal-year data from the DD Form 1499--Report of Individual Contract Profit Plan--used on negotiated contracts over $500,000. The findings of DOD were somewhat divergent in some areas. The DOD findings are compared to the GAO study as follows:

1. DOD found that the overall level of profit had increased slightly.

2. DOD did not present any finding on the evidence of increased production efficiency or lower costs.

3. DOD was unable to develop any trend information on the rate of contractor investment due to the revised profit policy.

4. DOD found that the offset of Cost Accounting Standard (CAS) 414 had been achieved [5:11-12].

Although somewhat divergent in the study findings, both GAO and DOD recommended additional changes to keep DOD profit policy targeted toward the original goals of increased contractor investment in cost-reducing facilities.

In 1978, the Office of Federal Procurement Policy

(OFPP) commissioned LMI to develop a uniform profit policy ". . . unconstrained both in terms of previous policy and practice throughout the Federal Government and in terms of budgeting impact of the recommended policy [23:I-3]." The 1978 LMI study recommended

> 1. Profit on service contracts, e.g., R&D studies, architectural-engineering, and other professional services should be based on the cost of the contract.
>
> 2. Profit on manufacturing and construction contracts should be a hybrid approach based on both capital (facilities and operating) and cost of performance. In the model, capital investment/cost would use a 70/30 percent ratio.
>
> 3. Profit rates should be updated to relate to commercial profits. LMI established initial profit rates based on their findings of the commercial sector and established procedures for determination of future profit rates [23:x-xii].

DOD felt that the profit rates recommended by LMI were too low compared to the commercial sector. DOD's rationale was that higher profit levels are required to offset unallowable costs such as advertising, interest, and contributions (24:I-2 to I-3). Responding to DOD's criticisms, LMI published an addendum report in November 1979 that revised ". . . proposed policy in the light of current government practices and existing policies that cannot, for the present, be changed. . . [24:I-3]." In the new report, LMI revised the profit recommendations upward to maintain current profit levels rather than base profit on commercial sectors as LMI had recommended in the 1978 study.

Weaknesses in the DPC 76-3 policy were outlined by

Major Grady Jacobs, Chairman of the Defense Department Contract Finance Committee:

> 1. The return on facilities investment is not adequate to be a positive motivation for contractors to increase their facilities investment.
>
> 2. Policy guidance for assigning weight to the contract cost risk factor is not sufficient.
>
> 3. There are too many exemptions to a manufacturing oriented profit policy.
>
> 4. The relationship between R&D and service contract profit levels is not desirable [1:42].

The weaknesses in DPC 76-3 led to significant modifications to DOD profit policy via Defense Acquisition Circular (DAC) 76-23.

Present DOD Profit Policy (DAC 76-23)--1980

Because of the weaknesses enumerated above for DOD profit policy outlined in DPC 76-3, DOD issued DAC 76-23 in February 1980 (see Appendix B). The facilities investment on the WGL form increased from 6-10 percent to the higher range of 16-20 percent. However, the change applies only to contracts for manufacturing and not to Research and Development (R&D) or services contracts. The new profit policy also gave more definitive guidance on the contractor risk factor as to type of contract. The third change gave R&D and services a profit policy separate from manufacturing. DAC 76-23 recognized that labor-intensive R&D and services contracts required relatively few facilities for contract performance, and hence no significant productivity gains

would be realized by increasing facilities investment. Therefore, in DAC 76-23 the R&D

> . . . weighted guidelines is essentially the same as the policy which existed prior to DPC 76-3 and should result in profit objectives similar to those arrived at under that policy [21:3].

With DAC 76-23 incorporated into the Defense Acquisition Regulation (DAR), the present DOD profit policy is found in DAR 3-808.

Summary

The acquisition policy model described in this chapter facilitates understanding of how DOD profit policy is the result of the integration of external and internal goals with feedback from many sources. Through a process of evolution, the acquisition policy process has continued to refine the DOD profit policy to its present state. The acquisition policy model was utilized for two reasons. First, the model facilitated understanding of the evolutionary changes that have taken place in DOD profit policy since 1947. Second, the policy model demonstrated the various stages--from policy formulation to implementation--where a possible breakdown in the policy process may be the cause of the research problem stated in Chapter 1.

After the Armed Services Procurement Act of 1947, the Armed Services Procurement Regulation (ASPR) provided the Government contracting officer with nine factors to use in determining a prenegotiation profit objective. However,

the Government contracting officers relied more on the "historical rate" used on previous contracts with a contractor, as the ASPR did not provide specific guidance for using the nine factors. In 1964, DOD adopted the recommendations of a Logistics Management Institute (LMI) study that weighted guidelines (WGL) be used to determine profits as a percent of cost with various weight ranges for different cost factors.

With erosion of the defense industrial base in the early 1970s, DOD attempted to recognize and measure facilities and operating capital on a contract and consider capital in determining profit objectives. However, not until the "Profit '76" study and subsequent DPC 76-3 change to the ASPR, were significant modifications made to the WGL profit policy. DPC 76-3 recognized facilities capital partly as an allowable cost by CAS 414 and partly as profit. Also, less emphasis was placed on the cost of the contractor's effort, and more emphasis was given to contract cost risk and facilities investment.

In 1980, further refinement by DAC 76-23 reaffirmed the need to stimulate capital investment and give higher profit on invested capital, but only for manufacturing type contracts. R&D as well as services type contracts were distinguished from manufacturing type contracts and divided into their own separate profit policies. The resulting profit policy for R&D type contracts after DAC 76-23 was

essentially a return to the DOD profit policy that existed prior to DPC 76-3.

After tracing the evolution of DOD profit policy, the research problem was examined in the context of R&D procurement as explained in Chapter 1. Chapter 3 presents the overall research methodology used to study the research problem, including the specific research hypotheses and procedures used to test the hypotheses.

CHAPTER 3

RESEARCH METHODOLOGY

Introduction

The previous chapters provided an introduction to the research problem (i.e., the weighted guidelines (WGL) method of developing prenegotiation profit objectives), how and why the Department of Defense (DOD) uses the WGL method, and background on the subject. Chapter 2 presented a review of the relevant literature pertaining to the WGL method. The literature review discussed the history and development of the WGL method, reviewed the current policies and procedures, and described in detail the changes to the WGL method which were the main interest of this research project.

This chapter describes the universe and population of interest for the research, operationally defines the data, discusses the sampling plan, explains how the sample size was determined, and describes the pilot study undertaken before the statistical tests were accomplished. In addition, Chapter 3 presents in detail the specific research objectives and the hypothesis tests used in the research.

The Universe

The universe for this research project was all R&D contracts which used the Department of Defense WGL method of

determining prenegotiation profit objectives. The population of interest from the above universe is described below.

The Population

Since the WGL procedures apply only to certain negotiated contracts, criteria were established to exclude any contracts that were not in the population of interest. This research study included only definitive, R&D contracts negotiated through the Directorate of R&D Contracting at ASD, which used the WGL procedures under DPC 76-3 or DAC 76-23. Contract actions excluded from the authors' study were those for non-R&D effort, contract actions in support of R&D, contract modifications, orders under basic ordering agreements, and negotiated contracts which did not use either the DPC 76-3 or DAC 76-23 WGL method. The above criteria sufficiently defined the population of interest such that statistical sampling techniques and tests could be used to make valid inferences about the population (19:78).

Since the goal of the researchers was to make inferences about the population, the sampling plan and the statistical tests employed were carefully constructed to ensure the validity of any inferences made (19:78). Further, the data were collected as objectively as possible to avoid bias in the research. Therefore, the data were carefully defined as described below well ahead of the actual data collection process.

Data Definition

The data for this research project consisted of the prenegotiation profit objective percentages, final negotiated profit percentages, and the differences between the prenegotiation profit percentage and the final negotiated profit percentage for each contract sampled. All data collected came from a random sample of negotiated, definitive contracts from the Directorate of R&D Contracting at ASD. The data were collected from official contract files. Specifically, the data for this research were taken from the weighted guidelines forms, DD Forms 1547(Appendix B contains samples of the forms along with a comparative example showing the differences in the two WGL methods involved in this project). The final negotiated profit percentages were taken from the "Record of Contract Action"[3] for each contract sampled. The researchers gathered cost and profit figures expressed in dollars and converted the dollar figures into percentages using the following formula (an example using the formula appears in Appendix C).

$$\text{profit percentage} = \frac{\text{profit}}{\text{contract cost - FCCM}}$$

[3]The "Record of Contract Action" is a document which contains a summary of all actions under a contract including the details of the negotiations.

The Facilities Capital Cost of Money (FCCM) is an imputed cost allowable in Government contracts under Cost Accounting Standard 414 (1:41). The FCCM represents the cost of capital based on a rate established by the United States Treasury. Since the FCCM is an allowable cost, profit was determined exclusive of the FCCM in this research project. Therefore, profit percentage calculations excluded the FCCM from the cost base.

Sampling Plan

A random sample of negotiated, definitive R&D contracts was taken for this research project. A computer listing of R&D contracts was provided to the researchers by ASD's Directorate of R&D Contracting. The computer listing included the contract number, buyer's name, contract type, and the contracting branch responsible for the contract.

For this study, the first step was to divide the R&D contracts into two groups to capture the effects of the last two changes to weighted guidelines policy (see Figure 1). Group I consisted of contracts negotiated under DPC 76-3 procedures. Group I contracts roughly correspond to fiscal years 1977 to 1980. Group II contracts were those negotiated under DAC 76-23 procedures. Group II approximately encompassed fiscal years 1980 to the present (see Figure 1).

Once the R&D contracts were roughly divided into the

appropriate group based on the fiscal year the contracts were awarded, each contract on the computer listing was numbered sequentially. Then, a Texas Instruments 58C hand calculator was used to generate a series of random numbers corresponding to the sequence numbers assigned to individual contracts. This random number assignment method was necessary since the contract numbers were coded to reflect the contract branch responsible for particular contracts. The random number assignment procedure utilized in this research ensured that the sample was random and had internal validity for making generalizations about the population of interest (19:79).

Fiscal year 1980 contracts caused a minor problem because DAC 76-23 was issued in February 1980 (see Figure 1). Normally, a Defense Acquisition Circular (previously called Defense Procurement Circulars) has an adjustment period of 90 days in which the purchasing activities conform to the new policy. Therefore, some contracts appeared to belong in one group based on the fiscal year in which the contracts were awarded, but actually belonged in the other group based on the WGL method used in the negotiations. Any contract which appeared to belong to one group, but actually belonged to the other group was discarded from consideration. For example, if a contract was sampled as a Group II contract, but upon examination the contract was found to be a Group I contract, the contract was discarded from the sample.

The discarded contract was not placed into Group I. This procedure ensured that each contract had an equal chance of selection.

The main reasons for discarding a randomly selected contract were (1) the file contained classified information to which the researchers did not have access, (2) no weighted guidelines procedures were used for the contract, (3) the contract was sampled from the wrong group, (4) the contract was not available to the researchers because the contract had been physically transferred to another office for administrative review, and (5) the contract had some sort of problem which prevented the researchers from obtaining the necessary information. Contracts in this latter category were classified as "other" in the authors' study.

The Pilot Study

A pilot study was conducted to obtain a variance estimate for the R&D contract data for use in computing the appropriate sample size. The researchers determined that 20 randomly selected contracts from Group I and 20 contracts from Group II were necessary to calculate an estimate for the variance. Since the researchers expected that up to one-third of the R&D contracts could not be used based on the previously established sample selection criteria, 30 contracts from Group I and 30 contracts from Group II were initially selected to ensure that the 20 necessary

data points were obtained for both data groups.

A computer package called "The Statistical Package for the Social Sciences" (SPSS) was used to analyze the statistical data. This computer package generates a variety of statistics and statistical tests. The SPSS computed variance for the population of differences between prenegotiation profit objectives and final negotiated profits was then "plugged" into the sample size formula described in the next section. The formula indicated that 35 R&D contracts were needed in the sample to make the sample results valid and enable the researchers to generalize the sample results to the population of interest (see Appendix C).

The pilot study was a prerequisite to determining the proper sample size, because the proper sample size could not be computed until an estimate for the variance was obtained. The sample size formula was computed as shown in the next section.

Sample Size

The following formula was used for determining the proper sample size for this research project (14:231)(see Appendix C):

$$n = \frac{NZ^2s^2}{Nh^2 + Z^2s^2}$$

where:

n = sample size

N = the population size

Z = the Z statistic corresponding to a 99 percent level of confidence

s^2 = the estimate of the variance from the pilot study

h = the error tolerance level

The level of confidence and the error tolerance level were established at 99 percent and 1 percent respectively. Using a sample size computed from the above formula meant that the researchers were 99 percent confident that the true mean would be at least within plus or minus 1 percent of the mean estimated from the sample.

All of the variables were obtained from the computer listing provided by ASD or were determined by the level of significance or tolerance level chosen by the researchers except "s^2," the estimate of the variance. The pilot study was used to obtain an estimate of the variance.

Distribution of Data

Figures 7 through 9 depict the distribution of data items included in the research sample and pilot study compared to those items discarded from the sample and the pilot study, data items sampled by contract type, and data items sampled by fiscal year. Tables 1 through 3 provide the same

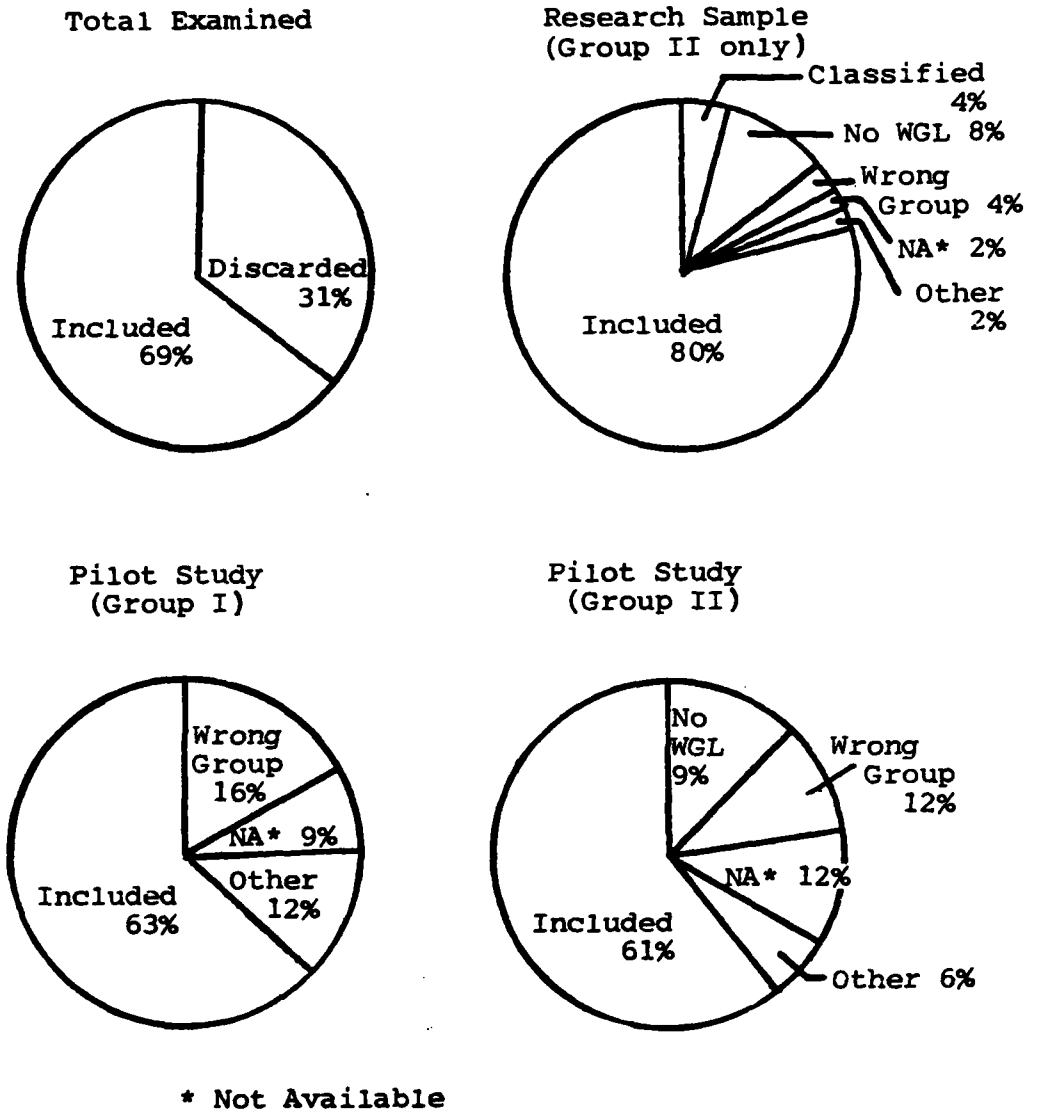
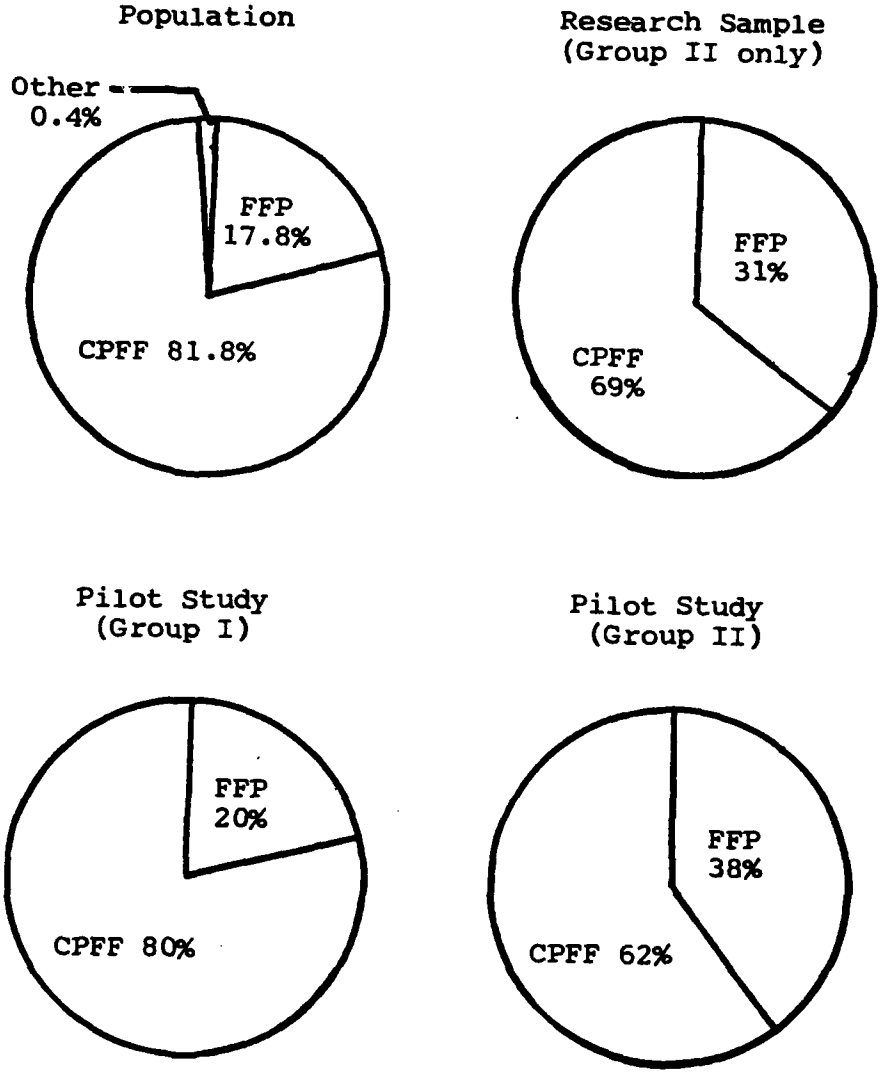


Fig. 7. Data items included in the research sample and pilot study compared to the data items discarded.



FFP = Firm Fixed Price

CPFF = Cost Plus Fixed Fee

Fig. 8. Data items sampled by contract type.

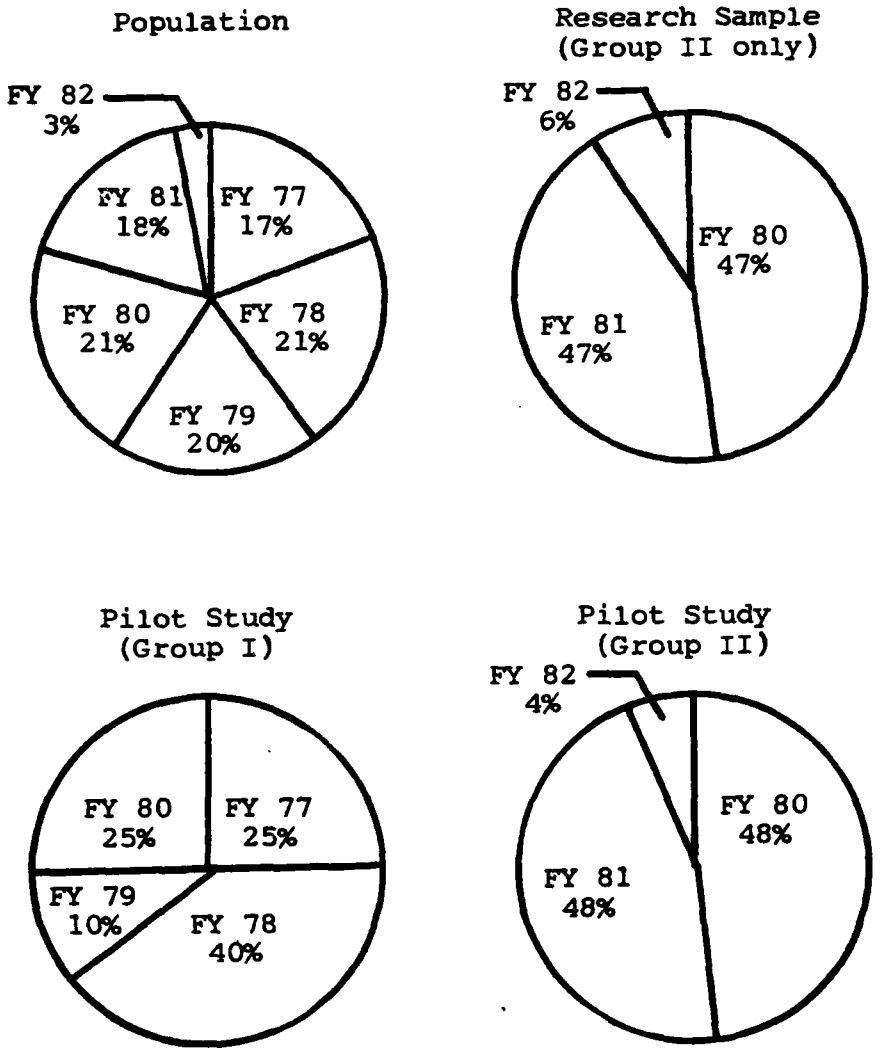


Fig. 9. Data items sampled by fiscal year.

TABLE 1

NUMBER OF DATA ITEMS SAMPLED
COMPARED TO THE DATA ITEMS DISCARDED

Reason	Pilot Study Group I	Pilot Study Group II	Research Sample Group II
Classified	0	0	2
No WGL	0	3	4
Wrong Group	5	4	2
Not Available	3	4	1
Other	4	2	1
Total Discarded	12	13	10
Total Included	20	21	36
Total Examined	32	34	46

TABLE 2

NUMBER OF DATA ITEMS SAMPLED
BY CONTRACT TYPE

Contract Type	Population	Pilot Study Group I	Pilot Study Group II	Research Sample Group II
FFP	409	4	8	11
CPFF	1882	16	13	25
Other	8	0	0	0
Total	2299	20	21	36

TABLE 3

NUMBER OF DATA ITEMS SAMPLED
BY FISCAL YEAR

Fiscal Year	Population	Pilot Study Group I	Pilot Study Group II	Research Sample Group II
1977	394	5	*	*
1978	474	8	*	*
1979	470	2	*	*
1980	484	5	10	17
1981	405	*	10	17
1982	72	*	1	2
Total	2299	20	21	36

*Not applicable

data but in terms of the number of data items instead of percentages.

Research Objectives

Two research objectives guided the authors' research study. The first research objective was to determine the severity of the perceived problem. The second research objective was to determine if the last change to WGL policy (i.e., DAC 76-23) caused the perceived research problem.

There were three research hypotheses formulated to address the stated research objectives. The first research hypothesis was a test of the population of differences between prenegotiation profit objectives and final negotiated profit percentages to determine if the population of differences was normally distributed. The other two research hypotheses used paired difference tests to determine if there was a significant difference between the prenegotiation profit objectives and the final negotiated profit results for Group I and then Group II data (see Figure 1).

Paired difference tests were used because the researchers expected a significant variability in prenegotiation profit objectives and negotiated profit levels for each R&D contract. In a paired difference test, observations are paired and the differences analyzed (10:269). The differencing process removes the variability based on the measurement values on which the observations are paired

(10:269). Therefore, contract-to-contract variability was removed by analyzing the differences between the prenegotiation profit objectives and the final negotiated profit for each contract sampled.

Paired difference tests assume that the population of differences is normally distributed and the sample is randomly selected. The researchers' sampling plan ensured that the research sample was randomly selected. Therefore, the first research hypothesis was used to determine if the population of differences was normally distributed.

Research Hypothesis #1

As mentioned above, this first research hypothesis was formulated to determine if the research sample was taken from a normal population. The specific research hypothesis is stated below (15:681-689).

H_o: The differences between the prenegotiation profit objectives and the final negotiated profits come from a normally distributed population with an unspecified mean and standard deviation.

H_1: The differences between the prenegotiation profit objectives and the final negotiated profits do not come from a normally distributed population with an unspecified mean and standard deviation.

Decision Rule: If T is greater than $W_{1-\alpha}$, reject H_o; otherwise fail to reject H_o.

Where:

T = The greatest absolute difference between the hypothesized cumulative distribution function and the sample cumulative distribution function.

$W_{1-\alpha}$ = A value determined from a table of critical values of the Lilliefors test statistic.

Assumptions:

1. The sample was a random sample.
2. The hypothesized cumulative distribution function was continuous.

This test for normality was accomplished to ensure that the population was normally distributed prior to addressing the two specific research objectives (Appendix D).

Research Objective #1

After the population of differences was determined to be normally distributed, parametric statistical tests were used to determine the severity of the perceived research problem. The prenegotiation profit objectives developed using the R&D WGL procedure under DAC 76-23 were compared to the final negotiated profits for each contract sampled in Group II (see Figure 1). If there was no difference between the prenegotiation profit objectives and the final negotiated profits, then one could conclude that the R&D WGL procedures under DAC 76-23 are adequate and provide profit levels that are determined by the R&D marketplace. The second research hypothesis was formulated to accomplish Research Objective #1. The structure for Research Hypothesis #2 is described in the succeeding section of this chapter.

Research Hypothesis #2

The statistical test utilized for Research Hypothesis #2 was a paired difference test between the prenegotiation profit objectives and the final negotiated profit results for Group II data (WGL procedures under DAC 76-23). The hypothesis is below (10:269-270)(see Appendix E):

H_o: Using the research and development weighted guidelines method in accordance with DAC 76-23, the prenegotiation profit objectives are the same as the final negotiated profit results.

H_2: Using the research and development weighted guidelines method in accordance with DAC 76-23, the final negotiated profit results are greater than the prenegotiation profit objectives.

Decision Rule: If $t^* > t$, then reject H_o; otherwise fail to reject H_o.

Where:

t^* = The SPSS calculated t statistic which was compared to the critical value from the t-distribution.

t = The critical value of the t-distribution bounding the rejection region.

Note: This is a one-tailed test. Therefore, only the t value on the right-hand side of the distribution was utilized in the statistical test.

The value of alpha chosen by the researchers was .05.

Assumptions:
1. The relative frequency distribution of the population of differences was normal.
2. The differences were randomly selected from the population of differences.

The researchers anticipated that the null hypothesis would be rejected. Rejecting the null (H_o) would mean that

there was a significant difference between the prenegotiation profit objectives and the final negotiated profit results for the R&D contracts using DAC 76-23 WGL procedures (Group II data). If a significant difference existed, then the researchers could conclude that the problem was as severe as claimed by ASD in the "Research Needs Statement" (see Appendix A). Further, rejection of the null hypothesis would imply that the WGL procedure under DAC 76-23 does not produce reasonable R&D profit objectives and that ASD has paid profits above the prenegotiation profit objectives for R&D contracts.

On the other hand, if the null hypothesis was not rejected, then the conclusion would be that insufficient evidence existed to conclude that a significant difference between prenegotiation profit objectives and final negotiated profits existed on R&D contracts. Not rejecting the null hypothesis would indicate that DAC 76-23 procedures accurately reflect the profits that would be determined by R&D market forces; DAC 76-23 procedures would then appear adequate in producing prenegotiation profit objectives for R&D contracts. If the null hypothesis for Research Hypothesis #2 was not rejected, then this research project would be terminated. In this instance, the perceived problem apparently would not exist under the current R&D WGL procedures. Whether the perceived problem existed prior to the latest change to WGL policy (i.e., DAC 76-23) would be of no

concern to the researchers, because any deficiencies which may have caused low prenegotiation profit objectives were probably corrected by the change in R&D WGL policy under DAC 76-23. Therefore, the second research objective would only be addressed if the null hypothesis of Research Objective #1 was rejected.

If the null hypothesis had been rejected, the researchers would have continued with Research Objective #2 via Research Hypothesis #3 to provide some further insight into the perceived problem area.

Research Objective #2

Research Objective #2 was to determine if the perceived problem with the R&D WGL method under DAC 76-23 existed prior to the issuance of DAC 76-23. The research plan to accomplish Research Objective #2 was to compare the prenegotiation profit objectives with the final negotiated profits for Group I data (see Figure 1). Group I represented the R&D contracts negotiated under DPC 76-3, the WGL policy prior to that promulgated under DAC 76-23.

Research Hypothesis #3

The statistical procedures utilized for evaluating Research Hypothesis #3 to address Research Objective #2 were identical to the statistical procedures developed for Research Hypothesis #2 (to address Research Objective #1). The paired difference test was used to determine if there

was a significant difference between the prenegotiation profit objectives and the final negotiated profit results. However, Group I data were used to evaluate Research Hypothesis #3. Using Group I data meant that if a difference was found then the research problem existed prior to the issuance of DAC 76-23, which would imply that DAC 76-23 would not have caused the perceived problem. The specific statistical procedures used for evaluating Research Hypothesis #3 are provided below (10:269-270)(see Appendix E):

H_o: Using the research and development weighted guidelines method in accordance with DPC 76-3, the prenegotiation profit objectives are the same as the final negotiated profit results.

H_3: Using the research and development weighted guidelines method in accordance with DPC 76-3, the final negotiated profit results are greater than the prenegotiation profit objectives.

Decision Rule: If $t^* > t$, then reject H_o; otherwise fail to reject H_o.

Where:

t^* = The SPSS calculated t statistic which was compared to the critical value from the t-distribution.

t = The critical value of the t-distribution bounding the rejection region.

Note: This is a one-tailed test. Therefore, only the t value on the right-hand side of the distribution was utilized in the statistical test.

The value of alpha chosen by the researchers was .05.

Assumptions: 1. The relative frequency distribution of the population of differences was normal.

2. The differences were randomly selected from the population of differences.

The researchers did not anticipate rejecting the null hypothesis. The expected conclusion would have been that there was insufficient evidence to state that a significant difference existed between prenegotiation profit objectives and final negotiated profit results. Not rejecting the null (H_o) would mean that the research problem did not exist prior to the issuance of DAC 76-23. This third hypothesis test would only be undertaken if Research Objective #1 (Research Hypothesis #2) indicated that there was a significant difference between the prenegotiation profit objectives and the final negotiated profits for Group II contracts (i.e., R&D contracts using DAC 76-23). The significance of not rejecting the null hypothesis for Research Hypothesis #3 was that one could conclude that the research problem did not exist prior to the issuance of DAC 76-23, and the perceived research problem most probably was caused by the DAC 76-23 WGL policy changes.

If the null hypothesis was rejected, then the conclusion would be that there was a significant difference, and the research problem existed prior to the issuance of DAC 76-23. In this case, DAC 76-23 may not have caused the perceived problem.

Summary

Chapter 3 presented the details of the research

objectives and the research hypothesis tests identified in the general research plan (refer to Chapter 1). Research Objective #1 was to determine the severity of the perceived research problem. Research Objective #2 was to determine if DAC 76-23 caused the perceived research problem. Research Hypothesis #1 was the Lilliefors test for normality and was utilized to address the two stated research objectives. Research Hypotheses #2 and #3 were paired difference tests of the difference between the prenegotiation profit objectives and the final negotiated profits for each individual R&D contract. Research Hypothesis #2 was evaluated with Group II data, while Research Hypothesis #3 was designed to use Group I data (see Figure 1).

This chapter provided the general framework for conducting the statistical tests. The next chapter follows with the results obtained from implementing the statistical tests.

CHAPTER 4

DATA ANALYSIS AND FINDINGS

Introduction

This chapter presents the data analysis and findings related to the three research hypotheses formulated in Chapter 3. The first section of this chapter describes the statistical findings relative to Research Hypothesis #1. The next section of the chapter addresses Research Hypothesis #2. The chapter concludes with a discussion of the fact that Research Hypothesis #3 was not evaluated in this research project because of the unanticipated results obtained in evaluating Research Hypothesis #2.

Research Hypothesis #1

This section presents the findings resulting from the analysis of the data concerning Research Hypothesis #1. Included in this section are a restatement of the research hypothesis, the method of data collection, and the results of the statistical test.

Restatement of Research Hypothesis #1

H_o: The differences between the prenegotiation profit objectives and the final negotiated profits come from a normally distributed population with an unspecified mean and standard deviation.

H_1: The differences between the prenegotiation profit objectives and the final negotiated profits do not come from a normally distributed population with an unspecified mean and standard deviation.

Data Collection

The data utilized to evaluate Research Hypothesis #1 were taken from the Group II data (refer to Figure 1). A sample size of 36 R&D contracts, that used the weighted guidelines method (WGL) under Defense Acquisition Circular (DAC) 76-23 procedures, was taken from Aeronautical Systems Division's (ASD) Directorate of R&D Contracting. The sample of 36 contracts from the population total of 961 R&D contracts provided at least a 99 percent level of confidence that the sample mean represented the true population mean (see Appendix C). The required sample size to obtain the 99 percent confidence level was 35 R&D contracts. The actual sample size in this research project was 36 R&D contracts, exceeding the required sample size to obtain the 99 percent confidence level by one contract.

Statistical Test Results

The Lilliefors test for normality was applied to the Group II data. The Lilliefors test was used to determine if the random sample possessed the shape of a normal distribution, where the population mean and standard deviation were unknown (see Appendix D).

The calculated test statistic T for the researchers'

sample was .0977. The $W_{1-\alpha}$ critical value for a .05 level of significance and a sample size of 36 is .1477. Since the calculated T value of .0977 was less than the critical $W_{1-\alpha}$ of .1477, the conclusion was to fail to reject H_o. Therefore, there was insufficient evidence to reject the sample as not coming from a normal distribution. By knowing that the sample distribution was normally distributed, the authors were able to use parametric statistics for evaluating subsequent research hypotheses.

Research Hypothesis #2

This section presents the findings resulting from the analysis of the data concerning Research Hypothesis #2 to determine if the final negotiated profit percentages exceeded the prenegotiation profit objective percentages since the enactment of Defense Acquisition Circular (DAC) 76-23. A restatement of the research hypothesis, the method of data collection, and the findings of the statistical tests are provided.

Restatement of Research Hypothesis #2

H_o: Using the research and development weighted guidelines method in accordance with DAC 76-23, the prenegotiation profit objectives are the same as the final negotiated profit results.

H_2: Using the research and development weighted guidelines method in accordance with DAC 76-23, the final negotiated profit results are greater than the prenegotiation profit objectives.

Data Collection

The data for evaluating Research Hypothesis #2 were taken from the Group II data (refer to Figure 1). A sample size of 36 R&D contracts was taken from the population of Aeronautical Systems Division's (ASD) Directorate of Research and Development (R&D) Contracting that used the weighted guidelines method under Defense Acquisition Circular (DAC) 76-23. The sample size of 36, from a population of 961 R&D contracts, provided at least a 99 percent level of confidence that the sample mean represented the true population mean (see Appendix C). The required sample size to obtain 99 percent confidence level was 35 R&D contracts. The actual sample size in this research project was 36 R&D contracts, exceeding the required sample size to obtain the 99 percent confidence level by one contract.

Statistical Test Results

Since Research Hypothesis #1 showed that there was insufficient evidence to reject the null hypothesis (i.e., the sample followed a normal distribution), parametric statistics were used for the primary statistical testing of Research Hypothesis #2. In addition, a nonparametric statistical test was used to lend credence to the parametric test results. The two statistical tests employed in evaluating Research Hypothesis #2 were the paired difference test (parametric), also called the matched pairs t-test, and the

Wilcoxon rank sum test (nonparametric).

The primary statistical test for Research Hypothesis #2 was the paired difference test (matched pairs t-test). The paired difference test involves pairing the sample observations and analyzing the differences between the prenegotiation profit objectives and the final negotiated profit results (see Appendix E). The calculated test statistic t*, as computed according to Appendix E, was 0.00. The critical t_{α,n_D-1} for a .05 level of significance and a sample size of 36 R&D contracts was 1.645. Since the calculated t* value of 0.00 was far less than the critical t_{α,n_D-1} of 1.645, the conclusion was to fail to reject H_o. There was insufficient evidence to reject the statement that using the Research and Development (R&D) weighted guidelines (WGL) method in accordance with Defense Acquisition Circular (DAC) 76-23 provided final negotiated profit results that were the same as the prenegotiation profit objectives. Since this research conclusion was unexpected by the researchers, a nonparametric statistical test was also used to lend credence to the parametric paired difference test results.

The additional nonparametric test employed to evaluate Research Hypothesis #2 was the Wilcoxon rank sum test (see Appendix F). The sum of the positive differences, T_A, was smaller than the sum of negative differences, T_B, giving

T* a value of 18.18. The T_o critical value for a .05 level of significance and a sample size of 36 was 228. Therefore, the calculated T* value of 18.18 was less than the critical $T_o(228)$, and the conclusion was to fail to reject H_o. There was insufficient evident to reject the statement that using the Research and Development (R&D) weighted guidelines (WGL) method in accordance with Defense Acquisition Circular (DAC) 76-23 provided prenegotiation profit objectives that were the same as the final negotiated profit results. The findings of the nonparametric rank sum test supported the findings of the parametric paired difference test.

Research Hypothesis #3

The Research Hypothesis #2 evaluation provided no evidence of a statistical difference between the prenegotiation profit objectives and final negotiated profit results for R&D contracts in Aeronautical Systems Division (ASD). Since the claim of the "Research Needs Statement" (Appendix A) was not confirmed by evaluating Research Hypothesis #2, the researchers had no reason to evaluate Research Hypothesis #3. Research Hypothesis #3 was designed to use the same foregoing statistical tests on Group I data, i.e., the weighted guidelines (WGL) procedures in accordance with Defense Procurement Circular (DPC) 76-3. Research Hypothesis #3 was designed to answer the question of whether or not the perceived research problem existed prior to the latest

change in DOD profit policy, Defense Acquisition Circular (DAC) 76-23. The findings of Research Hypothesis #3 would not have provided any additional insight into the stated research problem, since Research Hypothesis #2 evaluation concluded that the perceived problem did not exist for ASD R&D contracts.

Sample Data Observations

In collecting data to evaluate the aforementioned research hypotheses, additional information was gleaned from the research sample in several different categories, i.e., competitive, sole source, cost plus fixed fee (CPFF), and firm fixed price (FFP). A matrix of these sample characteristics is given in Table 4. It should be noted that the data in Table 4 should not be used to make inferences about the population from which the sample data were drawn. However, the data in Table 4 may provide some additional insight into the R&D contracts utilized in the research sample with respect to contract type and contracting methodology. Table 4 does support the overall research conclusion for the total sample of 36 contracts since the prenegotiation profit objectives were the same as the final negotiated profits at 8.8 percent.

Summary

The overall research methodology outlined in Chapter 3 was followed in the testing of Research Hypothesis #1 and

TABLE 4

MEAN PRENEGOTIATION AND FINAL NEGOTIATED PROFIT PERCENTAGES BY CONTRACT TYPE AND CONTRACTING METHODOLOGY

Contracting Methodology \ Contract Type	Cost Plus Fixed Fee (CPFF)	Firm Fixed Price (FFP)	Totals
Competitive	7.2% 7.9% (7)	12.2% 12.4% (2)	8.3% 8.9% (9)
Sole Source	7.6% 8.0% (18)	11.5% 10.2% (9)	8.9% 8.7% (27)
Totals	7.5% 8.0% (25)	11.7% 10.6% (11)	8.8% 8.8% (36)

Notes:

1. The number in parentheses for each block represents the number of contracts in the sample taken from that category.

2. The two percentages in each block represent the mean prenegotiation and final negotiated profit percentages, respectively, taken from that category in the sample.

3. The data represent the results of the 36 sampled R&D contracts using weighted guidelines in accordance with Defense Acquisition Circular 76-23, January 1980.

4. The "Totals" show the total number of R&D contracts for each category and the overall mean percentages for the contracts in that category.

Research Hypothesis #2. Testing of Research Hypothesis #3 was not necessary due to the results obtained from evaluating Research Hypothesis #2.

Research Hypothesis #1 was employed to determine if the population of differences between the prenegotiation profit objectives and the final negotiated profit percentages was normally distributed. Since the population of differences followed a normal distribution, the stronger parametric statistical test was used for evaluating Research Hypothesis #2. In addition, a nonparametric statistical test supported the conclusions made from the parametric testing procedure. To verify the perceived problem identified in the "Research Needs Statement" (Appendix A), Research Hypothesis #2 was tested to demonstrate that the final negotiated profit percentages exceeded the prenegotiation profit percentages on R&D contracts using the WGL procedures of DAC 76-23, i.e., the present method of computing DOD prenegotiation profit objectives. The results from evaluating Research Hypothesis #2 provided evidence that no statistical difference existed between the prenegotiation profit objectives and the final negotiated profit percentages. Both the parametric statistical test and the nonparametric statistical test confirmed the same research results.

The conclusions and recommendations relative to these research findings are presented in the following chapter.

CHAPTER 5

SUMMARY, IMPLICATIONS, AND RECOMMENDATIONS

Introduction

The previous chapters provided the introduction and background on the research problem, a literature review, a detailed description of the research methodology, and the research findings. This chapter presents a summary of the research methodology and findings, the implications of those research findings, and recommendations for future research.

This research project examined the current R&D WGL procedures and determined if those WGL procedures produced prenegotiation profit objectives that were too low for the present R&D marketplace. This research project discovered that no significant difference existed between the prenegotiation profit objectives and the final negotiated profit results when DAC 76-23 R&D WGL procedures were employed. This research result implied that current WGL procedures were adequate and did reflect current market-determined profit rates for ASD R&D contracts. A summary of the research methodology and findings is provided in the next section.

Summary of Research Methodology and Findings

The research methodology consisted of two research

objectives which were to be accomplished by evaluating three research hypotheses. Research Hypothesis #1 was a simple test of normality for the distribution of differences between the prenegotiation profit objectives and the final negotiated profit results. Using a Lilliefors test for normality, the statistical test showed that the population of differences was normally distributed (see Appendix D). This Lilliefors test fulfilled one of the two assumptions[4] necessary for the paired difference tests used for evaluating subsequent research hypotheses.

The researchers used paired difference tests to determine the variability of profit percentages between prenegotiation profit objectives and final negotiated profit results for R&D contracts. In these difference tests, one pairs the observations and analyzes the differences (10:270). The researchers collected the sample data by obtaining the prenegotiation profit objectives and the final negotiated profit results for each individual R&D contract. The differences between the prenegotiation profit objectives and the final negotiated profits on each R&D contract became the sample observations which represented the population of differences analyzed in this research.

Research Objective #1 was to determine the severity

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[4]The other assumption was that the sample observations were randomly selected from the population of differences (10:270).

of the perceived research problem. Research Hypothesis #2 was used to accomplish Research Objective #1. The "Research Needs Statement" (see Appendix A) indicated that the average difference between the prenegotiation profit objectives and the final negotiated profits could be as high as 2.4 percent (i.e., average final negotiated profits that were 2.4 percent greater than the average prenegotiation profit objectives). The actual empirical results from the research sample found the mean difference to be -.0011 percent. In other words, this research project found that the average final negotiated profit results for the R&D contracts were actually slightly lower than the prenegotiation profit objectives.

The above research results were not anticipated. The contracting personnel interviewed, when the researchers first began this research project, hypothesized that the current WGL method (under DAC 76-23) produces low prenegotiation profit objectives causing a significant difference between the prenegotiation profit objectives and the final negotiated profit results. The researchers shared that expectation based upon their past experience with DAC 76-23 WGL procedures.

The first indication that the actual research results may be contrary to original expectations occurred in the pilot study. The pilot study indicated that there was insufficient evidence to conclude that a significant difference

between the prenegotiation profit objectives and the final negotiated profit results existed in either Group I (DPC 76-3) or Group II (DAC 76-23) data (see Figure 1). The researchers expected no significant difference in Group I data, since the WGL changes created by DAC 76-23 were thought to have caused the research problem. The change under DAC 76-23 allowed 100 percent of the profit dollars from the "Contractor's Effort" section of the WGL form (see Appendix B for an example of WGL forms). However, the Facilities Capital Cost of Money (FCCM) was also subtracted from the total profit objective (1:41). The researchers anticipated that the subtraction more than offset the additional profit dollars gained by the deletion of the .7 deflation factor previously applied to the "Contractor's Effort" section of the WGL form. Therefore, the researchers expected there to be a significant difference between the prenegotiation profit objectives and the final negotiated profits for Group II contracts. However, insufficient evidence existed in the pilot study to state that such a difference was present.

Moreover, the Group II pilot study data were questionable, because the pilot study contained what, in retrospect, could be called an "outlier." There was one firm-fixed price contract which had a prenegotiation profit objective of 15.5956 percent, a final negotiated profit of 6.0004 percent, and a difference between the two profit figures of

-9.5952 percent. This large negative difference was felt to have significantly skewed the data for the pilot study.

In addition, each contract file and supporting documentation reflected the individual buyer's style. Many variations existed in reporting the results of the negotiation process. Therefore, the researchers modified slightly the planned data collection process based on the pilot study results.

For the pilot study, each of the two researchers sampled contracts from only one of the two data groups. Since the Group II pilot study data were somewhat suspect, the researchers decided to alter that scheme by collecting the research sample data from each group as a team. Therefore, the research sample for Group II was taken by both researchers who could each review the contract file separately to ensure that the profit data were correctly recorded. This data collection procedure assumed that the profit data were recorded correctly in the official contract files.

In addition, the two researchers collected the research sample data separately and independently to avoid the errors which may have occurred in the pilot study due to the inexperience of the researchers. The Group II research sample data were collected first. Since there was insufficient evidence to state that a significant difference existed between the prenegotiation profit objectives and the final negotiated profit results in the Group II research

sample, no research sample of Group I data was ever taken.

Research Objective #2 was to determine if DAC 76-23 caused the problem. Research Hypothesis #3 was designed to utilize the same statistical test used for Research Objective #1 (Research Hypothesis #2), but the data collected from Group I were to be used to evaluate Research Hypothesis #3. Research Objective #2 was established because the researchers expected that a significant difference would be found between the prenegotiation profit objectives and the final negotiated profits for Group II data. Since there was insufficient evidence to state that a significant difference existed, Research Objective #2 was not undertaken in this research project.

From the above discussion, it appears that DAC 76-23 could not have caused the perceived research problem. The implications of this research are discussed in the next section.

Implications of the Research

The main implication of the research results is that the current WGL procedures adequately reflected the actual profits which had to be paid by the Aeronautical Systems Division (ASD) of Air Force Systems Command for R&D contracted efforts. Based on the above, the R&D WGL procedures under DAC 76-23 do not need revising for R&D efforts.

Authors' Speculations

The question arises as to why experienced contracting personnel would believe that a problem existed when the authors' research does not support the existence of that problem. The researchers can only speculate on some reasons why.

One reason may be the fact that people usually tend to remember the worst case situation. The range of the population of differences between the prenegotiation profit objectives and the final negotiated profit results was 7.481 percent, from -3.754 percent to 3.727 percent. The researchers had to ask each buyer to retrieve each sampled contract file, because the buyer usually maintained the contract files for which he was responsible in the buyer's own workplace. Each time the researchers explained the need to examine a contract file, the buyer offered another contract file which proved the research problem existed. However, if that particular contract was not included in the random sample, the contract was not reviewed by the researchers. Therefore, most buyers could point to a particular contract where a large difference existed, such as the 3.727 percent difference reported above.

However, no buyer offered a contract file which reflected a case where the prenegotiation profit objective exceeded the final negotiated profit. Such contracts existed as evidenced by the contract where the -3.754

percent observation occurred. The researchers speculated that some buyers may tend to remember only the worst case situations.

A corollary to the above is that people tend to resist change and may emphasize the worst case situation as support for not accepting that change. This speculation is supported by the fact that the "Research Needs Statement" (Appendix A) was created and submitted at a time when very little experience existed with the new DAC 76-23 R&D WGL procedures. Therefore, the problem may have been perceived to exist without an adequate data base to evaluate whether the problem was as severe as projected.

Another explanation for the unexpected research results was that some buyers may have completed the WGL form (DD Form 1547) after the negotiations took place by manipulating the WGL form to reflect the actual negotiated profit rate. This situation may have occurred on small dollar contracted efforts where the Government negotiation position was informally approved before negotiations began. Larger dollar R&D buys would not have been handled in this manner, because the prenegotiation profit objective approval cycle is much more formalized. However, the researchers found no evidence of any buyer completing the WGL form after the negotiations.

It is possible that the original data on which the "Research Needs Statement" was based may have created the

perception that a problem existed when no real problem exists. No verification of the original data could be made by the researchers since the original data were not available.

In conclusion, the unanticipated results obtained in this research may have been caused by several factors described above. Because of the unanticipated research results obtained from this study, the authors suggest several areas for future research.

Recommendations for Future Research

The researchers identified five areas that are worthy of future research concerning the WGL method of pre-negotiation profit objective development for R&D contracts.

Replication of This Study

Recognizing that the authors' research findings do not conclusively prove that the current R&D WGL procedures produce profits appropriate for R&D contracted efforts, the researchers suggest that this research study be replicated. Another sample should be taken from the ASD Directorate of R&D Contracting or from other purchasing activities which use the R&D WGL method to establish greater confidence in the authors' research results.

Contractor's Viewpoint

Since the payment of profit on an R&D contract is

normally determined through the negotiation process, the contractor's viewpoint should be studied to determine if contractors see any deficiencies in the R&D WGL procedures. The problems encountered by contractors in using R&D WGL procedures should be addressed in follow-on research.

Total Contract Price Analysis

Since profit is only one element of the total price of a Government contract, the effects of the current WGL procedures could best be determined if the total contract price were analyzed. The authors' study examined only the profit rate, because the "Research Needs Statement" indicated that the specific problem existed with respect to the profit rate and not with any other element of the contractor's proposal.

Profitability of R&D Contracting

This research project addressed only the profit rate for R&D contracts and the method the Government uses to determine if the profit rate is fair and reasonable. Therefore, the researchers suggest that another study delve into the profitability of R&D contracting in general. The follow-on profitability research project should address the issue of what an appropriate profit rate should be for R&D contracting and also address whether the WGL basis of return-on-sales is the appropriate basis on which to determine profits for Government R&D contracts.

Facilities Capital Cost of Money

Facilities Capital Cost of Money (FCCM) is an allowable cost on most Government R&D contracts. The DAC 76-23 WGL procedure subtracts FCCM from the profit objective, which lowers the profit rate. One way negotiators can raise the profit rate without raising the contract price is by not recognizing FCCM. The amount of profit then increases, while the contract cost decreases by the same amount. The profit rate is increased because the higher profit dollars are spread over a smaller cost base. The future research should investigate how prevalent the practice of not recognizing FCCM is and what effect the practice has on the contractor's incentive to invest in new facilities.

Concluding Remarks

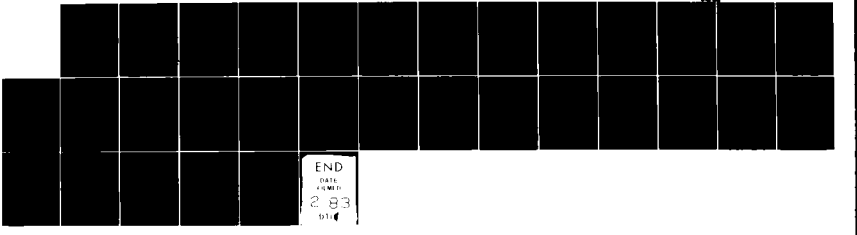
After researching the perceived research problem involving prenegotiation profit objectives, the researchers concluded that the present R&D WGL method adequately reflects the market-determined profit rate that should be paid to R&D contractors. In certain cases, the WGL method allowed the payment of profits above the R&D WGL prenegotiation profit objective. But, such cases were the exception rather than the rule.

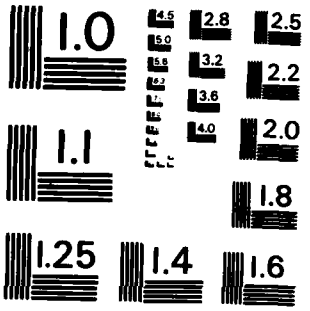
Several potential research issues, such as the appropriate profit rate for R&D contracts, were not examined in this research project. Therefore, the researchers hope that

this study will serve as a catalyst for further examinations into DOD profit policy and, in particular, the weighted guidelines method of determining prenegotiation profit objectives.

AD-A123 040 WEIGHTED GUIDELINES: AN EMPIRICAL INVESTIGATION OF RESEARCH AND DEVELOPME (U) AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH SCHOOL OF SYST.. 2/2

UNCLASSIFIED M R CRAIG ET AL. SEP 82 AFIT-LSSR-48-82 F/G 9/2 NL





APPENDIX A

RESEARCH NEEDS STATEMENT

N 81-20
005

RESEARCH NEEDS STATEMENT

TITLE: Profit/Fee Objective

BACKGROUND:

RESEARCH OBJECTIVE: To develop a realistic profit/fee objective in the R&D contracting environment.

REFERENCES: (Prior or related studies, regulations, articles, policy letters, etc.)

DPC 76-3

SOURCES OF AVAILABLE DATA FOR RESEARCH: Contract files - Directorate of R&D Contracting.

POTENTIAL DOLLAR/MANPOWER SAVINGS: Savings cannot be determined.

POINT OF CONTACT: Ralph Brinkman, Chief, Propulsion Division (ASD/PMRS) AV 785-4300

RECOMMENDED PRIORITY CODE: 4

DATE SUBMITTED: 19 May 1981

The use of the weighted guidelines, form DD 1547, to develop the fee/profit objective in the research and development environment does not permit the buyer to consider the economic realities associated with the negotiation.

The average fee objective developed in accordance with the provisions of the weighted guidelines generally reflect a fee of between 6% and 7%. However, the average fee negotiated is in excess of 8.4%.

APPENDIX B

EXAMPLE OF THE USE OF WEIGHTED GUIDELINES (WGL) AS AFFECTED BY DOD PROFIT POLICY CHANGES

This appendix illustrates how the changes in DOD profit policy have affected the weighted guidelines (WGL) profit/fee objective computation on the DD Form 1547. As noted in Chapter 2, the WGL approach was first introduced in 1964 but was subsequently revised in 1972, 1976, and 1980. Since the "Profit on Capital Policy" in 1972 was never fully utilized (3:45), the WGL approach, up until Defense Procurement Circular (DPC) 76-3 was issued in 1976, was basically the same as the original 1964 version except for relatively minor changes. Therefore, this appendix includes a hypothetical example of a Research and Development (R&D) contract to illustrate three periods of time: (1) before DPC 76-3 (FY 1964-1976); (2) DPC 76-3 (FY 1976-1980); and (3) Defense Acquisition Circular (DAC) 76-23 (FY 1980 to the present). By using one example for all three periods of time, the effect of DOD profit policy changes will become apparent. Figures 10, 11, and 12 show a copy of DD Form 1547 (Weighted Guidelines Profit/Fee Objective) dated for each of the three time periods: 1 September 1972, 1 September 1976, and 1 January 1980.

Before comparing the three time periods, refer to the DD Form 1547 in Figure 10 for a brief description of the WGL method of computing the profit/fee objective. The WGL method is used to determine a profit/fee objective as

WEIGHTED GUIDELINES PROFIT/FEE OBJECTIVE

INSTRUCTIONS: 1. See ASPR 3-808 for determination of assigned weight factors.
2. See ASPR 3-811 for documentation of profit objective.

1. RFP/RFQ OR CONTRACT NO.	2. CONTRACTOR		3. CONTRACT TYPE FFP(LOE)	
4. COST INPUT TO TOTAL PERFORMANCE (ASPR 3-808.5(b))				
COST CATEGORY a	GOVERNMENT'S COST OBJECTIVE b	ASPR 3-808 WEIGHT RANGE c	ASSIGNED WEIGHT d	WEIGHTED PROFIT/FEE (Col b x d) e
DIRECT MATERIALS: PURCHASED PARTS	$	1% TO 4%	%	$
SUBCONTRACTED ITEMS		1% TO 5%	%	
OTHER MATERIALS		1% TO 4%	%	
ENGR DIRECT LABOR	194,400	9% TO 15%	12.5 %	24,300
ENGR OVERHEAD	182,153	6% TO 9%	7.8 %	14,208
MFG DIRECT LABOR		3% TO 5%	%	
MFG OVERHEAD		4% TO 7%	%	
OTHER COSTS Travel	6,548		2.0 %	131
			%	
			%	
			%	
GENERAL AND ADMINISTRATIVE	63,327	6% TO 8%	7.2 %	4,560
TOTAL	$ 446,428			$ 43,199
5. COMPOSITE PROFIT/FEE ON COST INPUT TO TOTAL PERFORMANCE (Col e ÷ Col b)				PROFIT/FEE OBJECTIVE 9.7 %
6. COST RISK	ASPR 3-808.5(c)	0% TO 7%		2.5
7. PERFORMANCE	ASPR 3-808.5(d)	-2% TO +2%		
8. SELECTED FACTORS	ASPR 3-808.5(e) & .7(i)	-2% TO +2%		
9. SPECIAL PROFIT	ASPR 3-808.5 & .7(i)	0% TO +6%		
10. COST-BASED PROFIT/FEE OBJECTIVE (Lines 5 thru 9)				12.2
11. CONTRACT CAPITAL TURNOVER RATE			DD Form 1861	x N/A =
12. CONTRACT CAPITAL INDEX			ASPR 3-808.7(i)	
13. CAPITAL-ADJUSTED PROFIT OBJECTIVE			Line 12 + 30% of Line 10	
14. SPECIAL PROFIT Prepare Line 9 if applicable			ASPR 3-808.7(i)	
15. TOTAL PROFIT OBJECTIVE			(Line 13 + Line 14)	12.2
DATE	PREPARED BY			

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Fig. 10. Weighted guidelines profit/fee objective--DD Form 1547, 1 Sep 72.

WEIGHTED GUIDELINES PROFIT/FEE OBJECTIVE				
CONTRACTOR: BUSINESS UNIT: ADDRESS:			RFP/CONTRACT PIIN NO.	
			CONTRACT TYPE	FFP (LOE)
PART A – CONTRACTOR EFFORT				
PROFIT FACTORS	MEASUREMENT BASE (a)	WEIGHT RANGE	ASSIGNED WEIGHT	PROFIT/FEE DOLLARS (b)
MATERIAL ACQUISITION Subcontracted Items	$	% 1 to 5	%	$
Purchased Parts		1 to 4		
Other Material		1 to 4		
ENGINEERING - Direct Labor	194,400	9 to 15	12.5	24,300
Overhead	182,153	6 to 9	7.8	14,208
MANUFACTURING - Direct Labor		5 to 9		
Overhead		4 to 7		
OTHER COSTS Travel	6,548		2.0	131
GENERAL MANAGEMENT - G&A	63,327	6 to 8	7.2	4,560
PROFIT SUBTOTAL				43,199
ADJUSTMENT FACTOR				x 7
1. TOTAL EFFORT	446,428			30,239
PART B – CONTRACTOR RISK				
2. COST (Line 1a)	446,428	0 to 8	2.5	11,161
PART C – FACILITIES INVESTMENT				
3. CAPITAL EMPLOYED	43,661	6 to 10	6.0	2,620
4. BASIC PROFIT OBJECTIVE (Lines 1 + 2 + 3)				44,020
PART D – SPECIAL FACTORS				
Foreign Military Sales		1 to 4		
Productivity (ASPR 3-808.8)				
Independent Development (Line 1a)		1 to 4		
Other (Line 4)		-5 to +5		
5. SPECIAL PROFIT OBJECTIVE				
6. TOTAL PROFIT OBJECTIVE (Lines 4 + 5)				$44,020

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Fig. 11. Weighted guidelines profit/fee objective--DD Form 1547, 1 Sep 76.

WEIGHTED GUIDELINES PROFIT/FEE OBJECTIVE

1. CONTRACTOR IDENTIFICATION	a. COMPANY NAME	b. DIVISION NAME (If any)		
	c. STREET ADDRESS	d. CITY	e. STATE	f. ZIP CODE

2. WEIGHTED GUIDELINES CATEGORY (Check one)	3. TYPE OF CONTRACT (Ref DAR, Sec III, Part 4)
a. ☐ MANUFACTURING b. ☒ RESEARCH AND DEVELOPMENT c. ☐ SERVICES	FFP (LOE)

4. BASIC PROCUREMENT INSTRUMENT IDENTIFICATION NO.				5. SPIIN
a. PURCHASING OFFICE	b. FY	c. TY-PROC-INST CODE	d. PRISN	

6. WEIGHTED GUIDELINES PROFIT FACTORS (DAR 3-808.4)

PROFIT/FEE FACTOR OR SUBFACTOR (a)	MEASUREMENT BASE (b)	PROFIT WEIGHT RANGES MPG (%) (c)	R&D(%) (d)	*VCS(%) (e)	ASSIGNED WEIGHT (%) (f)	PROFIT/FEE DOLLARS (g)
PART I – CONTRACTOR EFFORT						
7. MATERIAL ACQUISITION						
a. SUBCONTRACTED ITEMS		1 TO 8	1 TO 8	1 TO 8		
b. PURCHASED PARTS		1 TO 4	1 TO 4	1 TO 4		
c. OTHER MATERIAL		1 TO 4	1 TO 4	1 TO 4		
8. ENGINEERING						
a. DIRECT LABOR	194,400	9 TO 18	9 TO 18		12.5	24,300
b. OVERHEAD	182,153	6 TO 9	6 TO 9		7.8	14,208
9. MANUFACTURING						
a. DIRECT LABOR		5 TO 9	5 TO 9			
b. OVERHEAD		4 TO 7	4 TO 7			
10. SERVICES						
a. DIRECT LABOR				8 TO 15		
b. OVERHEAD				4 TO 8		
11. OTHER COSTS Travel	6,548				2.0	131
12. GENERAL MGMT – G & A	63,327	6 TO 8	6 TO 8	6 TO 8	7.2	4,560
13. SUBTOTAL PROFIT/FEE						43,199
14. LESS: ADJUSTMENT FACTOR		30				N/A
15. TOTAL EFFORT	446,428					43,199
PART II – CONTRACTOR RISK						
16. COST RISK	(Total from Col b) 446,428	0 TO 8	0 TO 7	0 TO 4	2.5	11,161
PART III – FACILITIES INVESTMENT						
17. CAPITAL EMPLOYED	(Line 8, DD Form 1861)	16 TO 20				
18. BASIC PROFIT/FEE OBJECTIVE (Items 15 + 16 + 17, Col g)						54,360
PART IV – SPECIAL FACTORS						
19. SPECIAL PROFIT/FEE OBJ	(See DAR 3-808.8(a))					
a. PRODUCTIVITY						
b. INDEPENDENT DEVELOPMENT	(See DAR 3-808.8(b))	1 TO 4	1 TO 4			
c. OTHER	(Total from Item 19)	-8 TO +8	-8 TO +8	-8 TO +8		
d. TOTAL SPECIAL PROFIT/FEE OBJECTIVE						
20. SUBTOTAL PROFIT/FEE OBJECTIVE (Items 18 + 19d, col g)						54,360
PART V – COST OF MONEY OFFSET (Applicable to Research and Development and Services Weighted Guidelines only.)						
21. LESS: FACILITIES CAPITAL COST OF MONEY (DAR 3-808.3(a)(1)(ii))						3,602
22. TOTAL PROFIT/FEE OBJECTIVE (Items 20 - 21, col g)						$50,758

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Fig. 12. Weighted guidelines profit/fee objective--DD Form 1547, 1 Jan 80.

a percent of cost within ranges for different cost factors. For example, in Figure 10, line four is "Cost Input to Total Performance." Under this category are a list of factors or subfactors in Column A. Column B shows the Government's cost objective. For "Engineering - Direct Labor" the estimated cost is $194,400. In Column C, the weight range for "Engineering - Direct Labor" is 9 percent to 15 percent. The contracting officer places an assigned weight in Column D. In this case, 12.5 percent was chosen. Column E shows the resulting profit/fee of $24,300 for "Engineering - Direct Labor." The contracting officer continues this same process for each applicable factor. Line 5 is the "Composite Profit/Fee on Cost Input to Total Performance," which is the total of Column E divided by the total of Column B. In this example, line 5 would be computed as follows:

$$\frac{\$43,199}{\$446,428} = 9.7 \text{ percent.}$$

After completing the "Cost Input to Total Performance," the contracting officer applies a weight to "Cost Risk" on line 6. The range is 0 percent to 7 percent. In this case, 2.5 percent was chosen. However, instead of showing the dollar amount, i.e., (.025)($446,428) = $11,161, the "Cost Risk" is indicated as a percentage. Lines 7 through 9 were not applicable to this contract, but the same procedure of choosing a weight within the associated range

would be used. Lines 11 through 14 were that portion of the WGL form that was not utilized from the 1972 "Profit on Capital Policy." Therefore, the "Total Profit Objective" in line 15 is 12.2 percent which would be $54,360. Table 5 shows the example just described under the "Before DPC 76-3" category.

The "Profit '76" study showed that the policy in effect since January 1964 allowed "Contractors Input to Total Performance"[5] to account for 65 percent of the WGL profit objectives (20:VII-8) (see Figure 13). For the example just shown, the weighted profit/fee of $43,199 is approximately 79 percent of the total profit objective ($54,360), and cost risk of $11,161 is approximately 21 percent of the total profit objective of $54,360 (see Table 5).

As a result of the "Profit '76" study and the subsequent DPC 76-3 change to the ASPR, the DD Form 1547 shown in Figure 11 shows a decreased emphasis on part A "Contractor Effort," which was the name for the previous "Cost Input to Total Performance." The "Contractor Effort" was scaled down from 65 percent to 50 percent of the total profit objective by using an adjustment factor of (.7). The change in policy is shown in Figure 11. Using the adjustment factor of (.7), rather than changing the weight ranges for each

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[5]"Contractors Input to Total Performance" refers to "Cost Input to Total Performance" on the DD Form 1547 dated 1 Sep 72.

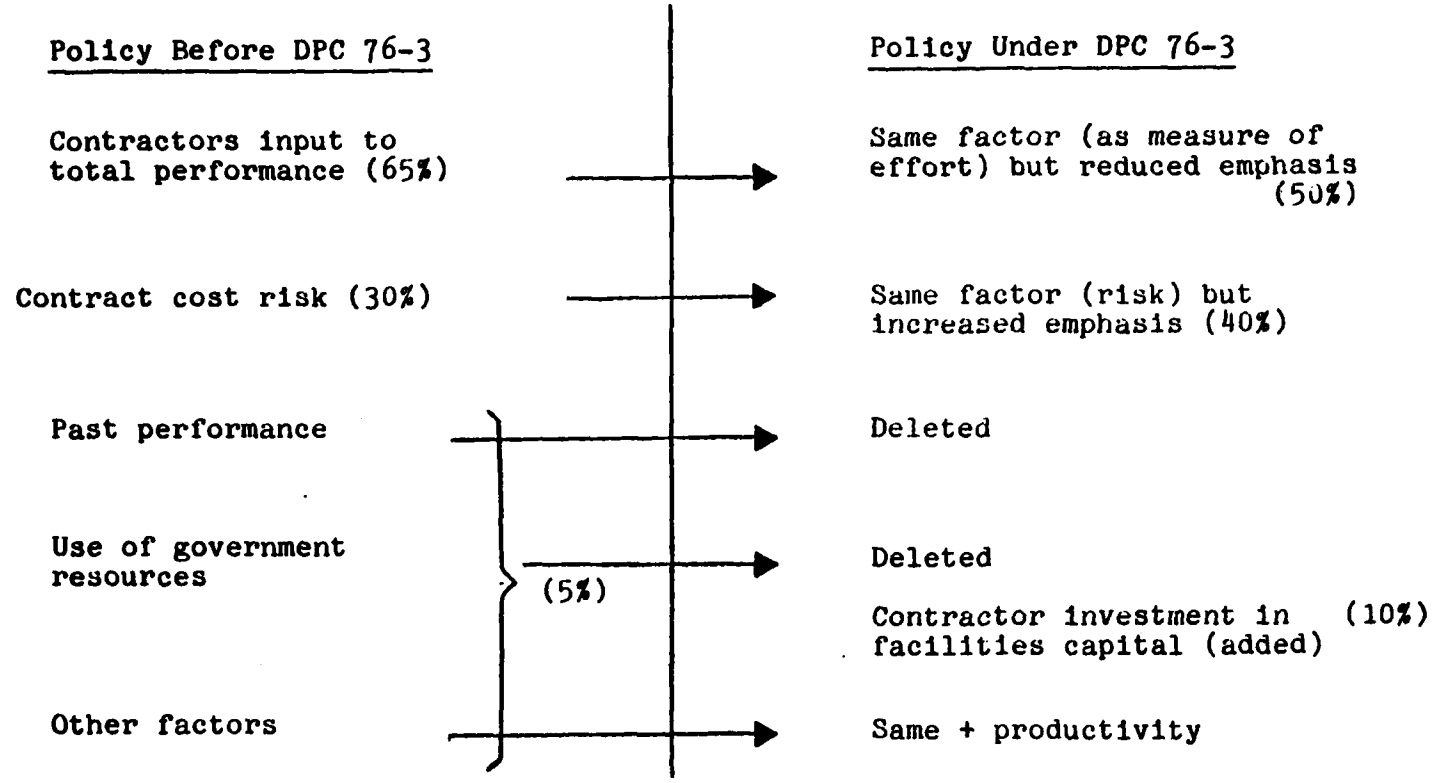
TABLE 5

COMPARISON OF WEIGHTED GUIDELINE RESEARCH AND DEVELOPMENT CONTRACT UNDER THREE DOD PROFIT PROJECTS

	Before DPC 76-3	DPC 76-3	DAC 76-23
Cost Input to Total Performance/ Contractor Effort			
Direct Labor	$24,300	$24,300	$24,300
Labor Overhead	14,208	14,208	14,208
Travel	131	131	131
G&A	4,560	4,560	4,560
Profit Subtotal	$43,199 (79%)	$43,199	$43,199 (85%)
Adjustment Factor (.7)	N/A	$30,239 (69%)	N/A
Cost Risk/Contractor Risk	11,161 (21%)	11,161 (25%)	11,161 (22%)
Facilities Investment	N/A	2,620 (6%)	N/A
Profit Total	$54,360	$44,020	$54,360
Cost of Money Offset	N/A	N/A	3,602 (-7%)
Total Profit Objective	$54,360 (100%)	$44,020 (100%)	$50,758 (100%)
Total Estimated Cost without Cost of Money	446,428	446,428	446,428
Cost of Money	N/A	3,602	3,602
Total Price	$500,788	$494,050	$500,788
Profit Percentage (see Appendix C)	12.2%	9.7%	11.4%

Assumptions:

1. The cost of money factors and the treasury rate employed were constant over the three time periods.
2. The weights used for each factor were equivalent over the three time periods, and the justification for using the chosen weight did not change.
3. The selected/special factors were not applicable to this example.



Note: The percentage figures for the "Policy Before DPC 76-3" refer to the actual percentage of the WGL profit objectives, while percentage figures for "Policy Under DPC 76-3" were the desired goals from the policy change.

Fig. 13. Changes in weighted guidelines under DPC 76-3 (20:IX-28).

factor, enabled the Government contracting officers to use the same profit calculation procedure before making the (.7) adjustment (20:VII-9).

For example in Figure 11, the profit subtotal of all the factors under "Contractor Effort" is $43,199. By multiplying $43,199 by (.7), the profit/fee dollar amount in line 1 becomes $30,239. Part B, "Contractor Risk," the new name for "Cost Risk," uses dollars instead of a percentage. Therefore, the dollar amount is $11,161 using the same weight of 2.5 percent.

A new addition to the WGL approach is part C, "Facilities Investment," which was allowed for the first time under DPC 76-3. The $43,661 comes from the DD Form 1861--Contract Facilities Capital and Cost of Money--and was computed by taking the contractor's cost of money of $3,602 divided by the treasury rate at that time of 8.25 percent. With a weight of 6 percent selected within the weight range of 6 to 10 percent, the calculated dollar amount for capital employed is $2,620. The profit/fee dollars for total effort (line 4) totals to the basic profit objective of $44,020. The new profit policy also changed some of the "Special Factors" in part D, but the "Special Factors" were not considered applicable to this example. Therefore, the total profit objective is $44,020 with the "Contractor Effort" being approximately 69 percent, "Contractor Risk" 25 percent, and "Facilities Investment" 6 percent of the total

profit objective (Table 5). This sample contract would be averaged with other contracts to achieve the goals listed in Figure 13 for the new profit policy under DPC 76-3.

The last profit policy change that occurred in 1980, with Defense Acquisition Circular (DAC) 76-23, is depicted on the DD Form 1547 in Figure 12. For R&D, the WGL procedures are essentially the same as the policy which existed prior to DPC 76-3. With DAC 76-23, R&D has a separate column on the DD Form 1547 with manufacturing and services type contracts in separate columns also. For manufacturing, an adjustment factor is still applied on line 14 but rather than multiplying the "Subtotal Profit/Fee" in line 13 by (.7), 30 percent is subtracted from "Subtotal Profit/Fee" giving the same results. However, the (30 percent) adjustment factor is not applied to R&D type contracts. Also, the "Facilities Investment" in part III of the DD Form 1547, which increased to 20 percent for manufacturing, is not used for R&D type contracts. Therefore, the present profit policy for R&D type contracts is similar to the policy before DPC 76-3 except for the use of cost of money.

Utilizing the DD 1547 dated 1 January 1980 (Figure 12), there is a part V called "Cost of Money Offset." The $3,602 is subtracted from the "Subtotal Profit/Fee Objective" in line 20 giving a Total Profit/Fee Objective of $50,758. Although the total profit/fee objective of $50,758 is not as high as the profit/fee objective before

DPC 76-3 of $54,360, the contractor can identify the $3,602 as a cost (Table 5). Therefore, although the contractor would show less profit (11.4 percent versus 12.2 percent), the bottom line total price of the contract is the same at $500,788.

As illustrated in this appendix, the changes in DOD profit policy in the area of weighted guidelines have affected the computation of the prenegotiated profit/fee objective. By using one example over the three time periods discussed, the effects of the policy changes promulgated by DPC 76-3 and DAC 76-23 are easily identified as the policy changes apply to R&D type contracts. The example illustrated how the DOD profit policy in the Defense Acquisition Regulation (DAR) has evolved to that currently used by R&D contracting officers.

APPENDIX C

DATA COLLECTION COMPUTATIONS

This appendix provides two examples of computations used in the research data collection process. The first example shows how the prenegotiation profit objectives and final negotiated profit percentages were computed from dollar amounts collected from official R&D contract files. The second example shows how the researchers calculated the appropriate sample size to ensure the statistical results of the research represented the true population of interest.

Prenegotiation and Final Negotiated Profit Percentages

The same computation procedure was used for both the prenegotiation and final negotiated profit percentages by substituting the applicable financial data. The following is an example of computing either the prenegotiation or the final negotiated profit percentages:

$$\text{profit percentage} = \frac{\text{profit}}{(\text{contract cost}) - (\text{FCCM})}$$

where:

profit = $50,758 (total profit/fee objective)

contract cost = $450,030 (total allowable cost of the contract)

FCCM = $3,602 (Facilities Capital Cost of Money)

$$\text{profit percentage} = \frac{50,758}{(450,030) - (3,602)} = 11.4 \text{ percent}$$

The Facilities Capital Cost of Money (FCCM) was excluded from the total allowable cost in computing the profit percentage, because FCCM is only an imputed cost which is allowed under Cost Accounting Standard (CAS) 414 (1:41). By excluding FCCM, the resulting profit percentage computed for this research was based on the estimated amount of costs that the contractor would have incurred in performing the contract.

Sample Size (14:230-231)

The following formula was used to compute the proper sample size (n) for a finite population in this research project:

$$n = \frac{NZ^2s^2}{Nh^2 + Z^2s^2}$$

where:

n = sample size

N = 961, the population size for Group II data

Z = 2.326, the Z statistic corresponding to a 99 percent level of confidence

s^2 = 6.5503, the estimate of the variance from the pilot study

h = 1, the percentage error tolerance level

The researchers planned for a 99 percent level of confidence that the sample mean would be within plus or minus one percent of the true population mean. The estimated

variance was computed from the initial pilot study described in Chapter 3. Therefore,

$$n = \frac{(961)(2.326)^2(6.5503)}{(961)(1)^2 + (2.326)^2(6.5503)} = 34.2$$

By rounding up to 35, the researchers were 99 percent confident that using a sample size of 35 would produce a sample mean that was within plus or minus one percent of the true population mean.

APPENDIX D

LILLIEFORS TEST FOR NORMALITY (15:681-689)

Assumptions

1. The sample $x_{D1}, x_{D2}, \ldots, x_{Dn}$ was a random sample. The sample x_D represented a sample from a population of differences, i.e., the differences between the prenegotiation profit objective percentages and final negotiated profit percentages.

2. The hypothesized population cumulative distribution function (CDF), denoted by $F_o(x)$, was continuous. The population CDF was a hypothetical normal distribution to which the sample CDF, denoted by $s(z)$, was compared to determine the test statistic T.

Hypothesis

H_o: The differences between the prenegotiation profit objectives and the final negotiated profits come from a normally distributed population with an unspecified mean and standard deviation.

H_1: The differences between the prenegotiation profit objectives and the final negotiated profits do not come from a normally distributed population with an unspecified mean and standard deviation.

Test Statistic

Standardize the x_{Di}'s by using

$$z_{Di} = \frac{x_{Di} - \bar{x}_D}{s_D}, \quad i = 1,2,\ldots,n$$

where $\bar{x}_D$ was the sample mean of differences, s_D was the sample standard deviation, and n was the sample size. The s(z) denoted the sample CDF of the z_i's. The test statistic was:

$$T = \sup_{z_D} |F_o(z_D) - s(z_D)|$$

The symbol, $\sup_{z_D}$, meant the greatest difference, and the test statistic T was therefore defined as the greatest absolute difference between $F_o(z_D)$, the hypothesized CDF, and $s(z_D)$, the sample CDF.

Decision Rule

It T was greater than $W_{1-\alpha}$, then reject H_o; otherwise fail to reject H_o, where $W_{1-\alpha}$ was determined from a table of critical values of the Lilliefors test statistics.

APPENDIX E

PAIRED DIFFERENCE TEST (10:266-275)

D_o = hypothesized difference between the means (e.g., $D_o = 0$)

s_D = sample standard deviation of observations

n_D = number of differences (i.e., sample size)

Decision Rule (One-Tailed Test)

If $|t^*|$ was greater than t_{α,n_D-1}, reject H_o; otherwise fail to reject H_o, where t_{α,n_D-1} was obtained from a table of critical values of the t-distribution.

APPENDIX F

WILCOXON RANK SUM TEST FOR THE PAIRED DIFFERENCE DESIGN

(10:496-501)

Assumptions

No assumptions were necessary.

Hypothesis

H_o: Using the research and development weighted guidelines method in accordance with DAC 76-23, the prenegotiation profit objectives are the same as the final negotiated profit results.

H_2: Using the research and development weighted guidelines method in accordance with DAC 76-23, the final negotiated profit results are greater than the prenegotiation profit objectives.

Test Statistic

The test statistic was:

T^* = smaller of the positive or negative rank sums T_A or T_B

The rank sums were calculated utilizing the absolute values of the differences between the measurements, i.e., the ranks of differences after removing any minus signs. After the absolute differences were ranked for both rank sum categories (positive and negative), the sum of the ranks of the positive differences, T_A, and the sum of the negative differences, T_B, were computed. Therefore, T^* was the smaller of the positive or negative rank sums, T_A or T_B.

Decision Rule

If T^* is greater than or equal to T_o, reject H_o; otherwise fail to reject H_o, where T_o for $\alpha = .05$ was

obtained from a table of critical values of the Wilcoxon paired difference sign-ranks test.

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