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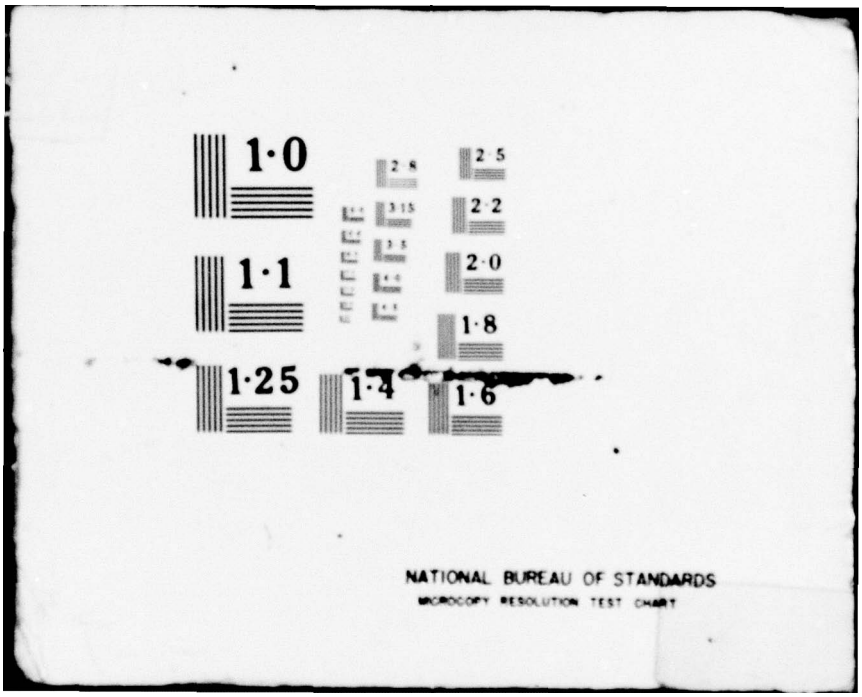
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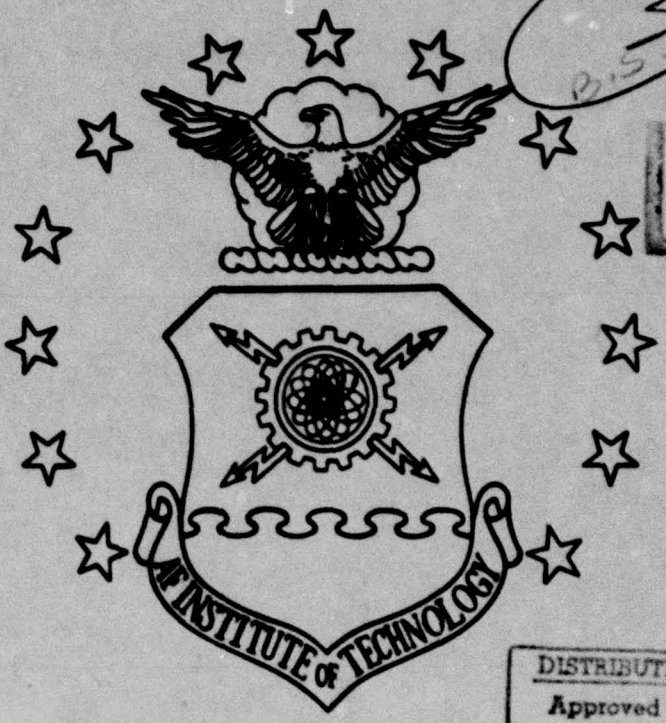

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The objective of this research was to determine whether improvement could be made in the current method of determining the need for pricing staff action. Currently, a dollar threshold is the sole criterion used in Air Force contracting and pricing offices to determine whether the price or cost analysis of a contractor's proposal should be performed by the pricing office or by the contracting office. While this sole criterion is convenient and easy to apply, it was not considered to be an effective decision rule. Interviews conducted with pricing experts in both Air Force Systems Command and Air Force Logistics Command revealed that the dollar threshold did not, in most cases, identify those contracts requiring the special expertise of the pricing offices. The research indicated that the use of a decision rule which considered the factors of type of contract, nature of buy, contracting officer skill, complexity, and contractor, in addition to dollar value would result in a more effective use of pricing resources.

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DEVELOPMENT OF IMPROVED CRITERIA FOR DETERMINING THE NEED FOR PRICING STAFF ACTION

A Thesis

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Logistics Management

By

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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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COMMITTEE CHAIRMAN

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Chapter 1

INTRODUCTION

Overview

The Defense Acquisition Regulation (DAR) requires that price or cost analysis be performed on all negotiated contracting actions (22:3:122). While this analysis is the ultimate responsibility of the Contracting Officer[1] (CO), it can be performed by either the CO or by an independent staff. The DAR does not specify the circumstances under which pricing staff assistance is required, but does provide general guidelines.

According to the DAR, pricing staff support should be obtained "when complex techniques are indicated [22:3:111]." The DAR does not define complex techniques. A related directive, the Defense Acquisition Regulation Manual (DARM) No. 1 while suggesting that pricing support be obtained on actions "involving costly, technically complex, or unique requirements [23:1A2]", does not define complexity either. Possibly because complexity is so

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[1] For the purposes of this thesis, the term "Contracting Officer" refers to the person in the contracting office having responsibility for the effort. It could be either the Principle Contracting Officer (PCO) or the buyer.

subjective, in actual practice, cost is the only factor considered by the contracting and pricing offices (6:23).

The directives delegate the responsibility for implementing the general guidelines to the major commands. Within both the Air Force Systems Command (AFSC) and the Air Force Logistics Command (AFLC), the two commands with major Air Force acquisition responsibility, every contracting directorate has established a dollar threshold as the sole criterion for determining if pricing staff action is required (6:23).

Problem Statement

Current implementation of contracting directives establishes dollar value as the sole criterion for pricing staff analysis of a contracting action. This singular criterion may be causing unnecessary expenditure of effort by the pricing staff on actions above the threshold which could be priced by the CO alone. And, at the same time, the theshold may be eliminating from the pricing staff's attention actions below the threshold which require pricing expertise beyond that of the CO.

Background

The purpose of the defense acquisition system is to develop and supply the weapons, equipment, and services required to meet United States national defense objectives.

Within the Air Force, this responsibility is carried out primarily by the two acquisition commands: AFSC and AFLC. The AFSC is responsible for the conception, design, development, and production of Air Force systems. In terms of acquisition functions, AFSC responsibility includes the purchasing of design studies, research and development, prototypes, engineering development, and initial production. After a system has reached the production stage, responsibility is shifted to AFLC. In acquisition terms, AFLC is responsible for purchasing the necessary support to operate and maintain the system throughout its system life.

In both commands, the acquisition process is basically the same. This process involves the steps of purchase request review, solicitation, evaluation, and award. Within the Department of Defense (DOD), there are two methods for carrying out this acquisition process: formal advertising and negotiation. Formal advertising is the method whereby bids are solicited and received from two or more offerers, bidding independently, and whereby the award will be made to the lowest responsible, responsive bidder (22:2:2). While this is the preferred method of contracting, only 12 percent of over $18 billion awarded for Fiscal Year (FY) 78 by the Air Force was awarded through formal advertising (5:32-37).

As a result, approximately $16 billion spent by the Air Force in FY 78 were awarded as a result of negotiation. Under negotiation, which can be either sole source or competitive, award is not always made to the lowest offerer, but rather to the offerer whose offer is "most advantageous; price and other factors considered [22:3:65A]." This places a requirement on the contracting office to evaluate, among other items, the price of the offer. This is done through price and cost analysis.

Price analysis is the evaluation of the total price (cost and profit/fee) of an item without the analysis of individual elements of cost (23:3A1). This analysis is basically a comparative technique which looks at only bottom line prices and which involves relatively simple analytical methods. Price analysis is performed either alone or in conjunction with cost analysis, on every negotiated action. Whenever price analysis alone is sufficient to determine the reasonableness of a price, the CO will generally perform the analysis without supporting action from the pricing staff. However, in cases involving both cost and price analysis, the CO may require assistance from the pricing staff.

Cost analysis, on the other hand, is much more detailed, involving an element by element examination of cost, and is required on every negotiated procurement above

$100,000.00 (23:3B1). It includes verification of cost data, evaluation of specific elements of cost, and projection of these data to determine the effect on price of such factors as:

1. necessity of costs,

2. reasonableness of the amounts of specific costs,

3. allowances for contingencies,

4. basis used for allocation of indirect costs, and

5. appropriateness of allocation of specific indirect costs to a particular action (22:3:122).

Cost analysis is considerably more complex and time consuming than price analysis. Frequently it involves highly sophisticated analytical techniques such as parametric cost estimating, regression analysis, and trends studies. This type of analysis generally requires specialized knowledge and expertise which are usually found only in the pricing office.

Every major contracting directorate within AFSC and AFLC has a separate pricing office. The pricing office, which in spite of its name performs both price and cost analysis, serves as a staff function and supports all of the individual contracting offices within the directorate. For instance, the staff pricing office of the Directorate of Research and Development Contracting, Aeronautical

Systems Division (ASD), Wright-Patterson AFB, OH provides pricing assistance for all of the buying divisions within the directorate (see Appendix A).

The primary function of the pricing office is to assist and support the CO in gathering, assimilating, and evaluating cost data, in establishing the government negotiation objectives, and in conducting negotiations (23:1A3). Specific tasks of the pricing office include price analysis, cost analysis, fact-finding, negotiation, and documentation (6:63). The pricing office is a staff agency reporting directly to the Director of Contracting and is autonomous from the buying divisions.

Price analysts are specifically trained in their tasks of price and cost analysis. These are the only functions performed and therefore analysts are not involved in other contracting duties as are COs. As a result, pricing personnel are considered to be "pricing experts" who possess technical competence and expertise beyond that of a CO.

While the function of the pricing office is to provide support to the CO, it was not intended that support be provided on every action requiring analysis. This is evidenced by the job description provision that 20 percent of a journeyman CO's time be spent on pricing (2:19). It appears then, that the role of the pricing office is to provide support in only those instances requiring expertise beyond that of the CO.

Currently, contracting offices are operationally defining contracts which require special expertise as those that are above a specified dollar threshold. Each contracting office has established its own threshold based upon dollar value of the actions handled by the office and by the workload level. The threshold varies significantly from office to office. For instance in AFSC, the threshold ranges from a low of $200,000.00 for Electronic Systems Division (ESD) to a high of $2,000,000.00 for Aeronautical Systems Division (ASD) (1:1:5; 7:1-3). In AFLC all offices have a threshold of $100,000.00 (18).

The dollar threshold provides a very convenient and efficient criterion. It is precise, unambiguous, and easily understood. It is extremely simple to apply and can be readily adapted to varying conditions.[2] However, the dollar threshold is an arbitrary measurement, and as such may not reflect complexity and uniqueness, factors which the directives suggest should be used by the CO in determining if the special expertise of the pricing staff is required.

The purpose of this study, therefore, was to investigate the effectiveness of the dollar threshold and

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[2] The AFSC and AFLC originally established their threshold at $100,000.00 (the level at which certified cost and pricing data are required). AFSC offices have frequently adjusted their thresholds to reflect increasing workloads and inflation. AFLC offices, however, have not made any adjustments.

feasibility of alternate criteria. This investigation, based upon a number of assumptions, attempted to meet the listed objectives by answering five questions.

Assumptions

The effective use of resources is a problem which is often linked to manpower allocation. Whether or not resources are being used effectively usually is not recognized until a manpower or workload problem exists. In recent years, a serious workload problem has surfaced within the pricing staff offices (13). This problem is most likely due to manpower shortages as well as other factors, such as, ineffective use of resources. While it is recognized that a manpower shortage may exist and may be related to the research problem, it is not considered to be an issue that can be resolved since additional manpower authorizations will not be approved by the United States Air Force (USAF) (13). Therefore, this study assumes that the present manpower situation will not change and looks for ways to increase the effectiveness of the utilization of the existing resources.

Research Objectives

The primary objectives of this research effort are to:

1. Determine what criteria are perceived by the pricing community to influence the need for pricing staff action.

2. Use the new criteria to develop a decision model which will predict when pricing staff action is required.

3. Test the use of the model to determine if its use results in different decisions than the use of the dollar threshold.

Research Questions

1. How can the current method of determining the need for pricing staff action be improved with respect to more efficient and effective utilization of pricing resources?

2. What factors are considered important in the pricing decision?

3. What skills do pricing staff personnel possess that are unique from those of the CO?

4. What constitutes "complexity" as referred to in the DAR and how can it be measured?

5. Will the use of criteria other than dollar value result in a more effective use of pricing resources?

Scope and Limitations

This study was limited to pricing staff offices within AFSC and AFLC. Since these commands constitute the major acquisition centers in the Air Force, this limitation is considered appropriate.

Justification

In recent years the number of pricing actions on an Air Force wide basis has been steadily increasing while

the workforce has been decreasing (6:17,59). As a result, pricing offices have been unable to handle the workload and have been often forced to return actions to the COs for analysis. Although no complete records are available which indicate the number of actions returned to the COs for analysis, the magnitude of the problem is evidenced by the continual raising of the thresholds within AFSC offices. The higher thresholds reduce the number of actions which are forwarded. As a result many actions which could benefit from the pricing staff's expertise are not being forwarded.

In addition, Headquarters United States Air Force (HQ USAF) has expressed concern over the efficiency of analysis being performed by both the pricing offices and the COs. Major Grady Jacobs, Contract Pricing Air Staff Officer, expressed that same concern and requested that a study of the criteria for pricing action be conducted (13). Operating level personnel have also expressed a concern that the current criterion is not adequate. Lt Col Richard Goven, ASD Pricing, and Mr. Harry Curtner, ESD Pricing have both stated that the current criterion often creates workload management problems (4; 10).

Literature Review

This research is an exploratory effort in the area of criteria for pricing staff action. While no literature

is available in the specific topic area, some related data are available in the general pricing area. A survey of pricing personnel conducted in FY 76 indicated that all major procurement directorates within the Air Force use a dollar threshold as the sole criterion for pricing staff action (6:23). The study further indicated that in some cases pricing staff action was performed, when requested by the CO, on actions below the threshold. In addition, the study revealed that in times of excessive workload, such as the end of the fiscal year, pricing staff action was waived on efforts above the threshold. In both of these instances, criteria other than threshold were considered; however, the survey did not discuss these specific criteria. As a result, we contacted contracting and pricing personnel in an attempt to identify the criteria used.

For actions below the threshold, criteria cited most often were type of contract, type of effort, and uniqueness of requirement (12; 19). While these criteria were also considered important in the decision to waive pricing staff action on efforts above the threshold, they were considered less important than the experience of the CO and the degree of competition (12; 13; 19). Both contracting and pricing personnel considered CO experience to be the most critical factor in the decision of pricing to waive pricing staff action.

The interviews with contracting and pricing personnel showed that while criteria other than dollar threshold are used in unusual cases, there are no set procedures in government pricing offices to regularly incorporate these criteria into the management process. However, such set procedures do exist within the defense industry.

Major defense contractors, for the most part, in buying from their own suppliers have contracting and pricing functions similar to those in the government. Our interviews with industry representatives revealed that while dollar threshold is used as one criterion, it is not usually the primary or driving factor. For instance, at the Defense Space and Systems Group of TRW, Inc., the primary criterion is type of effort. All study proposals and all space component efforts require pricing staff action regardless of dollar value. Further, the type of contract and the proposed contractor are considered more important than dollar value (3). Similar criteria are used by other major defense industries. At one major electronics manufacturer a dollar threshold is used as the primary criterion. However, a number of different thresholds are used based upon the type of contract and the degree of competition.

The data obtained from the pricing management study and from the interviews indicated that use of other criteria in addition to cost was operationally feasible and could result in improvement in pric' g management. Therefore, this area was investigated.

The remaining chapters of this thesis discuss the achievement of our research objectives. Chapter 2--Methodology--discusses the methods which were used for data collection and analysis. Chapter 3--Data Summary and Analysis--presents the results of the interviews conducted and the results of the statistical tests performed. Chapter 4--Findings and Recommendations--discusses our proposed model based upon interview results and provides suggestions for further study.

Chapter 2

METHODOLOGY

This chapter describes the universe, population and sample from which data were collected for this research, the techniques employed in collecting the data, the statistical tests used in the analysis of those data, the development of the model, and research assumptions and limitations.

Description of Universe, Population and Sample

The universe for this research project consists of all Air Force personnel who perform pricing actions. This includes not only the "pricing experts" who perform pricing as their primary activity, but also contracting officers and buyers who perform pricing tasks on an intermittent basis. The primary population of interest is the group of "pricing experts". We define the population to include all personnel above journeyman level assigned to selected pricing offices within AFLC and AFSC. AFLC has five pricing offices, one for each Air Logistics Center (ALC). AFSC has ten pricing offices, three of which are located at major procurement centers (ASD, ESD, SAMSO) as defined by HQ USAF (6:3). The primary population was limited to those pricing personnel assigned to the five ALCs, the three major AFSC

offices, and two non-major offices (see Appendix B). Since this population includes those offices from the two acquisition commands which are responsible for the majority of Air Force contracting and includes both very large and very small offices, generalization of results of this study to the universe is considered valid.

A sample of 37 members of the primary population was taken. A stratified random sample was used to assure that members from each of the offices in the primary population were selected in the sample. Current personnel rosters and a random number table were used to generate the sample.

The prime objective in sampling was to select a group of people who would provide responses which could be considered to be representative of the population (16:157). Since the selected sample included approximately one-third of the total population and included members from all of the different elements in the population, the sample was considered representative.

Data Collection

Data collection was performed in two phases. The first phase involved the identification and definition of specific criteria considered important for the determination of pricing staff actions and the development of decision

rules to be used to apply these criteria. The second phase involved the abstraction of the criteria, identified in phase I, from randomly selected contracts.

Phase I. This first step was the identification and definition of criteria which pricing experts felt should be included in the pricing action decision. This information was obtained through a survey of members of the pricing sample. The survey was conducted by personal and telephone interviews. While a review of existing literature is an obvious starting point in the research of any problem, in many cases only a small portion of current knowledge of the problem has been put into writing. Therefore, much can often be obtained through gathering current information from people knowledgeable in the area. One method of obtaining such information is to conduct a survey and to solicit ideas from experts in the field (8:84-85). The survey technique was selected as the method of data collection.

A survey may be conducted on a one-to-one basis, as in an interview, or on an impersonal basis through the use of a questionnaire (8:199). The interview technique was selected over a questionnaire for a number of reasons. First, the primary questions of interest were open ended and very subjective. The interviewees were asked to make

judgements and give opinions. Second, the initial response to a question often determined subsequent questions. And third, many of the terms and concepts which were discussed were quite vague and ambiguous and therefore needed to be explored in detail with each interviewee in order to develop operational definitions.

Both personal and telephone interviews were conducted. For in-depth, subjective questions requiring probing, a personal interview is the preferred technique (9:209). However, due to the wide geographic dispersion of the sample members, personal interviews with all members in the sample were not possible within the limitations of time and funds. Therefore, personal interviews were conducted with people located at Wright-Patterson AFB, and telephone interviews were conducted with those people located elsewhere.

The use of both telephone and personal interviews presupposes that replies will be the same irrespective of the interview method. While this is true in most cases, some studies have suggested that on questions of attitudes the presence of a personal interviewer " . . . may interject a modifying element in the interview situation [9:212]." However, for this research, the "interjection of a modifying element" is not considered a serious problem for two reasons. First, the population consists of highly

trained professionals who provided professional rather than personal opinions. Second, the interviewers followed the same interview guide for both the personal and telephone interviews.

The interview guide (see Appendices C and D) consisted of a cover letter containing an introduction and explanation of the purpose of the research and a list of questions. The questions were used to obtain general background information and to establish a baseline for further questioning. These questions covered such items as the value of current thresholds, the basis for the thresholds, and whether or not contracts under the threshold were reviewed and if contracts over the threshold were returned to the CO for analysis.

Additional questions were asked based upon responses to those questions listed in the interview guide and were directed toward obtaining criteria and recommendations for improved criteria. Questions centered on identifying, defining, and ranking recommended criteria. Whenever a large number of criteria were identified during the interviews, the interviewees were instructed to rank only the five which they considered to be most significant. This was done since studies have indicated that ranking more than five factors is usually difficult and results in unreliable rankings (8:241).

Obtaining definitions of recommended criteria was a major part of the interviews. Based upon previously conducted interviews, it appeared that many of the recommended criteria used terms which did not have a commonly accepted and understood definition. For instance the terms "complexity" and "CO experience" had both been previously suggested as possible criteria. Since these terms would require operational definitions if they were to be used in any model, the interviews were used to determine what factors make an effort "complex" or a buyer "experienced."

In addition to obtaining identification and definition of criteria, a decision rule for each selected criterion was also obtained. The decision rule was a statement of how the selected criteria would be applied in making a pricing action decision.

The interview guide was tested prior to its use. A test ensures that

> . . . the questions meet the objectives of the survey; all important phases of the survey have been adequately covered; the questions stimulate respondent cooperation; the questions are in satisfactory order; and the questions are completely understood by the respondents [21:2-3].

The guide was tested on Air Force Institute of Technology (AFIT) procurement instructors from both the graduate and the continuing education programs. Personal interviews were conducted with the instructors followed

by a discussion of the interview itself. While the AFIT instructors were not part of the population of pricing experts, they are familiar with both pricing policies and procedures and proper research methods and therefore we considered the instructors to be a valid test group. Changes recommended by the test group were considered for inclusion in the interview guide. A field test of the interview guide, with members of the population, was not considered feasible due to the limited size of the population.

Support and cooperation from the interviewees were essential to this research, since the interviews required considerable thought and time from the respondents. In order to assure this support, two steps were taken. First, HQ USAF notified the major commands which in turn notified the director of each office and requested his support prior to the interviews. Second, the interviewers provided advance notice to all interviewees and established a time convenient to the interviewee for the interview.

The data obtained from the interviews were analyzed in order to determine the criteria which are considered important in the decision to provide pricing staff action. These selected criteria and the decision rules were used in Phase II of data collection and were used to develop a decision model in Phase II of data analysis.

Phase II. Phase II involved the collection of contract data for use in applying the decision rules obtained from Phase I. Information concerning the selected criteria and decision rules was abstracted from contract files.

A stratified random sample of 50 contracts awarded in FY 78 was made. The sample included contracts from one major AFSC office, one non-major AFSC office, and one AFLC office. Half of the contracts selected were selected from those which were above the threshold and analyzed by the pricing staff and half from those below the threshold which were not analyzed by the pricing staff. Listings of completed contracts from each office and a random number table were used to select the contracts based upon the last four digits of the Procurement Instrument Identification Number. This stratified sampling plan was selected to assure that a broad range of dollar values and types of buys were included in the sample.

We abstracted, from each contract, information pertaining to the criteria identified by the price analysts and ranked highest by the statistical tests. This information was subsequently used in Phase II of the data analysis.

Data Analysis

Data analysis was performed in two phases, with each phase corresponding to a data collection phase.

Phase I. The data obtained from the first phase of interviews were analyzed to identify and rank the decision criteria. This phase of analysis determined the existence and degree of association or agreement between the ranked criteria provided by the interviewees. The degree of association was examined in two groups.

Group I--within the population of pricing experts

Group II--between subsets of population AFLC or AFSC.

This test, a measure of consistency within the pricing community, was necessary in order to generalize the results of the pricing population. The second test was performed to determine if the differences in buying mission between AFSC and AFLC affected decision criteria. Both tests were performed using Kendall Coefficient of Concordance. (See Appendix H.)

The Kendall's Coefficient of Concordance is a measure of the agreement of rankings of a number of subjects and therefore in this study we used the Kendall test to determine the degree of agreement among the criteria provided by interviewers. The coefficient equals one when

there is perfect agreement and zero when there is no agreement (14:148). The hypothesis tested was:

H_0: No agreement exists

H_A: Agreement does exist.

Through the use of this test, a significance level was determined. A small significance level indicates that consistency or agreement exists and that the null hypothesis may be rejected (20:26). The results of the test permitted the rejection of the null hypothesis which indicated that the rankings were a valid basis for further study. Detailed analysis is contained in Chapter 3.

The data from Phase I were also analyzed to provide a decision model. We had intended to develop the model based upon decision tree analysis, using the criteria and decision rules obtained in Phase I. The model was to be limited to a maximum of five factors and include only those criteria which had been provided decision rules by at least 51 percent of the interviewees in response to question ten of the interview guide. Each criterion was to be established as a decision point in the decision tree, and at each point a decision would be made as to whether the proposal was to be sent to the pricing staff or retained in the buying office. However, due to the nature of the decision rules provided by the interviewees, we were unable to employ the decision tree approach. The rules obtained

from the pricers, in almost every case, involved a caveat, which prevented its use in decision tree analysis. As a result, we developed a model consisting of the five selected factors, but which called for a "majority rule" decision rather than a decision tree approach.

Phase II. Data collected in the second phase were analyzed to determine whether or not the use of the decision model, based upon the selected decision rules, resulted in decisions different from those made using the dollar threshold. The determination of differences was accomplished through the comparison of actual decisions made using the dollar threshold to decisions we arrived at using the model. Results discussed in Chapter 3 show that the use of the model did result in different decisons than those obtained under the threshold.

While our analysis indicated that the model produced different results, it could not indicate if the results were "better". However, since the model identifies contracts which, in the opinion of the experts, received action by the wrong group (pricing staff when COs should have handled them or visa versa) then we assumed that the model provided for a better utilization of pricing resources.

Assumptions/Limitations

Assumptions

1. The samples of pricing personnel were representative of the Air Force contracting community and therefore results can be generalized.

2. Selected statistical tests were appropriate for the type and nature of the data obtained.

3. Interviewees answered questions honestly and conscientiously and have the knowledge necessary to provide valid opinions and decisions.

Limitations

1. Time and resources available to researchers.

2. Time provided by interviewees.

3. Access to offices located outside of Wright-Patterson AFB, OH.

Chapter 3

DATA SUMMARY AND ANALYSIS

This chapter discusses the data collected and the analysis of that data. This chapter contains a discussion of interview questions, a statistical and descriptive summary of interview results, and an analysis of the statistical tests performed on interview results. Our findings and recommendations based upon these analyses are contained in Chapter 4.

Interview Procedures

Interviews were conducted with the pricing personnel in accordance with our research design outlined in Chapter 2. Thirty interviews were conducted out of the selected sample of 37 personnel. One person refused to participate in an interview on the basis that he felt that research studies in the Air Force were too frequent and did not produce any results. Three people had left Government service or had been transferred out of the pricing office, and three were on leave or travel status during the interview period. The remaining 30 represent a stratified sample of the population and are considered representative.

We found that the pricing personnel who participated in this research effort were very helpful and cooperative. Many had prepared written responses to the questions on the interview guide prior to the interview. Further, although the questions asked for only opinions and best estimates, many of the pricers checked historical files and records prior to responding to the questions. On the average, the interviews lasted approximately 45 minutes, yet all of the interviewees were willing to spend the time needed to answer the questions.

General Questions

The interviews consisted of ten basic questions as outlined in the interview guide (Appendix D). These questions were used as a starting point for further questions. Additional questions and issues were raised to determine the rationale and reasoning behind the responses to the first ten questions. The questions were asked in the sequence shown on the guide since latter questions built on earlier ones. We tabulated the responses to each question both by command and by total Air Force response. We analyzed the responses to determine trends and also to determine if the research objectives of each question had been met.

Question #1. We began each interview with a general discussion of the pricing dollar threshold. Our objective of

the first question was to focus the interviewee's thinking on the reason for and basis of the threshold. The first question was in two parts. The first part sought to determine the rationale for the use of any threshold, in lieu of the use of possible other criteria, as the primary decision rule. We were only somewhat successful in meeting this objective with part one of the question. Most of the pricers' initial responses dealt with the rationale for the specific dollar value of the threshold, rather than with the rationale for the threshold itself. Even after we clarified the question, some responses still dealt with the specific dollar amount. This is shown below in the table of responses.

QUESTION 1a: IN YOUR OPINION, WHAT IS THE BASIS FOR THE USE OF A DOLLAR THRESHOLD AS THE DECISION CRITERIA?

RESPONSE	AFLC	AFSC	COMBINED
Easy to apply	36%	50%	44%
All rules by threshold	7	11	9
Relates to complexity	29	17	22
Required by ASPR	64	6	32
Focuses on potential savings	21	39	31

NOTE: Totals for each command add to more than 100 percent because multiple responses were allowed.

Of the categories above, we considered the first three to deal with the rationale for the threshold itself and the last two to deal with the rationale for the specific dollar amount of the threshold. Of those responses dealing with the threshold itself, the majority focused on the ease of application as the basis for the use of a threshold. A dollar threshold is easy and convenient to use. Since this was regularly cited as a major benefit of the use of a threshold, the ease of application of any alternative is an important consideration.

The pricers also indicated that the relationship of dollar value to complexity is an important basis for the threshold. We believe that this indicates that complexity should be considered in the pricing decision and that dollar value is an effective way to measure complexity. However, this was not borne out by later questions. A small percentage of the responses focused on the pervasiveness of dollar thresholds throughout the contracting process. Dollar thresholds are used as a basis for the inclusion of special clauses, for the requirement for various reviews, and for the obtaining of administrative approvals. This attitude was expressed by one pricer as, "We use dollar thresholds for everything else, why not pricing."

As mentioned above, two categories of responses dealt with the rationale for the specific dollar amount rather than with the rationale for the use of a dollar threshold. We believe that this perhaps indicates that the use of a dollar threshold is perceived as a "given", or in other words, as something which is not even subject to change. One of the responses provided indicates that there is a widespread misconception, particularly among AFLC pricers, as to what the DAR requires. A significant proportion of AFLC pricers (64 percent) stated that the reason for the threshold is that the DAR established it. This is plainly incorrect. The DAR does set $100,000.00 as the level at which some form of price analysis must be performed; however, the DAR does not state by whom the pricing must be done. It does not set dollar value as the sole basis for making that decision.

In AFLC, HQ AFLC Pricing Policy has established a $100,000.00 threshold for all AFLC pricing offices. We feel that this contributes to the misconception since the offices see the threshold as directive and not subject to adjustment. This misconception is also evident in the responses to part two of the question.

The objective of part two of the question was to determine the rationale for the specific dollar amount

used in each pricing office. While the dollar amount is $100,000.00 in all of the AFLC offices, the amounts vary significantly within AFSC. The dollar thresholds for the AFSC offices are shown below.

SAMSO	$ 500,000	
ESD	200,000	(R&D)
	500,000	(Systems)
ASD	2,000,000	
ASD/R&D	500,000	
ADTC	500,000	

Prior to conducting the interviews, we believed that the dollar level was related to workload and to type of item purchased, since this seemed to explain the difference between the commands. The results of question 1b indicate that this is partially true.

QUESTION 1b: IN YOUR OPINION, WHAT IS THE BASIS FOR THE SELECTION OF THE PARTICULAR DOLLAR VALUE USED AS THE THRESHOLD?

RESPONSE	AFLC	AFSC	COMBINED
Due to workload	14%	72%	47%
Related to review levels	14	22	19
Set by regulation/law	72	17	41
Related to inflation	0	11	6

The results show that the basis for the specific dollar amount of the threshold varies significantly by command. This may reflect the type of item being purchased since the commands purchase very different type of products.

As mentioned earlier, HQ AFLC Pricing Policy has set a $100,000.00 threshold for all ALC offices, and therefore the individual pricing offices do not have the authority to adjust the threshold. This is reflected in the low AFLC response of inflation and workload as determinants of the dollar amount for the threshold. Again, the misconception that the level has been established by the DAR is prevalent, as indicated by the 72 percent response to this answer.

In AFSC, on the other hand, each office sets its own threshold level. While the majority of the offices originally established the level at $100,000.00, the offices have increased the threshold over time. The increase has been due mainly to workload, with a small percentage of the increase due to the effects of inflation.

In both commands, a small number of the pricers cited other review levels as the basis for the dollar amount of the pricing threshold. We believe that the dollar levels are set the same for the number of staff actions, such as reviews and pricing, in order to avoid confusion and for administrative ease.

Question #2. With the first question, we established the basis for the use of the dollar threshold decision rule. In our second and third questions of the interviews, we

attempted to determine if the rule was always followed, and if not, under what circumstances was it not followed. Prior to the interviews, we believed that the threshold rule was most likely not always strictly adhered to, mainly due to workload problems. Further, we felt that by examining the instances when the rule was not followed, we could gain insight into the decision making processes used in pricing. We used question #2 as a lead-off question for this topic.

QUESTION #2: DO YOU KNOW OF ANY PRICING ACTION ACCEPTED BY THIS OFFICE WHICH DID NOT FOLLOW THE DOLLAR THRESHOLD RULE? IN OTHER WORDS, CONTRACTS ABOVE THE THRESHOLD BEING RETURNED TO THE CONTRACTING OFFICER, OR CONTRACTS BELOW THE THRESHOLD BEING ACCEPTED BY THIS OFFICE?

As we expected, we found that the rule was not followed in all cases.

RESPONSE	AFLC	AFSC	COMBINED
Accept cases below threshold	93%	78%	84%
Reject cases above the threshold	64%	44%	
Reject above, but only with a partial	0	39%	} 83% 81%

The responses indicate that almost all of the offices do accept cases below the threshold. However, this does not mean that the pricers are handling below the

threshold cases as normal price actions. Rather, on these cases, the pricers provide advice and guidance, assist in the use of special techniques such as the learning curve, and may review the final Price Negotiation Memorandum (PNM). However, the final responsibility for the case still rests with the contracting officer who must prepare the negotiation objective, handle negotiations, and write the PNM. As one pricer stated, "we'll hold the CO's hand and provide moral support, but we won't do all the work for him."

At least some of the personnel in every pricing office stated that actions above the threshold were returned to the contracting officer because the workload in the pricing office was too great. In most instances, these cases were returned without any action at all. The most that was offered was assistance as would normally be provided on a below the threshold case. However, in one pricing office (SAMSO), no cases were returned without some form of pricing analysis. Every file returned received at least a partial review consisting of a summary of audit findings, a listing of potential problem areas, and an indication of possible negotiation approaches. We believe that this procedure represents an excellent compromise between the use of limited resources and the need to provide assistance to the contracting officers.

An interesting phenomenon was noted in two separate offices. In both offices the chief of the office stated that no cases were returned without action that were above the dollar threshold. Yet pricers in these offices indicated that they had personally returned a number of such cases. This indicates both a lack of standard procedures within the office and a lack of communication.

Question #3. With the second question we determined that the dollar threshold was not always followed. We then attempted to determine when and why it was not followed. Question 3 examined these issues. The first part of this question was aimed at determining the percentage of pricing actions which did not follow the rule. Our purpose was to determine if non-adherence to the dollar threshold rule was a common occurrence. The results indicate that non-adherence is fairly common.

QUESTION 3a: WHAT PERCENTAGE OF THE TOTAL NUMBER OF CONTRACTS ACCEPTED BY THIS OFFICE DOES NOT FOLLOW THE THRESHOLD RULE?

RESPONSE	AFLC	AFSC	COMBINED
Less than ten percent of cases	86%	39%	59%
Between ten and thirty percent	7	17	13
Above thirty percent	7	44	28

The responses seem to indicate that AFSC returns a much higher percentage of cases than does AFLC. We believe that this indicated that AFSC had a much more severe workload problem than does AFLC. This belief was later supported by responses to question 3c.

The responses to this question (3a) varied greatly even within the same office. We believe this is due to the fact that an individual pricer would only have knowledge of the number of contracts he personally handled which did not follow the rule, and would not necessarily be aware of the percentage of an office wide basis.

After determining that the dollar threshold rule was not followed in a relatively large number of cases, we attempted to determine who made the decision to accept a case below the threshold or return a case above the threshold. Our primary purpose with this question was to determine if the contracting personnel were involved in this decision.

QUESTION 3b: WHO MAKES THE DECISION TO ACCEPT/RETURN THESE ACTIONS?

RESPONSE	AFLC	AFSC	COMBINED
Pricing Chief	86%	17%	47%
Price Analyst	7	38	25
Pricing Group	7	28	19
Joint decision with contracting	0	17	9

The results indicate that the pricing office alone, without contracting officer input, makes the decision in almost all cases (91 percent). It appears that in AFSC the price analysts are delegated somewhat more authority to make these decisions than in AFLC where most of the responsibility rests with the pricing chief. In one AFSC office, a panel of pricing analysts and branch chiefs review all contracts being considered for return to the contracting officer, and a joint decision of all the pricing personnel is made. We believe that this allows for more efficient use of pricing personnel since it allows for the shifting of workload among the individual pricers. In only one office is contracting involved directly in the initial decision making process. However, in discussions following this question, we found that the contracting officer has the final decision in almost all cases. A pricing decision to return a case above the threshold is actually only a recommendation since the contracting officer can refuse to accept the case back.

Since the interviews up to this point clearly indicated that the pricers were making decisions using some criteria other than just dollar threshold, our next question attempted to determine what factors were used in making that decision. The purpose of the question was only to determine

what factors were considered important by the pricers. In this question we did not attempt to obtain definition of the factors or a ranking or prioritization of the factors. We believed that these items were not necessary at this point in the interviews since the factors mentioned in response to this question would be used only as a foundation for later questioning.

QUESTION 3c: ON WHAT BASIS IS THE DECISION MADE?

RESPONSE	AFCL	AFSC	COMBINED
Workload	21%	72%	50%
Complexity	71	22	44
Contracting officer experience	29	56	44
Contractor	0	6	3
Dollar value	21	11	16
Completeness of proposal	36	39	38
Political pressure	7	17	13
Type of contract	29	22	19
Amount of competition	14	11	12
Performance period	7	6	6
Special provisions	14	22	19

NOTE: Percentages add to more than 100 percent because multiple responses were allowed.

As was expected, workload was listed as the most important factor. This is logical since no decision would have to be made if workload was not a problem. The response to this question seems to indicate that AFLC has a much lower workload problem than does AFSC. This was also indicated in question 3a which showed that the majority of the pricers in AFLC felt that less than ten percent of the contracts were returned to the contracting officers, while the majority of the pricers in AFSC felt that more than 30 percent of the contracts were returned.

While AFSC cited workload as the primary factor, AFLC cited complexity most often. In all of the other factors, the commands showed little difference. Detailed discussions of these factors and the basis for the factors are provided in the analysis of question #7, #8, and #9.

Our final question in the area of non-adherence to the threshold rule was to determine if the individual pricing offices had a written policy of how these decisions should be made. We found that only one office in both AFSC and AFLC had a written policy. The policy was a pricing office operating instruction which was prepared by the Chief of Pricing for internal use within the pricing office.

QUESTION 3d: IS THERE A WRITTEN POLICY?

RESPONSE	AFLC	AFSC	COMBINED
Written policy	29%	0%	13%
No written policy	71	100	87

Question #4. The first three questions indicated that contracting officers were, on a somewhat regular basis, having to analyze pricing cases which were above the threshold. In other words, contracting officers were performing price analysis which according to office instructions should have been handled by the pricers. Since this was the case, we sought to determine if there was any perceived difference between the quality of the work performed by the price analysts as compared to the work performed by the contracting officers. Our purpose here was to find out if the pricers had any special skills or unique talents above those of the contracting officers.

QUESTION #4: DO YOU FEEL THAT THERE IS A DIFFERENCE IN THE EFFECTIVENESS (ACCURACY, COMPLETENESS, TIMELINESS, DOLLAR SAVINGS TO THE GOVERNMENT, ETC.) OF PRICING ACTIONS PERFORMED BY THIS OFFICE AS COMPARED TO PRICING ACTIONS PERFORMED BY THE CONTRACTING OFFICERS?

Since we asked this question only of the pricers we expected an overwhelming "yes" response, and we received one. Every pricer stated that pricers performed a better

job than contracting officers in the area of pricing. Most felt that pricers did significantly better. Typical comments included a comparison of pricers to buyers as analogous as comparing doctors to nurses. Other comments included statements such as, "CO's just don't have the ability to do pricing," "Most CO's don't like pricing and therefore do a poor job," and "Many times the CO's just give away the farm."

We recognized the inherent weakness of asking the question only of pricers. We expected the responses to be heavily biased; however, we included the question mainly as a starting point to determine why pricers considered themselves so much better in pricing than contracting officers. Our objective was to determine what factors made the pricers such experts in the field.

QUESTION 4a: WHY ARE PRICERS BETTER THAN CO'S IN PERFORMING PRICING ACTIONS?

RESPONSE	AFLC	AFSC	COMBINED
Educational background	57%	49%	53%
Technical Training	43	44	44
Experience	50	44	47
Focus/attitude	64	56	59

NOTE: Percentages add to over 100 percent since multiple responses were allowed.

As shown above, the most cited answer was that the "focus" was different between pricers and buyers. By this the pricers meant that the two groups looked at the task of pricing differently. The pricers see pricing as their primary task and one that had to be done thoroughly and completely in all cases. The contracting officers, on the other hand, see pricing as just one of many tasks which must be completed in order to get the contract awarded. It has no more importance than any other contracting task. Further, pricers stated that the contracting officers faced a number of time pressures which were not so evident in the pricing office. Contracting officers are constantly under pressure from the customer to get a contract awarded as soon as possible. While pricers are faced with time standards for performing a pricing task, the pressures are not as intense. Pricers stated that the combination of the need to get the job done quickly and the fact that pricing was just one of many tasks for the contracting officers greatly contributed to the poor quality of pricing actions performed by the contracting officers.

Experience and educational background were also cited as important factors. Experience was defined as the amount of time spent in the area of pricing. The pricers stated, in general, that since pricing was all they did and since

they did it on a regular basis, they were naturally better at it. Conversely, since the contracting officers performed pricing only on an intermittant basis, they were not as skilled in the area. The educational background of the two groups was also mentioned a number of times. Pricers, for the most part, had a strong background in accounting and financial management, and stated that this background was necessary to understand the complex accounting systems of most defense contractors. For instance, in one AFLC office of the fourteen price analysts, all had an accounting degree, three had Masters Degrees in Accounting, and one had a CPA. While this is perhaps higher than the Air Force average of 60 percent accounting degrees in pricing, it shows the depth of accounting knowledge. In the contracting offices on the other hand, only about 40 percent of the professional personnel have degrees and many of the degrees are in areas not related to accounting (15:121). The pricers felt that this lack of an accounting background was of critical significance to the quality of the pricing performed.

While technical training was also cited as a factor which contributed to the different quality of pricing actions, this factor was considered somewhat less important than education and experience. Further, the pricers stated that technical training by itself, without the prior educational

background, and without continual experience in pricing, would not suffice to make for a quality pricer.

In the discussions of these four factors of education, experience, training and focus, the pricers continually mentioned the "skill" of the pricer. This was usually defined as a "knack" to do pricing. While it was related somewhat to the four factors, it seemed to be more related to a natural ability to do the pricing and a natural liking of the pricing job. A frequent comment was that all pricers had the "knack" since those who didn't had long left the pricing field. However, since only a small portion of the contracting officers' jobs involved pricing, most of the COs did not have this "knack" for pricing. This seems to indicate that the pricers feel that even with increased training, contracting officers would not improve their pricing skills.

Question #5. After discovering the reasons why pricers felt they performed a better job, we asked if the pricers had any evidence to support their assertion. The purpose of this question was to determine if the pricers could back up their answer to question 4.

QUESTION 5: DO YOU HAVE ANY EVIDENCE OR INFORMATION WHICH COULD BE USED TO SUPPORT YOUR ANSWER TO QUESTION 4?

RESPONSE	AFLC	AFSC	COMBINED
Reviews of PNMs	79%	83%	82%
Subjective feelings (no evidence)	14	0	5
Pricing saves more	7	17	13

We found some support of the pricers' responses to question #4. Most of the pricers stated that reviews of the PNM's of contracts priced by the contracting officers revealed that the CO's were not doing a good job of performing the pricing task. Most pricers felt that based upon the PNMs, the COs were missing essential cost areas, were not negotiating "hard enough", and were not documenting the file properly. However, since the pricers review only the PNMs and did not review the complete file, it could be argued that perhaps only the documentation was poor and not the actual pricing task. A few of the pricers stated that on the average pricers saved the Government 10-15 percent more than did the contracting officers. However, no evidence was given to support this claim.

Detailed Questions

In the first five questions discussed above, we attempted to develop background information and a basis for

further questioning. The last five questions dealt directly with the effectiveness of the dollar threshold and on ways that the decision criteria might be improved. Our sixth question dealt with the effectiveness of the dollar threshold. Our purpose was to determine if the pricers felt that the threshold adequately identified those contracts which required the special "knack" of pricers discussed in question 4.

Question #6. QUESTION 6: HOW EFFECTIVE DO YOU THINK THE DOLLAR THRESHOLD IS AS A DECISION RULE?

RESPONSE	AFLC		AFSC	
Threshold is effective as is	35%		6%	
Threshold concept is effective but amount should be raised	29		0	
TOTAL EFFECTIVE		64%		6%
Threshold is not effective at all	36		76	
Threshold is not effective but is only thing practicable	0		18	
TOTAL NOT EFFECTIVE		36%		94%

The responses reveal a marked difference between AFLC and AFSC. The difference is so great that any combined percentages would be meaningless, and therefore were not

computed. In AFSC, 94 percent felt that the dollar threshold was not effective. Most of the AFSC pricers stated that to really identify those contracts needing the special skills of pricers would require review of the contract and the consideration of a number of factors in addition to the dollar value. However, a number of these pricers added that while the dollar threshold was not totally effective it was the only thing practicable. The general attitude was that any other method would require an in-depth analysis of the contract prior to making a decision and that this would require too much time and effort. An interesting note, however, is that based upon the responses to questions 2 and 3, this in-depth analysis is already being performed on those contracts which must be returned to the contracting officer due to workload problems.

In AFLC, on the other hand, the vast majority stated that the dollar threshold was very effective. A few, but not a large number, suggested raising the limit of the threshold. This difference, we feel, can be attributed to a difference in philosophy between the two commands. As discussed earlier, AFLC has one threshold for all of its offices, while AFSC has a number of different thresholds set by the individual offices. Further, AFLC buys relatively standard off-the-shelf type items, while AFSC buys a number of different types of items ranging from R&D to production items.

Question #7, #8, #9. After discussing the effectiveness of the threshold we asked the interviewees to provide alternative factors which they would use if they were free to determine their own decision rule. Surprisingly, even though the majority of AFLC pricers felt that the dollar threshold was effective, they still suggested a number of other factors which they would use given the opportunity. Our purpose here was to determine what factors are considered important in the pricing decision. We also wanted to obtain a ranking of the factors and an operational definition for each factor. Questions #7, #8, and #9 were used together to obtain this information. The interviewees were asked to think of all possible factors, define each one, and to select and rank the five most important.

QUESTION #7: IF YOU COULD RECOMMEND A METHOD WHICH CONSIDERS FACTORS OTHER THAN DOLLAR THRESHOLD, WHAT FACTORS WOULD YOU RECOMMEND?

QUESTION #8: PLEASE DEFINE EACH OF THE FACTORS LISTED ABOVE. MAKE YOUR DEFINITIONS AS SPECIFIC AS POSSIBLE. FOR INSTANCE, IF YOU'VE LISTED TYPE OF CONTRACT AS A FACTOR, YOUR DEFINITION MIGHT BE "AS DEFINED BY DAR."

QUESTION #9: OF THE FACTORS LISTED ABOVE, SELECT THE FIVE (5) YOU CONSIDERED TO BE THE MOST IMPORTANT. INDICATE WHY YOU FEEL THESE ARE IMPORTANT FACTORS AND RANK THEM IN ORDER OF IMPORTANCE WITH THE MOST IMPORTANT RANKED #1.

Identification and Definition of Factors

The pricers cited eleven (11) factors as being important in the decision to perform price analysis on a particular contract. These factors were discussed in detail in order to obtain a clear, concise, operational definition which did not require any subjective judgement. However, on some factors such as Contracting Officer Skill, we were not able to do this. The definition put forth by the majority of the pricers was subjective and judgemental and all attempts to definitize it failed. The eleven factors and their definitions are as follows:

FACTOR	DEFINITIONS
CONTRACTING OFFICER SKILL	How good of a pricer the CO who would be assigned the action is. According to the pricers, this does not relate to the number of years of experience of the CO, or the number of pricing courses taken. Rather it depends upon whether the CO has the "knack" for pricing. In each pricing office the pricers felt that they could identify those COs who possessed this "knack".
TYPE OF CONTRACT	Reimbursement arrangement as defined by DAR (includes FFP, FPIF, CPFF, CPIF, CPAF, CR).
NATURE OF BUY	Type of action based upon the history of the buy. Whether the item is an initial buy or a follow on effort for an item purchased previously.

FACTOR	DEFINITIONS
AMOUNT OF COMPETITION	Whether effort is sole source or competitive.
CONTRACTOR	The difficulty of dealing with the particular contractor involved. It is a function of the contractor's accounting system, past performance during negotiations, and complexity of proposals.
AMOUNT OF DATA AVAILABLE	Amount and quality of data available for analysis. Depends upon quality and findings of the audit report, and information in contracting files for same contractor or like items.
PERIOD OF PERFORMANCE	Length of time from the date of award of the contractor to completion or delivery of final item.
SPECIAL PROVISIONS	Special pricing arrangements as evidenced by presence of escalation clauses, state tax clauses, or milestone--billing provisions.
DOLLAR VALUE	Amount of estimated cost proprosal.

After each pricer identified and defined the factors considered to be important, he was asked to select and rank the five that he considered to be the most critical in the pricing decision. The rankings are shown on the following tables. Factors are shown with a one (1) for the factor selected as most important and a five (5) for the

Table 1

Ranking of Factors--AFLC

Factors	Interviewee Number													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Contracting Officer Exp.		1	1											
Type of Contract	4			3				1	4		1	2	4	4
Nature of Buy	3			1		1		5	2	4	2	3	1	2
Type of Instrument								2						
Complexity								2		5	4	1	3	5
Amount of Competition	1									1				3
Contractor				2					3	3				
Amount of Data	2		2				2	4	3	2	3	4	2	1
Performance Period						4								
Special Provisions			3											
Dollar Value						3			1					

Table 2

Ranking of Factors--AFSC

Factors	Interviewee Number																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Contracting Officer Exp.			3		1		4	2	3		1	2	1				3	
Type of Contract	1	3	2	3			1	4	1	1		1	4	3	2	1	3	
Nature of Buy			1	4		3	3		2		3					3		3
Type of Instrument	3																	
Complexity	2			1	2			1			2		2				1	
Amount of Competition		4	5					5	4									2
Contractor				2														
Amount of Data			4		4	1												
Performance Period	5																	
Special Provisions	4	2			5	2				2	5	3		4				
Dollar Value														2	1	4	2	1

factors considered the least important. Some interviewees identified less than five factors and therefore ranked less than five factors.

Analysis of Rankings

As discussed in Chapter 2, our purpose in obtaining a ranking of factors was to develop a model based upon the rankings and decision rules provided by the interviewees. The decision rules were provided in response to question ten which will be discussed later. However, prior to using the decision rules in the development of our model, we tested the rankings for consistency. If the rankings were not consistent, their use in the development of a model would be questionable. Therefore, before conducting an analysis of the response to question ten, the rankings provided in question nine were analyzed.

Consistency was tested through the use of the Kendall W test described in detail in Chapter 2. In performing the test, we used the standard SPSS subprogram NPAR test package. Therefore, test statistics were not computed manually; however, a listing of the applicable formulae for the tests is shown in Appendix H. In using this test, we established a data file of the rankings provided by the pricers. A separate file was established for each command as well as a file for all of the responses. Each file

contained the number of cases (interviews) in the file, and consisted of 11 variables, one for each factor. The rankings (1-5) for each factor were recorded in the data file whenever the factor was ranked for a specific case. If the factor was not ranked, a value of six was given to the variable. For example, the data file for AFLC interviewee number one (1) was as follows:

6 4 3 6 6 1 6 2 6 6 6

A complete listing of all of the data files the programs used to run the Kendall test and the program output are contained in Appendices E, F, and G.

In performing the Kendall test, we realized that since in every case at least seven out of eleven variables would be ranked as a six (showing non-selection) that the test was actually testing the consistency of those not ranked. However, since all cases contained the same 11 factors, if the results showed consistency of the factors not ranked, consistency of the factors ranked could be assumed.

The results of the Kendall W test are as follows:

AFL	W	Chi-Square	Significance Level
AFLC	.2692	37.6891	.0000
AFSC	.2692	48.4485	.0000
COMBINED	.1992	63.7479	.0000

In the Kendall test a W score of close to one usually indicates consistency, so it may appear from the results above that there is no consistency in the responses. However, the significance level is also a measure of consistency--one which takes into consideration both the W score and the Chi-square statistic. The Chi-square statistic is a measure that when tested with the degrees of freedom indicates the probability that our null hypothesis (no agreement exists) can be rejected. Due to the high Chi-square statistic in all three tests, which allows for the rejection of the null hypothesis at significance levels of less than .001, we were able to conclude that the consistency indicated by the Kendall test was due to more than pure chance (17:237). On this basis, we concluded that there was consistency in the five factors selected most often, but we were not able to conclude consistency in the ordering or ranking of the five factors.

Therefore, in order to develop an ordering of the five factors, were performed two tests. One was the computation of weighted averages based upon the ranks provided during the interviews, and the second was a review of the Kendall mean ranks. Both of these tests produced the same results and showed the ordering of the top five factors to be as listed below.

AFLC

Nature of buy
Amount of data
Type of contract
Contracting officer skill
Complexity

AFSC

Type of contract
Contractor
Contracting officer skill
Complexity
Nature of buy

As can be seen from the rankings above, not only are the factors which were considered important consistent, the selection of the top five is also very consistent between the commands. Four out five of the factors are the same in both groups, and the factors which are different are quite related. The amount of data available is, in many cases, related to whom the contractor is. Because the rankings by command were so similar, we felt that further analysis and model development could be done on the basis of a combined ranking of the results of the two commands. The combined ranking was computed in the same manner as the individual rankings and produced the following five factors in order of importance.

Type of contract
Nature of buy
Contracting officer skill
Complexity
Contractor

We find this final ranking interesting from two standpoints. First, complexity is ranked last of the five factors. This factor was mentioned in all of our preliminary interviews and was constantly discussed during the data collection interviews. Yet, when ranked against other factors, the pricers found complexity to be relatively unimportant. The second interesting feature is that dollar value does not even make it to the top five. This seems to be inconsistent with the responses to question ten.

Question #10. In question #10 we asked the pricers to develop decision rules for the factors which they felt were the most significant. We specifically asked for a decision rule which could stand alone; in other words, one which could be used without the consideration of any other factor. However, the pricers for the most part would not commit themselves to rules which did not in some way consider dollar value. The pricers stated that any decision rule had to be used in conjunction with the dollar value of the proposal. The decision rules proposed for the top five factors on an Air Force wide basis are as follows.

QUESTION 10: FOR EACH OF THE FIVE FACTORS SELECTED ABOVE, PROVIDE A DECISION RULE WHICH YOU FEEL WOULD BE APPROPRIATE TO USE IN DECIDING IF A PRICING ACTION SHOULD BE ACCEPTED BY THIS OFFICE. FOR EXAMPLE, IF ONE OF YOUR FACTORS IS TYPE OF CONTRACT, YOUR DECISION RULE MAY BE "ALL COST TYPES SHOULD COME HERE, ALL FIXED PRICE SHOULD GO TO CONTRACTING OFFICER."

FACTOR	RULE			
TYPE OF CONTRACT	a. FFP & incentive to pricing Cost to CO	29%	78%	56%
	b. FFP to CO all other types to pricing	14	22	19
COMPLEXITY	Complex go to pricing Non-complex go to CO	36	67	53
CO SKILL	CO is competent--CO CO is not--pricing	21	44	34
NATURE OF BUY	Follow or standard items to CO Non-standard to pricing	43	36	34
CONTRACTOR	Accounting system is difficult, poor history for negotiations complex proposal--go to pricing Non-difficult, etc. go to CO	43	44	44

Model Development

As discussed earlier and in Chapter 2, we intended to develop decision rules which (1) could stand alone and be used as the basis for decision tree analysis, and (2) reflected agreement of at least 51 percent of the pricers. However, this was not feasible. First, only two of the decision rules reflected agreement of at least 51 percent; and second, four out of the five decision rules not only required subjective evaluations, they also contained the caveat that they were to be used in conjunction with some dollar level.

Therefore, since the use of decision tree analysis was not appropriate, we took a different approach in developing our model. We included all five decision rules which related directly to the top five factors in our model, giving equal weight to each rule. In other words, no attempt was made to weight the factors to reflect the ordering or ranking. In making a decision with the model, our model called for a separate decison to be made on the basis of each decision rule. The decision (either for pricing or for the CO) which received the majority of the decisions made on the basis of each decision rule would reflect the overall decision of the model. For example, if three of the decision rules resulted in a decision that

the action should be priced by the CO, and two of the rules resulted in a decision for the pricing staff, then the overall decison would be to have the action priced by the CO.

Test of the Model

To test the model we abstracted information pertaining to the decision rules from the selected contract file. However, we found that we could abstract information on only three of the five decision rules. Information was not available to make a decision on the CO skill or the amount of data. Therefore, these decision rules were not used in this instance. The results of our decisions based upon the model (reflecting only three factors) are shown in the following tables.

The results indicate that the inclusion of factors other than dollar value in the decision making process produces decisions different than those produced by use of the dollar threshold alone. According to our results, 19 of the 47 contracts tested (40.4 percent) were priced by the wrong office. Of the 24 contracts originally sent to pricing, 14 should have been handled by the contracting office; of the 23 contracts originally handled in the contracting office, five should have been sent to pricing. By command, the results were as follows.

Table 3

Model Results--AFLC

Contract Number	Threshold Decision	Model Decision
1	CO	CO
2	P	CO
3	CO	CO
4	P	CO
5	CO	CO
6	P	CO
7	P	CO
8	CO	CO
9	P	CO
10	P	CO
11	CO	P
12	P	CO
13	CO	CO
14	CO	CO
15	CO	CO
16	CO	CO
17	CO	CO
18	P	CO
19	CO	CO
20	P	CO

P = Pricing

CO = Contracting Officer

Table 4

Model Results--AFSC

Contract Number	Threshold Decision	Model Decision
1	P	P
2	P	P
3	P	P
4	P	P
5	P	P
6	P	P
7	P	CO
8	P	P
9	P	CO
10	P	P
11	CO	CO
12	CO	CO
13	CO	P
14	CO	CO
15	CO	CO
16	CO	P
17	CO	CO
--		
18	CO	CO
19	P	P
20	P	CO
21	CO	P
22	CO	P
23	CO	CO
24	CO	CO
25	P	P
26	P	CO
26	P	CO

P = Pricing

CO = Contracting Officer

AFLC

Of 9 originally handled in pricing,
9 should have been handled by the CO

Of 11 originally handled by the CO,
1 should have been handled by pricing

AFSC

Of 15 originally handled in pricing,
5 should have been handled by the CO

Of 12 originally handled by the CO,
4 should have been handled by pricing

These results indicate a number of things. First, the use of the model does appear to change the outcome of pricing decisions. Second, while the use of the model results in no net change to the number of contracts priced by pricing personnel in AFSC, it does produce a significant change for AFLC personnel. The use of the model results in only one out of twenty AFLC contracts being priced in the pricing office, with all of the remaining being priced by the CO. This suggests that the pricing offices in AFLC could be descreased significantly.

While the use of this model does result in different decisions than the use of the dollar threshold alone, its use and therefore the results are subject to a number of limitations. First, while the model developed based upon the interviews calls for the inclusion of five decision rules, only three were included in the test model due to lack of information on the other two. The inclusion of the other two rules could alter the results of the test. Second, the use of the model calls for subjective and judgemental evaluations which should be made by pricing experts. While we did use the information provided by pricing experts to make our decisions, we are not pricing experts. The results of the test may have been different had the decisions been actually made by the pricing experts. Third, no weighting was assigned to any factor; all were given equal consideration. If a weighting was assigned based upon the ordering of the top five factors, the test results could have been different. And fourth, data from contract files were abstracted from files at only one location for AFLC (SAALC) and from only one major AFSC office (ESD) and one non-major AFSC office (R&D Contracting). Had contracts been selected from additional bases, the test results might have been different.

Chapter 4

FINDINGS AND RECOMMENDATIONS

This chapter discusses our overall findings and how they relate to the research objectives and questions, our recommendations for a pricing policy, other related observations, and our recommendation for future study.

Achievement of Objectives/Questions

As a result of this research effort, all of our objectives were, although to varying degrees, met. Our first objective was to determine what criteria are perceived, by the pricing community, to influence the need for pricing staff action. This study revealed that 11 factors, listed below, were considered important.

CO experience
Type of contract
Nature of buy
Type of instrument
Complexity
Degree of competition
Contractor
Amount and completeness of field reports
Performance period
Special provisions
Dollar value

We believe that these results fully meet the first research objective. However, we feel that we have only

partially met the other two objectives and that these areas warrant further study.

The second objective was to develop a decision model, based upon a decision tree analysis, that would predict when pricing staff action should be performed. While we did develop a model, it was not based upon a decision tree analysis. Rather the model was simply a statement that the top five factors should be used in the decision making process which employs a "majority rule" decision. This model can, however, be used for predictive purposes if the pricing experts use their subjective judgement in applying the model.

The third objective was to test the model to determine if its use resulted in a different decision than the use of the dollar threshold. While we tested the model in this manner and determined that the results were different, the test is suspect for two reasons: first, the model called for subjective evaluations by pricing experts, and we are not pricing experts. Second, because of the unavailability of information, we were able only to make judgements on three of the five factors. Therefore, two factors which should have been included were not.

Our research provided answers to all of the research questions. Our first question asked how the current method could be improved. Our findings indicated that the current

method could be improved by the inclusion of other criteria, in addition to dollar value, in the decision making process. Inclusion of additional criteria would alleviate the following two deficiencies noted in the current method.

1. The present method is not effective in identifying the contracts which require the specialized expertise of the pricing staff.

2. The threshold rule, in practice, is not enough of a basis for a decision.

The second question dealt with determining what factors the experts considered important in the pricing decision. Our research identified the 11 factors listed earlier.

The third question focused on the difference between the skill of the pricers versus the skill of the COs. Our research indicated that the "skill" is really a knack or ability to perform pricing which is related to education, experience and training. Further, the ability to use this knack depends upon the focus or attitude of the person performing the analysis.

The fourth research question asked for a definition of complexity. Our interviews revealed that most pricers defined complexity from a technical standpoint. Complexity involved the state-of-the-art, the level of technology, and the existence of special technical features

such as Reliability Improvement Warranty (RIW) or Design to Cost (DTC).

The final question, and perhaps the most important, asked if the use of criteria other than dollar threshold would result in decisions which would provide a more efficient use of resources, i.e., the pricing staff. Based upon our model's test, we answer this question with a qualified "yes". Since the use of the model resulted in different decisions, and since the model was based upon criteria which pricing experts indicated were important, we conclude that the model's decisions provide a more efficient use of resources.

Findings

With most efforts, research is undertaken with the intent of having the findings either prove or disprove certain a priori expectations. This effort was an exception in that we had no expectations to prove or disprove. We did however believe, with some justification, that other criteria besides dollar value could be used in the pricing decision. Our efforts were directed to determining if our beliefs were merited. In Chapter 3, we described the identified criteria, and the decision model developed from them. Throughout that chapter, we either directly referred to or alluded to several overall findings of this effort. For purposes of summation, these findings can be divided

into major and minor categories. In the major category we included:

1. AFLC appears to be pricing more proposals than it needs to.

2. AFSC while maintaining the same relative workload, requires a shift in emphasis on which proposals should be priced.

In the minor category we included:

1. Most pricing divisions are implicitly using the identified criteria. However, this is being done only when workload becomes a factor and, with the exception of two pricing offices, no written policy on the use of the criteria is available.

In addition to these findings, were received several observations/comments from those we interviewed. The following is a list of observations we derived from the comments of the interviewees.

1. COs, as a whole, do not possess the expertise to analyze many of the contracts. This opinion seemed more prevalent within AFLC than AFSC.

2. The five identified criteria should be used as a basis for making the pricing decision, in conjunction with a dollar threshold level. While this is somewhat similar to current practice, the major difference is that all proposals above the threshold would always be evaluated not just when workload is a factor.

3. Each pricing office should establish a written policy for its decision criteria and should coordinate that policy with the contracting office.

4. When efforts must be returned to the CO for action, a partial analysis should be accomplished. The procedure currently used at SAMSO could be used as a guideline.

5. AFLC should critically examine its use of $100,000 as a threshold level. The level should be periodically examined and possibly tied to an index.

6. The $100,000 threshold, established by PL 87-653, was set in 1962. It is outdated and should be raised to parallel the rise in the consumer price index. The time required to analyze a proposal has not changed over the years; however, the amount of money saved per effort has declined because the contractors are more aware of the government's requirements for proposals and thus submit better proposals. In addition, the salary of the average analyst has risen since 1962. As a result of the above factors, pricing of a proposal in the neighborhood of $100,000 is no longer cost effective.

7. The pricing office should receive all proposals above a minimum threshold. For proposals above this minimum but below some higher threshold, the pricing office should compare the proposal to the field audits. If the differences do not exceed a specified percent the proposal should be returned to the CO, otherwise, the pricing office should conduct the analysis.

8. The threshold level should be raised to $500,000 as recommended by Senator Childs.

9. Tie any increase in the threshold level to the requirement for a contractor to file a DD 633.

Significance of Findings

Comparing the results of the model's tests to our a priori expectations, provided some unexpected results. As stated in the problem statement, in Chapter 1, we believed that criteria existed which were inherent in all contracts and which could be used to determine which proposals required specialized analysis by the pricing office. We further believed that by identifying these factors, proper emphasis could be placed on those proposals which required the expertise of the pricing staffs. Thus, we expected the test results to show a change in emphasis on

who performs the analysis, but no drastic change in the number of proposals analyzed by each divisi[illegible].

Test results of the model on contracts sampled from AFSC were just as expected. As previously mentioned, of the 27 AFSC contracts sampled, 15 were originally analyzed by pricers while 12 were analyzed by COs. After application of the model, 33 percent should be analyzed by pricers while 67 percent should be analyzed by COs. Although there was no drastic change in the number each division should analyze, the emphasis was redirected as evidenced by the nine contracts which changed divisions. Unlike the AFSC results, quite different results were found with the AFLC sample contracts.

Model results of the AFLC sampled contract indicated a very significant change in workload. Of the 20 contracts from an ALC, half were originally analyzed by pricers and half by COs. The model results indicated that only one needed the pricing division's expertise. This result, if replicated, could prove to have a far reaching effect upon the workforce makeup of this ALC. In fact, if the other ALCs were sampled, similar results would necessitate a command-wide evaluation by AFLC of its workforce at each ALC.

Recommendations for Further Study

As a result of this effort, we have several recommendations which we believe would inhance and refine the results already obtained. These recommendations can be divided into two areas: (1) recommendations concerning the criteria used in the model, and (2) recommendations concerning testing the model.

Model criteria. Currently the model's decision of who performs the pricing action is based upon a simple "majority rule". This occurs because the criteria are not weighted. The decision can be refined by weighting the criteria included in the model. The weighting will remove the subjectiveness of the overall model decision.[3] This weighting process can be accomplished in three steps.

The first step would involve formally defining each criteria identified in this research effort. This is necessary so that future interviewees will have a common ground from which to rate.

Second, some form of a Likert scale should be devised so that each criteria can be weighted either against the other criteria or against overall importance.

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[3]Some subjectiveness would still exist in some of the criteria, for example, CO experience.

The third step would be to incorporate the first two steps into a questionnaire, and to take a larger sample of the pricing community. In fact, a sample of the entire pricing population could be made without difficulty.

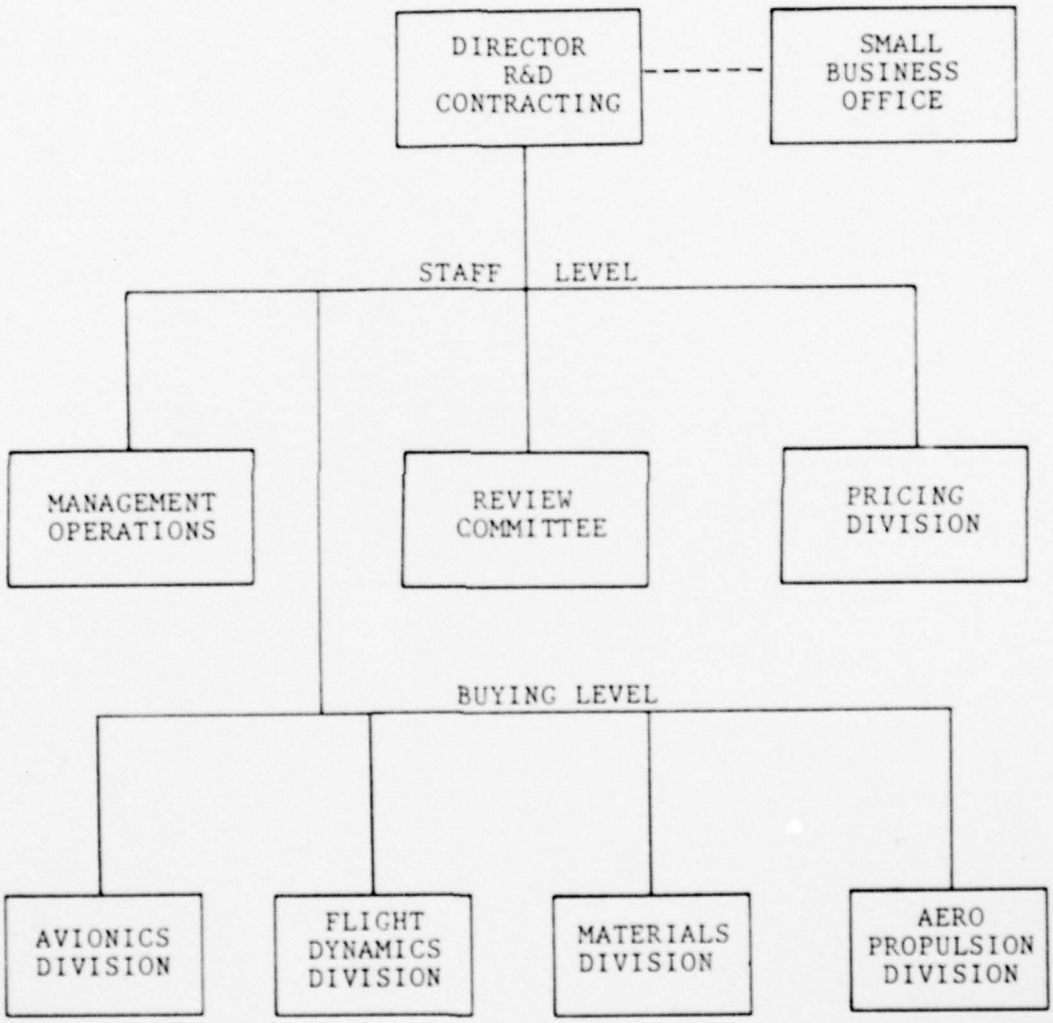
Model testing. In addition to enhancing the model, we believe that further tests of the model should be performed. Further tests, with the enhanced model, should be conducted to refute or confirm the preliminary findings. We firmly believe that in light of the surprising results from San Antonio ALC's sampled contracts, contracts from all the ALCs should be sampled and included in the model's tests.

Other Related Findings

Two findings were revealed in areas related to pricing but not directly related to the dollar threshold or other criteria. The first is that the Copper Impact System is not being used by most of the AFLC offices and by a number of the AFSC offices. This seems to be due to a lack of understanding of the system and the inappropriateness of many of the standard impact programs. The second finding is that pricing offices have a need for someone with both pricing and computer programming ability. Further study in these areas is warranted.

APPENDIX A

DIRECTORATE ORGANIZATION CHART


DIRECTOR
R&D
CONTRACTING
SMALL
BUSINESS
OFFICE
STAFF LEVEL
MANAGEMENT
OPERATIONS
REVIEW
COMMITTEE
PRICING
DIVISION
BUYING LEVEL
AVIONICS
DIVISION
FLIGHT
DYNAMICS
DIVISION
MATERIALS
DIVISION
AERO
PROPULSION
DIVISION

APPENDIX B

PRIMARY POPULATION

Air Force Logistics Command

*Oklahoma City Air Logistics Center (ALC)
*Ogden ALC
*San Antonio ALC
*Warner Robbins ALC
*Sacramento ALC

Air Force Systems Command

Major Centers
*Aeronautical Systems Division
*Electronic Systems Division
*Space and Missile Systems Organization

Non-Major Centers
*Armament Development and Test Center
Air Force Flight Test Center
Rome Air Development Center
*Directorate of Research and Development Contracting
Air Force Contract Management Division
Directorate of Contracting, Space and Missile Technical Center
Arnold Engineering Development Center

Selected offices included in the population are marked with an asterisk.

APPENDIX C

LETTER TO INTERVIEWEES

DEPARTMENT OF THE AIR FORCE
AIR FORCE INSTITUTE OF TECHNOLOGY (ATC)
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

May 4, 1979

Dear :

You have been selected, as a pricing expert, to participate in our Air Force Institute of Technology (AFIT) research thesis on the effectiveness of the use of a dollar threshold as the sole criterion for determining when a proposal is forwarded to the pricing office for analysis. The objective of the research thesis, which is being sponsored by HQ USAF, is to determine the feasibility of using other decision criteria.

Within the next three weeks, Capt. McConnell or I will contact you and arrange a convenient time for a telephone interview with you on this subject. The interview will last approximately one hour and will follow the attached interview guide. Since the validity of our research results will depend, in part, on the independence of the responses, please do not discuss the interview questions with others in your office. Your responses will be kept confidential. All responses will be tabulated and reported by categories only so that no specific response will be attributed to any individual.

The results of the effort will be forwarded to HQ USAF for possible use in future pricing policy decisions. Your cooperation and support of this effort would be greatly appreciated.

MARGARET A. MARTINEZ
AFIT/LSG Class 79B

APPENDIX D

INTERVIEW GUIDE

1. According to your Office Operating Instruction, a dollar threshold is the sole criterion for determining whether a pricing action is accepted by this office.

   a. In your opinion, what is the basis for the use of the dollar threshold as the decision criterion?

   b. In your opinion, what is the basis for the selection of the particular dollar value used as the threshold?

2. Do you know of any pricing actions accepted by this office which did not follow the dollar threshold rule? In other words, contracts above the threshold being returned to the Contracting Officer, or contracts below the threshold being accepted by this office?

3. If your answer to question #2 is yes:

   a. What percentage of the total number of contracts accepted by this office does not follow the threshold rule?

   b. Who makes the decision to accept/return these actions?

   c. On what basis is the decision made?

   d. Is there a written policy on this practice?

4. Do you feel that there is a difference in the effectiveness (accuracy, completeness, timeliness, dollar savings to the Government) of pricing actions performed by this office as compared to pricing actions performed by the Contracting Officers?

5. Do you have any evidence or information which could be used to support your answer to question #4?

6. How effective do you think the dollar threshold is as a decision rule?

7. If you could recommend a method which considers factors other than dollar threshold, what factors would you recommend? List as many factors as you can think of.

8. Please define each of the factors listed above. Make your definitions as specific as possible. For instance, if you've listed "type of contract" as a factor, your definition might be "as defined by DAR."

9. Of the factors listed above, select the five (5) you consider to be the most important. Indicate why you feel these are important factors and rank them in order of importance with the most ranked 1.

10. For each of the five factors selected above, provide a decision rule which you feel would be appropriate to use in deciding if a pricing action should be accepted by this office. For example, if one of your factors is type of contract, your decision rule might be "all incentive type contracts should be accepted by this office; no CPFF type contracts should be accepted by this office."

APPENDIX E

PROGRAM, DATA, OUTPUT--AFLC

AD-A075 582 AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH SCHOOL--ETC F/G 5/1
DEVELOPMENT OF IMPROVED CRITERIA FOR DETERMINING THE NEED FOR P--ETC(U)
SEP 79 M A MARTINEZ , T J MCCONNELL

UNCLASSIFIED AFIC-LSSR-1-79B NL

2 OF 2
AD-
A075582

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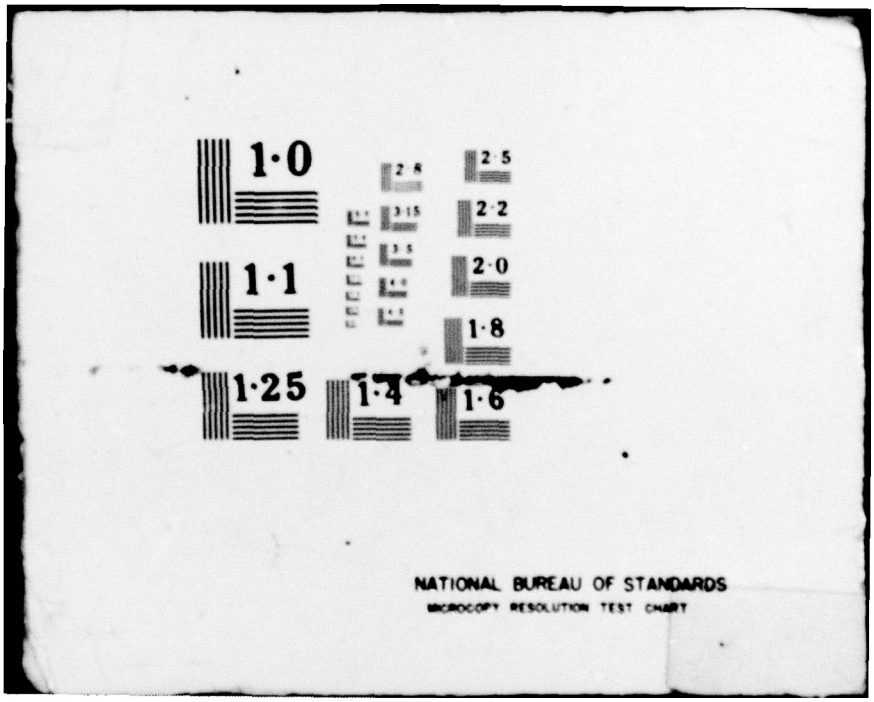
1·0
1·1
1·25
1·4
1·6
2·8
3·15
3·5
2·5
2·2
2·0
1·8
NATIONAL BUREAU OF STANDARDS
MICROCOPY RESOLUTION TEST CHART

```
100=RUN NAME        KENDALL W AFLC
110=VARIABLE LIST   A,B,C,D,E,F,G,H,I,J,K
120=INPUT FORMAT    FREEFIELD
130=N OF CASES      14
140=NPAR TESTS      KENDALL=ALL
150=OPTIONS         5
160=READ INPUT DATA
170=FINISH

        180=6 4 3 6 6 1 6 2 6 6 6
        190=1 6 6 6 6 6 6 6 6 6 6
        200=1 6 6 6 6 6 6 2 6 6 6
        210=6 3 1 6 6 6 2 6 6 6 6
        220=6 6 6 6 6 6 6 6 6 6 6
        230=2 6 1 6 6 6 6 6 6 6 3
        240=1 6 6 6 6 6 6 2 6 6 6
        250=3 1 5 6 2 6 6 4 6 6 6
        260=6 4 2 6 6 6 3 3 6 6 1
        270=6 6 4 6 5 1 3 2 6 6 6
        280=6 1 2 6 4 6 6 3 6 6 6
        290=6 2 3 6 1 6 6 4 6 6 6
        300=6 4 2 6 6 5 3 6 1 6 6
        310=5 4 1 6 3 6 6 2 6 6 6
```

- - - - - KENDALL COEFFICIENT OF CONCORDANCE

	A	B	C	D	E	F
MEAN RANK	5.429	4.750	3.607	7.714	5.821	6.429

	G	H	I	J	K
MEAN RANK	6.179	4.321	7.179	7.714	6.857

CASES	S	W	CHI-SQUARE	D.F.	SIGNIFICANCE
14	3661.5	.2692	37.6891	10	.0000

APPENDIX F

PROGRAM, DATA, OUTPUT--AFSC

```
100=RUN NAME        KENDALL W AFSC
110=VARIABLE LIST   A,B,C,D,E,F,G,H,I,J,K
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150=OPTIONS         5
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170=FINISH
```

```
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110=6 1 6 6 6 3 6 6 6 2 6
120=3 2 1 6 6 5 6 4 6 6 6
130=6 3 4 6 1 6 2 6 6 6 6
140=1 3 6 6 2 6 6 4 6 5 6
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190=6 1 6 6 6 6 6 6 6 2 6
200=1 6 3 6 2 6 4 6 6 5 6
210=2 1 6 6 6 6 6 6 6 3 6
220=1 4 6 6 2 6 3 6 6 6 6
230=6 3 6 6 1 6 6 6 6 6 2
240=6 4 3 6 6 6 2 6 6 6 1
250=6 1 3 6 6 6 2 6 6 6 4
260=6 3 6 6 6 6 1 6 6 4 2
270=6 2 6 6 6 6 3 6 6 6 1
```

- - - - - KENDALL COEFFICIENT OF CONCORDANCE

	A	B	C	D	E	F
MEAN RANK	5.278	2.639	5.583	7.667	5.389	7.111

	G	H	I	J	K
MEAN RANK	5.167	7.083	7.778	5.944	6.361

CASES	S	W	CHI-SQUARE	D.F.	SIGNIFICANCE
18	6979.0	.2692	48.4485	10	.0000

APPENDIX G

PROGRAM, DATA, OUTPUT--COMBINED

```
100=RUN NAME        KENDAL W
110=VARIABLE LIST   A,B,C,D,E,F,G,H,I,J,K
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130=N OF CASES      32
140=%PAR TESTS      KENDALL=ALL
150=OPTIONS         5
160=READ INPUT DATA
170=FINISH
```

```
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270=6 2 6 6 6 6 3 6 6 6 1
280=6 4 3 6 6 1 6 2 6 6 6
290=1 6 6 6 6 6 6 6 6 6 6
300=1 6 6 6 6 6 6 2 6 6 6
310=6 3 1 6 6 6 2 6 6 6 6
320=6 6 6 6 6 6 6 6 6 6 6
330=2 6 1 6 6 6 6 6 6 6 3
340=1 6 6 6 6 6 6 2 6 6 6
350=3 1 5 6 2 6 6 4 6 6 6
360=6 4 2 6 6 6 3 3 6 6 1
370=6 6 4 6 5 1 3 2 6 6 6
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390=6 2 3 6 1 6 6 4 6 6 6
400=6 4 2 6 6 5 3 6 1 6 6
410=5 4 1 6 3 6 6 2 6 6 6
```

```
100=6 1 6 3 2 6 6 6 5 4 6
110=6 1 6 6 6 3 6 6 6 2 6
120=3 2 1 6 6 5 6 4 6 6 6
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220=1 4 6 6 2 6 3 6 6 6 6
230=6 3 6 6 1 6 6 6 6 6 2
240=6 4 3 6 6 6 2 6 6 6 1
250=6 1 3 6 6 6 2 6 6 6 4
```

- - - - - KENDALL COEFFICIENT OF CONCORDANCE

	A	B	C	D	E	F
MEAN RANK	5.344	3.563	4.719	7.688	5.578	6.813

	G	H	I	J	K
MEAN RANK	5.609	5.875	7.516	6.719	6.578

CASES	S	W	CHI-SQUARE	D.F.	SIGNIFICANCE
32	15376.0	.1992	63.7479	10	.0000

APPENDIX H

KENDALL COEFFICIENT OF CONCORDANCE: W FORMULAE

Kendall W Statistic

$$W = \frac{S}{1/12k^2(N^3-N)}$$

where:

S = sum of squares of the observed deviations from the mean of R;

k = number of sets of rankings;

N = number of items ranked.

Chi-square statistic

$$\chi^2 = k(N-1)W$$

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