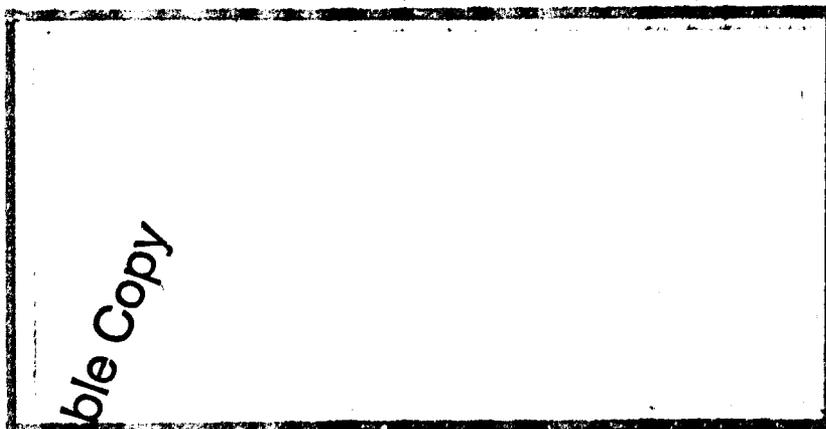


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AN ASSESSMENT OF THE PROBLEMS
SURROUNDING THE DATA ACQUISITION
PROCESS, AND POSSIBLE IMPROVEMENTS

THESIS

Daniel C. Brink, Captain, USAF

AFIT/GSM/LSY/90S-3

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AFIT/GSM/LSY/90S-3

AN ASSESSMENT OF THE PROBLEMS SURROUNDING THE DATA
ACQUISITION PROCESS, AND POSSIBLE IMPROVEMENTS

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 Systems Management

Daniel C. Brink, B.S.

Captain, USAF

September 1990

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Preface

The purpose of this study was to investigate problems in the data acquisition process. The study shows data is a cost driver and the poor training of data managers and lack of awareness of program managers costs the Air Force over \$1 billion yearly in excess contract costs. Seven studies, an auditor's report, and a survey of data managers were used to find common problems and possible corrective actions.

Many thanks are due to Ms Brenda Stanley for her assistance in securing information for this thesis and Professor Dan Reynolds for his technical assistance. I especially thank my advisor, Mr Samuel Epstein, who spent countless hours reviewing, encouraging, and supporting me on this effort. Mr Epstein continues the battle to improve the data acquisition process. His dedication to his work and his country were truly an inspiration that kept me going at those times when I'd have rather not.

Those deserving the most thanks are my family. My son, Tom, and daughter, Lisa, always understood when Dad was too busy, and they undoubtedly sacrificed the most for this thesis. My wife, Kathy, has now survived our second AFIT tour. Her encouragement, understanding, love, patience and sense of humor were abundant and continuous throughout this effort and without her, this effort truly would not have been possible. And finally, I thank the Lord for the strength and guidance he so generously bestows upon us.

Daniel C. Brink

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List of Definitions and Acronyms

- Data: A document, drawing, report, manual, revision, technical order, or other submission entered on the DD Form 1423 and required to be delivered to the government (10:9-29).
- Data Call: Where potential users of data are asked to identify their data requirements for a specific contract (3:5).
- Data Requirements Review Board, DRRB: This board is usually comprised of functional area representatives that have data requirements. They review all of the data requests for applicability. The DRRB is chaired by the program manager or designated alternate (3:6).
- P-value: The smallest level of significance at which the Null Hypothesis, H_0 , would be rejected when a specified test procedure is used on a given data set. It is customary to call the data significant when H_0 is rejected and not significant otherwise (11:311).

AE	Aeronautical Equipment SPO (ASD/AE)
AEOI	Aeronautical Equipment Operating Instruction
AFIT	Air Force Institute of Technology
AFLC	Air Force Logistics Command
AFFRO	Air Force Plant Representative Office
AFSC	Air Force Systems Command
ALC	Air Logistic Center
ASD	Aeronautical Systems Division
BSD	Ballistic Systems Division
CALS	Computer-Aided Acquisition And Logistic Support
CDRL	Contract Data Requirements List (DD Form 1423)
CM	Configuration Management
CPT	Critical Process Team
DID	Data Item Description
DMO	Data Management Officer

DOD	Department of Defense (also DoD)
DRAT	Data Review Action Task
DRRB	Data Requirements Review Board
EDM	Engineering Data Management
EM	Engineering Management
EN	Engineering (ASD/EN)
ESD	Electronic Systems Division
FAR	Federal Acquisition Regulation
GAO	Government Accounting Office
ICBM	Inter-Continental Ballistic Missile
MAPIT	MSD Acquisition Process Improvement Team
MIL-STD	Military Standard
MSD	Munition Systems Division
OSD	Office of the Secretary of Defense
PR	Purchase Request
PRP	Purchase Request Process
RFP	Request for Proposal
SOW	Statement of Work
SPO	System Program Office
SPSS-X	Statistical Package for the Social Sciences
SSD	Space Systems Division
TQM	Total Quality Management
YW	Training Systems SPO (ASD/YW)

Abstract

This ~~study~~^{Issue} investigated the data management and data acquisition area of the overall acquisition process. The investigation looked at seven studies, an Auditor General's Report, and a survey of data managers in Air Force Logistics Command and Aeronautical Systems Division of Air Force Systems Command. The purpose was to determine what problems with data management and data acquisition are universal across units, divisions, and commands. After identifying definite problem areas, the study probed the information to find what actions should be taken to improve the data acquisition process. The problems identified included a lack of personnel training, poor definition of data requirements, and a proliferation of data by the government. The study showed that data is a significant cost driver in the acquisition of systems and program managers are not aware of the extent of those costs. The data manager survey was examined to determine if AFLC and ASD data managers agreed as to the problems and possible solutions. Problems that permeate the acquisition process were found, thus enabling future policy decisions to address these problems. (54)

AN ASSESSMENT OF THE PROBLEMS SURROUNDING THE DATA ACQUISITION PROCESS, AND POSSIBLE IMPROVEMENTS

I. What Is Wrong with the Acquisition Process

The Department of Defense (DOD) must confront the challenge of implementing a new method to acquire weapon systems. The current system is overwhelmed with schedule slips, systems that do not perform up to standards after delivery, cost overruns, and nonsupportability after fielding the weapon systems. The President has directed the DOD to ". . . acquire needed new weapon systems at less cost, in less time, and with greater assurance of promised performance . . . and ensure the continued strength and readiness of the nation's Armed Forces" (9:2). Robert Costello, Assistant Secretary of Defense (Production and Logistics) declared that a one-percent improvement in the way we buy weapon systems would reduce costs by \$1.5 billion (7:4). There is a recognized need to change the business as usual way the DOD acquires weapon systems, but there appear to be severe differences of opinion as to just where the problem lies and what corrective actions need to be taken. This chapter attempts to identify reasons the present acquisition system is not working satisfactorily, and the impact this has on the budget and national security. The four areas of data management, regulations, personnel, and equipment are addressed.

Data Management

The current practice of requesting extensive data from contractors represents an unacceptably high cost to the DOD. In 1970 the cost of data that contractors delivered to the government represented a then unacceptable 14% of the weapon systems acquisition (22:1). Sixteen years later the problem had only gotten worse, with data requirements costs increasing to 20% - 50% of the total contract price for a weapon system (8:10-13). The problem is not solely that the data requirements placed upon the contractors are exorbitant, but sometimes the lack of data requested by the government also increases costs. If the technical data requested is not adequate, extensive costs are incurred in trying to recapture the data necessary for procurement or reprocurement of spare parts. Thus, the problem is not only quantity of data requested of the contractor, but requesting the right data. Three areas of data management found to be particularly critical are frequency of reporting, overspecification, and transfer of information.

In a recent letter to the President, the Secretary of Defense outlined plans to charter a joint Office of the Secretary of Defense (OSD) - Services task force to review DOD's systems acquisition. The task force is instructed to give ". . . special scrutiny . . . to those items that impose unnecessary reports and reviews on program offices and contractors" (9:13). Contractors often spend as much time doing the work required as they spend on the reporting

of that work, yet the government needs a way to keep track of the contractor's progress and make technical assessments. The government can take actions to acquire necessary information and relieve the contractor's reporting burden. Requests for proposal (RFP) should ask the contractor for suggestions to reduce data deliveries and associated costs. Also, instead of requiring monthly delivery of data (which by the time it is prepared and delivered is 60 - 90 days old) the government should require certain technical data be presented at on-site reviews every month, but not require delivery of that data to the government in formal reports (8:10-16). This allows the contractor to get on with the work instead of using valuable time and money to prepare formal reports of what he has already told the government.

Overspecification on the part of the government is also responsible for high acquisition costs. Not only does the government overspecify product requirements, it overspecifies technical data to be delivered. An example of product overspecification is the now famous \$7600 coffee pot for the C-5A. Adequate commercial airline coffee makers were available for \$3000, but government specifications required the coffee pot withstand 40 gravities of acceleration and operate in the event of cabin pressure loss. Consideration was not given to the fact that neither man nor aircraft could survive 40-Gs and it is unlikely that coffee would be served if an emergency such as loss of cabin pressure occurred (30:2). Similar overspecification occurs

in attempts to militarize technical data supplied to the government. For example, computer and support equipment areas can use commercially available equipment with commercially available manuals, yet in the past, military format has been unnecessarily requested, driving the cost ever higher (8:10-16).

In an effort to remedy the problems of timely transfer of the data requested of defense contractors, DOD and industry have joined in an effort to implement a Computer-Aided Acquisition and Logistics Support System (CALs). Planners envision CALs as a link among all defense contractors, all DOD agencies, and the users of weapon systems through digital exchange networks (6:1). However, no price tag has been attached to the implementation of the highly sophisticated computer system. The system will require extensive security measures which are not likely to be overcome even if the budget would support acquiring the system. A Feb '88 GAO report concluded the security measures for a \$2.3 billion new computer system requested by DOD could not meet the security requirements for use within DOD agencies (5:31) let alone networking to contractors. It appears any savings in time or reduced data delivery costs could be quickly eliminated when the cost of the computer network is included, though this is an early assessment of CALs.

Regulations

The problem of over regulation is not new, nor does it appear it will disappear quickly. Several levels of bureaucracy must be traversed by the acquisition process, both at the DOD and Congressional levels. The military departments and the Defense Logistics Agency are reviewing the acquisition process with an eye toward moving responsibility and authority to the lowest possible levels. Robert Costello indicates "the goals are clear; we must simplify the regulations" (7:8). One defense contractor identifies the Federal Acquisition Regulation (FAR) as the main problem. He says the FAR should be recognized for what it is, ". . . thousands and thousands of pages of rules and regulations which I would retitile FARCE. The major ingredient missing from the regulation is encouragement to use good old common sense" (20:9). Even the Secretary of Defense recognizes the seriousness of the problem. In his letter to the President, Sec Cheney acknowledges

. . . the (acquisition) system is encumbered by overly detailed, confusing, and sometimes contradictory laws, regulations, directives, instructions, policy memoranda and other guidances . . . Much of the stifling burden is a consequence of legislative enactments, and urgently requires attention by Congress. Much also has been administratively imposed and requires prompt corrective action by the DOD. (9:12)

Although the most dominant position by the DOD and defense contractors is to reduce regulations, this is not a universally endorsed way of improving the acquisition process. The Defense Monitor calls for more and tighter

regulations and more direct involvement by Congress in the acquisition process (30:5). Even so, in an effort to streamline the acquisition process, now cumbersome regulations are likely to be reduced and simplified in the future.

Personnel

Personnel in the acquisition system come under attack for two reasons. First, there are too many of them, and second, they are not trained well enough. The Packard Commission Report concludes that implementation of its recommendations ". . . should allow for a substantial reduction in the total number of personnel in the defense acquisition system, to levels that compare with commercial acquisition counterparts." The report goes on to warn that "Eliminating a layer of management by moving the functions and people of that layer to some other layer clearly will not suffice" (9:17). Just how this reduction in personnel will take place has not yet been fully determined and has not yet been officially announced. However, training requirements for acquisition personnel are getting attention. W. Edwards Deming sites formal training and retraining of personnel as the key to maintaining a superior work force (29:68-69). Evidently Sec Cheney agrees as he has initiated plans to declare the Defense System Management College (DSMC) as an intermediate service school, and establish a senior level service school comparable to the

National War College with a curriculum to train senior acquisition managers (9:15). This will necessitate a change in the career paths of military personnel. It has generally been thought advantageous to have senior military officers move from the operational arena to the acquisition field. However, the training requirements of a professional acquisition force will prevent a military officer from attaining the level of expertise required in both the operational and acquisition fields (9:15). Thus, it appears acquisition reform will not only displace many jobs, it will alter the time honored tradition of placing senior operational military officers into acquisition jobs by creating an acquisition career field with qualifications which will almost certainly exclude operational experience.

Technical Risk and the Budget

Uncertainties in the budget, and program cost overruns have forced the acquisition process into a react rather than act mode. Usually this reaction comes in the form of adjusting production schedules, eliminating prototypes, and sacrificing reliability and maintainability for performance or perceived performance. When the budget axe falls, programs are seldom, if ever, canceled. Budget shortfalls are dealt with by delaying production schedules or reducing the overall number of units purchased. In an effort to acquire as many of a unit as possible, the budget for spare parts is often reduced or eliminated in favor of more

complete units. Thus a weapon system is often fielded without enough spare parts to maintain initial readiness (30:4). Adding to this problem is the perception that eliminating prototypes and jumping to full production will save money. This usually results in systems being fielded with flaws that require expensive retrofit and reduced performance as well as reduced reliability and maintainability. The quest for performance usually survives all else. Program managers know promised performance and "great technological leaps" are what sell programs. Managers believe they must preserve the most "glamorous" portion of their program, i.e. performance, and will cut everything else in order to preserve performance. This attitude usually works to the detriment of reliability, maintainability, spare parts, and operational readiness (30:4). While this problem is usually blamed on the budget, it is only a part of the problem here. The problem appears to be primarily a misguided quest for program preservation no matter the quality of the product.

Summary

The acquisition process currently in place needs a drastic overhaul. The President, high DOD officials, and the defense industry have acknowledged the problem. The process will not be changed easily. Jobs will be lost, more rigorous training requirements will be mandated, and new career paths will upset tradition. If such drastic change

is to take place, total commitment and a change of outlook and attitude must be made within and throughout DOD. Piecemeal changes will not work. A new philosophy is required. A new culture must be established within DOD. Several areas have been targeted to receive immediate and drastic attention. Some, perhaps many, of these reforms may charge down the old familiar path of fantastic promises with little "real" results. The reforms must be thoroughly dissected in advance of implementation to ensure any "across the board" changes will lead to a more efficient acquisition system which fields quality systems, thus contributing to vastly improving the combat readiness of our national defense.

II. The Specific Problem and How to Investigate

While the acquisition process is plagued with the four problems areas noted in Chapter One, a program manager has the power to improve the process in all of these areas. Each of these problem areas can be addressed in varying degrees if the program manager is aware of the type of data and the data reporting requirements of his contract. The program manager needs to understand and determine the cost impact to his program resulting from data requirements. In order to structure the new acquisition process to be more efficient, it is essential that those in the acquisition arena understand the impact of data requirements on program cost and performance.

The Specific Problem

Inherent in the way the DOD currently acquires weapon systems is the voluminous amount of paperwork generated during the acquisition process. This paperwork is a result of the data requirements associated with the acquisition process. Data requirements are various reports due to the DOD (as determined by the DOD) during the course of the acquisition process. In 1970, data requirements represented a then unacceptable 14% of the weapon systems acquisition cost (8:1). By 1986, data requirements' costs increased to 20% - 50% of the total contract price for a weapon system (6:10-13). Why has the price paid for data grown to such a

large part of the acquisition budget? How will the new acquisition system address the cost, quality, and quantity of data and data reporting requirements?

Tentative Hypotheses and Investigative Questions

The reason data has become such a large portion of the cost of the acquisition process could be as simple as program managers not realizing how much the data requirements they place on contract cost their program. Or, the problem could be rooted in the basic way the DOD does business, continually stressing meeting minimum requirements and lowest cost, but reporting everything thereby sacrificing quality for quantity. My hypotheses are that: (1) program managers do not know how much data requirements actually cost their program, (2) persons program managers appoint to manage data are poorly trained and not in a position to exercise real authority over ordering data, and (3) past efforts to bring data costs under control have failed due to a lack of a consensus and a lack of identification as to the real problems surrounding data management. Questions needing answers include: (1) Are program managers aware of data requirement costs? and (2) What can be done to ensure data reporting requirements are adequately considered and regulated by persons in positions of authority in the acquisition process?

The Particular Investigative Methodology

The exploration phase of this research followed two courses. First, a literature review was done (Chapter One) to determine if the acquisition process had been addressed recently, what was said about it, who said it, and who is listening. The search for material included journals, DOD reports, Air Force Institute of Technology (AFIT) continuing education materials, and Air Force and DOD publications. The purpose of this initial search was to find a problem area(s) within the acquisition process. The search revealed that the acquisition process was hindered in part by the amount of paperwork, the inadequate training of people, the number of and conflicting regulations, and poor definition of requirements in Requests for Proposals (RFPs) and Statements of Work (SOWs). A common thread in these four areas is data. The acquisition of and handling of data impacts each of these areas. Reaching this point, the investigation turned to yet another source of information.

Identifying the specific areas of the data acquisition process as a major problem area in the overall acquisition process was not new. Permissions were obtained to re-examine within this thesis three recent studies: an Auditor General's audit (1988), a DOD wide survey (1989), and an Air Force Systems Command (AFSC) survey (1990) addressing data. Some of the studies were conducted at the Air Force 2-Letter level, while others were sanctioned by major commands or the DOD. Selected studies are reviewed in Chapter Three, along

with a summary of the findings from each. The DOD survey titled "Career Series Project for Data and Configuration Management Personnel Within the DOD" concentrated on data managers, their many different career series and a counting of total people involved. The results of this DOD survey are in Chapter Three. The Auditor General's report addressed the limited pricing of data, the uneconomical acquisition of data and the high cost of ordering unnecessary data. Another survey, commissioned by Major General Teal, Deputy Chief of Staff, Requirements, Headquarters Air Force Systems Command, addressed problems and possible improvements in the acquiring and managing of data. The Teal survey was part of a larger effort to address improving the overall acquisition process. A description of the analytical procedures used on the DOD survey, the auditor's report, and the Teal survey follows in this chapter. The analytical results can be found in Chapter Four.

The Career Series Project for Data and Configuration Management Personnel Within the DoD Survey. This DOD wide survey was sponsored by Mr. Peter Yurcisin the Acting Deputy Assistant Secretary of Defense for Total Quality Management and for Standardization and Data Management. This survey was used to address the job status of data managers, configuration managers, and engineering data managers in DOD to determine if the concerns over no distinct career ladders for these people were valid.

Because Defense Secretary Cheney and the Packard Commission desire the formation of an Acquisition Work Force (9:15-16), which the present acquisition process lacks, there is concern over how to define, identify, and include these people in the acquisition work force. The survey, hereafter referred to as the DM/CM/EDM survey, investigated the tri-service career levels of data managers. Jobs, titles, and head counts by service, as well as percent of job time spent on data management, configuration management, and engineering data management were used as a measure of the number of people utilized within each military service to weigh the importance placed on the management of data within the DOD. Simple frequencies and averages were used to determine if trends existed between the career series used and the number of people responsible for managing data. The Air Force used 2400 people; the Army 600 people; and the Navy 500 people and nearly 40 different career series. The reason so many career series had to be surveyed was that there is no distinct series for data, configuration, or engineering data management (14).

The Auditor General's Report. This report investigated the cost of unessential and uneconomically acquired data. The report included 32 contracts from the Aeronautical Systems Division (ASD), Armament Division (now Munition Systems Division, MSD), Electronic Systems Division (ESD), Ballistic Systems Division (BSD) and Space Systems Division (SSD). Information available included total

contract price, total price (or estimates) of data items, and an in-depth look at unessential or uneconomically acquired data items obtained from a sample of data items from each contract (3). The problems encountered in compiling and interpreting this report demonstrate why it is so difficult to address the data acquisition process. These are discussed in Chapter Four. This thesis analyzes the report by using frequencies of instances of unessential and uneconomical data to determine how common these circumstances are. Averages of costs of data versus contract value and costs of unessential and uneconomical data versus total data costs are also used to analyze the potential magnitude of the waste in data acquisition.

The Teal Survey. This Air Force survey conducted by Headquarters AFSC was requested by Major General David J. Teal, Deputy Chief of Staff, Requirements. The survey, hereafter referred to as the Teal Survey, was part of an effort to determine a way of improving the request for proposal (RFP) process. Within the broader effort to improve the RFP process, the tailoring of data, data and data calls were identified as critical areas to be addressed. The Teal survey addressed those issues related to the critical area of data by questioning people in two subject areas: 1. problems with the current method used in the tailoring of data, data call, and the data acquisition process, and 2. possible improvements to the data

acquisition process (28). The raw data from the Teal survey can be found in Appendix A.

Teal, Part One. The first part of the survey gathered information on data acquisition problems. Those surveyed were asked to evaluate 17 problem statements. Each statement was evaluated with the following Likert scale:

STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
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A response of AGREE to a problem statement meant the respondent thought the statement identified a problem in the data acquisition process. Likewise, a response of DISAGREE meant the respondent felt that the statement did not identify a problem in the data acquisition process. The responses of STRONGLY AGREE and STRONGLY DISAGREE were used to allow respondents to indicate an increased emphasis to their response. A neutral response indicated the respondent acknowledged the statement condition or situation existed, but he/she could not determine whether or not the condition represented a problem. An abstention from giving a response to any problem statement was interpreted to mean the respondent was not familiar with the condition or situation identified in the statement. The 17 problem statements are listed in Appendix B (28).

Teal, Part Two. In the second part of the Teal survey, respondents were presented with 30 statements, each suggesting an action aimed at improving the data acquisition

process. The improvement statements can be found in Appendix C. Following each improvement was a five-point Likert scale where the respondent could rate the importance of the suggested improvement. The following Likert scale was used.

VERY HIGH HIGH MODERATE LOW NONE

A response of HIGH was interpreted to mean the respondent thought the suggested improvement would improve the process and should be implemented if possible. Likewise, a response of LOW was interpreted to mean the respondent doubted the ability of the suggested improvement to improve the process. The response of VERY HIGH indicated the respondent thought the suggested improvement should be implemented without delay, while a response of NONE indicated the respondent could find no benefit from the suggested improvement. The response of MODERATE indicates the respondent acknowledges only marginal potential benefits. An abstention from giving a response to the improvement statements was interpreted to mean the respondent was not familiar enough with the suggested action to determine whether or not the suggested action would result in an improved process (28).

Teal Analysis Overview. The Teal survey consisted of two parts, data acquisition process problem identification and potential improvements. The survey originators treated the survey responses as a whole and reported frequency distributions, thus ranking the problems and improvements. A summary of their findings can be found in Appendix D. The

survey results are re-examined in this thesis in a new perspective. While the survey contained responses from AFLC, ASD, BSD, ESD, SSD, HQ AFSC, and contractors, AFLC and ASD provided the most responses, 38 each. Since these combined 76 responses accounted for 70% of the total responses, and since the number of responses from any remaining organizations were small, only those responses from AFLC and ASD are considered. The areas of strong agreement between AFLC and ASD are emphasized, since agreement between the two on problems or improvements should impact the complexion and direction of the new acquisition work force. The analysis of the Teal survey also determined differences in AFLC and ASD responses to the survey questions. Finding differences in the perceptions could reveal the need for different regulations, training, and upper level management attention between AFLC and ASD. Since this thesis attempts to uncover not only what, but why problems in data acquisition exist, it is appropriate to determine if AFLC and ASD agree or disagree on what they perceive to be the problems and possible solutions. The analysis attempts to find those problem areas that both organizations find severe. Also, the analysis strives to find those areas of improvement where both organizations believe would be the most beneficial. After identifying those most severe problems and the "best" improvements, the analysis attempts to determine if the improvements thought to be the most beneficial correlate with the problems. It

is important that this correlation exist, or the most severe problems may not be addressed by the most beneficial improvements, and implementation of the suggested improvements could very well result in treatment of symptoms instead of problems.

Analytical Concepts and Methods Employed

The Auditor's report and the Teal survey used for this research required a variety of analytical methods. The various procedures and techniques are described below.

Median. The median is the middle value in a list of sample values when those values are arranged in increasing order. If the number of sample values is odd, then the median is the single middle value. If the sample value is even, the median is the average of the two middle values. The median is not sensitive to sample values that may be large or small when compared to other sample values (11:15-16). For purposes of this thesis, the median will be used to rank survey questions. In Chapter Four, the Teal survey analysis ranks the responses by how strong the responses were. For example, in the Teal survey it was desirable to determine which improvement the respondees felt would benefit the most. However, when the medians were examined, several survey questions had the same median. So, a method of sorting the medians was used in this thesis. If two questions had a median = 4, then the number of responses "below yet equal to" the median became the sorting

discriminator. This is most easily demonstrated with an example. Suppose two sets of values are as listed below:

Set A	Set B	
5	4	
4	4	
4*	4*	
3	4	
2	4	* median response

Both sets have the same median = 4, but the method of sorting used for this thesis ranks Set B higher than Set A because the number of responses "below yet equal to" the median in Set B is two, while it is zero for Set A. i.e. There are two fours below the median in Set B, and there are no fours below the median in Set A.

Percentages. Percentages serve two purposes in presenting and analyzing data. First, they bring all numbers within a range of 0 to 100. Second, percentages translate data into a standard form, with a base of 100, enabling relative comparisons (13:327). In their book Marketing Research, Harper W. Boyd and Ralph Westfall caution the researcher on the misuse of percentages. They suggest the following rules which are observed in this paper.

1. Percentages cannot be averaged unless weighted by the size of the group from which it is derived.

This demands the use of weighted averages.

2. If using too small of a base, percentages can hide the base from which they have been computed. e.g. When contrasting 60% to 30%, a sizable difference is

indicated. However, if there are only three case in one category and ten in another, the differences may not be significant (13:327).

Likert Scales. The use of a Likert scale is common in surveys like the Teal survey. The Likert scale can be used with a large number of statements that meet two criteria. First, each statement used in the survey must be relevant to the attitude being studied. Second, each statement is believed to reflect a favorable position on that attitude (13:256).

The Wilcoxon Signed-Rank Test. Part of the analysis of the Teal survey involves determining if the responses to the problem statements are significantly different from the neutral response. This is important, since an AFLC or ASD median response of neutral reveals little information. However, knowing that the AFLC and/or ASD responses vary significantly from neutral suggests a decisive group response. The Wilcoxon signed-rank test is a nonparametric test that can be used to test for differences in the median responses of two groups. AFLC and ASD responses will each be tested for a Median = 3. The Wilcoxon signed-rank test requires the data be a random sample from a continuous and symmetric probability distribution (11:602). For purposes of this research, the data will be assumed to be continuous and symmetric. The Wilcoxon signed-rank test efficiently tests the Null Hypothesis, H_0 , that the sample median equals 3. The software package STATISTIX (25:6.7) easily

computes the Wilcoxon signed-rank test and is used for that purpose in this thesis. Also, for purposes of this thesis, any responses not significantly different from neutral will be treated as neutral responses.

The Kolmogorov-Smirnov Test. The Kolmogorov-Smirnov (K-S) test is used to determine if the distributions (spread and shape) of two samples are the same. This test is done to satisfy one of the conditions of the Mann-Whitney or Wilcoxon Rank-Sum tests discussed later. STATISTIX easily computes a P-value for the K-S test, and will be used for all K-S calculations (25:4.6). For this thesis, a P-value less than 0.20 will indicate a significant difference in sample distributions. For the analysis in this thesis, a level of significance of 0.20 is sought. Thus, an alpha of 0.20 is used and any P-value < 0.20 will result in rejecting the null hypothesis (11:308-313). In other words, if the null hypothesis is rejected, there is 80% confidence that the null hypothesis is wrong and was rightly rejected. For example, the distributions of the responses to problem statement one by AFLC are compared to the distribution of the responses to problem statement one by ASD. If the null hypothesis is that two distributions are the same and the K-S test yields a P-value exceeding 0.20, the distributions are considered to be the same. That is, there is not a significant difference between the AFLC and ASD response distributions. Likewise if the P-value is less than 0.20,

the null hypothesis is rejected and the distributions are declared different. The K-S test results are in Appendix E.

The Wilcoxon Rank-Sum Test. The Wilcoxon rank-sum test is a nonparametric test used in this thesis to determine if the medians of the two samples are significantly different. The Wilcoxon rank-sum test is sometimes referred to as the Mann-Whitney test. While these are different tests, they lead to identical results (25:6.12). The rank-sum test assumes two independent random samples from continuous distributions. The sample distributions must have the same shape and spread, with only the medians or the means being allowed to be different (11:609). Because of ease of use, SPSS-X is used to perform the Wilcoxon rank-sum test. SPSS-X also computes a 2-tailed P-value (26:809-834). For purposes of this thesis, a P-value less than 0.20 indicates a significant difference in sample responses. Thus, any survey question having a rank-sum test P-value less than 0.20 indicates AFLC and ASD significantly differ in their responses.

Reliability. The data were tested for reliability using the reliability test available on SPSS-X (26:857-72). A reliability test (sometimes referred to as a reproducibility test) is an application of correlational analysis used to determine if the responses to survey questions can be replicated. If responses cannot be replicated, the responses are unstable and of little use to the researcher. This test is ideally used to determine the

reliability of successive responses in a test-retest situation (19:217-18). That is, measure the responses to a survey, then compare these first responses to a later set of responses obtained from giving the survey again. Since the Teal survey was only given once, a random split-half technique known as Cronbach's Coefficient Alpha was used to determine reliability. This technique randomly splits the sample responses into two groups and measures reliability (13:98-100). Two reliability tests (Cronbach's alpha) were performed, one on the responses to the problem statements and another on the responses to the suggested improvements. The results are reported in Chapter Four.

Validity. Validity is the extent to which the measurements made actually measure what they are intended to measure. For a set of measurements to show validity, they must first be reliable, since validity cannot exist without reliability (19:219). Validity takes two major forms, internal and external. External validity, the ability to be generalized across persons, settings, and time (13:94-5), is examined in this thesis. External validity will be assessed by comparing the findings of the Teal survey to the findings of the studies reviewed in Chapter Three. If the survey and the studies reveal similar findings, the Teal survey will demonstrate its validity. While this may be a less than rigorous correlational analysis to determine validity, it will nevertheless demonstrate agreement (or lack thereof) as to the problems affecting the data acquisition arena.

Correlational Analysis. Correlational analysis allows the statistical analysis to go beyond the central tendency and variation that one is limited to in an analysis involving only one variable. When using two variables, an assessment of the association, if any exists, can be made (19-195). For example, it might be beneficial to know if persons managing data in AFLC believe the same data related problems exist as do persons in ASD.

Factor Analysis. The Teal survey was designed to collect information on a wide variety of questions. Factor analysis is a technique used to identify and summarize the inter-relationships that exists among the individual questions. For this thesis, factor analysis will be used to confirm whether or not there is a correlation between the perceived worst problems and the top ranked suggested improvements. Factor analysis is a higher order data reduction technique that can systematically reduce the large correlation matrices resulting from correlating all of the survey questions (19:378). This helps identify a grouping of the questions that those surveyed answered in a similar manner. Since factor analysis identifies groupings of the survey questions that are highly correlated with each other (19:380), the factor analysis can be used to confirm whether or not the logical groupings have identified correlated survey responses.

Computer Tabulation. Statistical analysis is done using SPSS-X (26) and the personal computer (PC) software

package called STATISTIX (25). SPSS is an integrated set of computer programs that are capable of doing correlations, nonparametric tests and reliability analysis. The data from the Teal Survey is analyzed using SPSS-X and STATISTIX. For performing repeated calculations, the PC software package Quattro (4) was used.

III. A Synopsis of Studies Involving Data and Data Management

This chapter contains a collection of unpublished studies conducted by various agencies within AFSC. Each study is synopsised and a summary of commonalties found across the studies is included. Each study was initiated because of a perception that the acquisition process was too cumbersome. The studies were initiated to search for ways to improve the process. Since some of the studies cited here included areas other than data and data management, this discussion will include only those areas related to data.

Electronic Systems Division, (ESD)

In August 1981, the final report of ESD's Data Review Action Task (DRAT) was delivered. DRAT was initiated by the ESD Commander, Lt Gen Robert T. Marsh and completed under Lt Gen James W. Stansberry. DRAT's purpose was to conduct a study to assess the perceived problem of the government ordering too much data on its contracts. The goal of the DRAT study was to recommend appropriate actions as required and establish controls for continued management of future data acquisitions (12). The following is a synopsis of the DRAT team's findings:

1. The government orders too much data in requests for proposals (RFPs) and contracts. To reduce the amount of

data requested, the DRAT recommended the development of an ESD Data Management Guide to better focus the requests for data. The DRAT study also advocated assigning a "journeyman level" data management officer (DMO) to each program office, plus establishing a Senior ESD Data Requirements Review Board (DRRB) that would remove the responsibility for accomplishing the DRRB function from the project officer.* While elevating the level of the data manager in a program office would help eliminate duplicate efforts by government personnel, the DRAT emphasized the need for more senior level involvement in the data management process (12).

2. Acquisition and processing of contractor data consumes a large share of ESD resources (money and people). Since neither the actual cost of data nor the number of man-hours expended on data management has been determined, how large of a share is unknown. To control the amount of government resources expended to manage data, the DRAT study recommended establishing programs to increase awareness that data is a cost driver (12).

3. The DRAT study found that data is a significant cost driver that has been neglected by senior level managers. Lack of consistent data pricing rules make it

* By 1989, ESD held two DRRBs. One at the program office level, and a second by senior management. The goal of the second was to reduce the data requests from the first DRRB by 10-20%. Also, ESD was developing the "preferred data list of 96 DIDs needing no justification, only tailoring, to fit the program (15).

impossible to accurately record and track data costs. However, the Office of Federal Procurement Policy has estimated annual costs of data on all procurements to be several billion dollars. ESD estimates data costs range from 6-20% of contract costs. However, the ESD data cost estimate does not include the actual proposal preparation costs (partially recovered only upon contract award as bid and proposal costs) or other costs which become part of a contractor's overhead and thereby subsequently are charged to the government. Nor does the ESD estimate include the cost to the government for government people in processing, reviewing and managing the data. While the DRAT's Final Report does not lead the reader to believe the cost of data and data management will ever be known exactly, it does suggest that higher level attention to the quantity and quality of data could significantly reduce costs. The DRAT Report suggests that the data manager be made the focal point for all organization data related activities, and suggests the establishment of participative management so data managers, program managers and data users play a greater role in reducing data requirements. The DRAT Report also suggests that program managers be required to report data costs in Program Management Reviews. Finally, the DRAT Report recommends that separate prices for data be included in the contract schedule, and that the government provide additional guidance to the contractor on what specific

efforts should be included in estimating and revealing actual data prices (12).

4. Data management suffers from a lack of experienced managers and from inadequate data manager training, both on-the-job and in formal training courses. The DRAT suggested several aspects of data manager training, including a training program with industry and an AFIT continuing education course (12). (The DRAT Report does not elaborate on whether its authors are suggesting the development of a new course, or merely referring to the AFIT Sys 370, Defense Data Management course, already offered.)

5. Data management pricing concepts have not been consistently applied, verified, nor archived for automated retrieval, thus making any attempts for use of historical data for trend analysis or price analysis impractical. The DRAT recommends ESD devise an automated central data pricing system for recording and analyzing data prices (12).

In summary, the DRAT Report repeatedly stressed the need for higher level manager involvement in the data and data management process. The DRAT Report concluded that data was a large cost driver which, at the time of the study, had received little attention from upper level management. The DRAT Report recommended higher level management participation in 14 of their 83 recommendations.

Aeronautical Equipment (AE) System Program Office (SPO)

On May 4, 1989, the ASD/AE SPO completed its Critical Process Team Final Report on the AE purchase request process. As part of an effort to implement the Total Quality Management (TQM) philosophy, the executive level of the AE SPO identified the purchase request (PR) process as one of the most "painful" processes within AE, and an area where improvements could lead to enhanced mission accomplishment. AE established a critical process team (CPT) to investigate and evaluate the PR process and implement improvements through the SPO Director. The CPT's goal was to eliminate non-essential elements and optimize essential elements of the PR process. The following are problems with the PR process that the CPT found.

1. There was no documentation directing the PR process. Discrete elements of the process were put forth in various instructions (i.e. AEOI 20-1, AEOI 57-2, and AEOI 310-1), but there was no single source that gave an overall perspective of the process from beginning to end. The CPT recommended assembly of a handbook documenting the PR process (21:3).

2. A lack of early and complete involvement by engineering personnel due to time constraints leads to poorly defined technical requirements. This has two simultaneous negative effects: a. The wrong or incomplete requirements are specified, and b. Costly changes must be made later in the program to correct inadequate

requirements. The CPT recommended early engineering involvement and an adequate amount of time be made available for thorough engineering analysis and requirements definition (21:5).

3. Participants, especially non-SPO participants, required for the data call process to be complete are typically non-responsive to the original data call. This results in significant time delays in the PR processing cycle to follow up with these offices to receive their input. The CPT recommended developing a "standard data package" for use by all project teams. This "standard data package" would include data which is common to virtually all AE programs. This would save time at the Data Requirements Review Board (DRRB) and eliminate the need for Air Force Form 585s (justifications) for those data items in the package. This would then allow the DRRB to concentrate on only those items that are program tailored (21:10).

4. Due to the heavy involvement of inexperienced personnel at the DRRB, the quality of the CDRL package developed is often less than desired. The CPT recommended that each organization participating in the PR process be required to designate one primary and one alternate DRRB member (21:10). The implication here is that consistency of personnel involved in the DRRB will lead to an improved DRRB. The final report made no other mention of specific training requirements or experience levels recommended for DRRB members.

Ballistic Systems Division (BSD) Study on Statement of Work (SOW) Preparation Process

This study performed at BSD and completed in December 1989 was initiated to investigate the SOW preparation process for the Small Intercontinental Ballistic Missile (ICBM) program. The Small ICBM program was in the Full Scale Development phase, and government and contractor input was solicited for this study. The following recommendations pertaining to data and data management were included in the study:

1. The study recommended establishing a SOW/CDRL requirements review board consisting of 2-Letter and 3-Letter chiefs that make up the program management team (PMT). This presents a high level management emphasis to ensure the SOW/CDRL contains only minimum essential requirements and is within budget constraints (17).

2. Minimize the total number of CDRLs ordered by eliminating non-essential reports, reducing multiple copy requirements, and minimizing the drafts for approval. This requires the thorough screening of CDRL requirements by personnel trained and knowledgeable about the process, and implies the necessity of high level program management involvement to "make" these actions happen (17).

3. Contractor input, with regard to data, cited that increasing the amount of downward tailoring of specifications and DIDs placed on CDRLs would reduce data costs to the government. The contractor recommended a

"zero-based" approach to tailoring, which means starting from scratch and defining needs, instead of using previous contracts as examples or proliferating a list of possible DIDs. The contractor recommendation also included a call for more contractor input to the draft RFP, SOW, and CDRL. This would provide increased opportunity for clarification of requirements prior to going on contract. These views were echoed by all 12 contractors responding to BSD's request for their input, as well as two AFPROs, Air Force Plant Representative Offices (17).

Training Systems (YW) System Program Office

In October 1987, ASD/YW established a critical process team (CPT) charged with examining the RFP process, finding ways to streamline the process, and creating tools to ensure each event of the process "gets done right the first time." The CPT used an interview questionnaire to gather input from individuals involved in previous RFP preparations. Listed below are those areas relating to data and data management that the CPT found to be problems or burdensome to the RFP process.

1. When developing the requirements for the RFP, there is a tendency for non-user (those not in the using command) requirements to creep into the RFP during the coordination process. This usually occurs when persons other than the user add technical enhancements, quality programs, and reliability demonstrations to the requirements. Also,

contract options are often added to a contract to hedge against funding cuts and uncertain or changing requirements. . . These actions add unnecessary work to RFP preparation, add to the amount of data requested but not used, and add unnecessary requirements and ambiguities to the contract (27:5).

2. A common misperception is that the program manager is an expert in RFP preparation and statement of work (SOW) writing, when in fact many of YW program managers had never written a SOW before. This reveals the lack of training and experience in RFP and SOW preparation that is common even among senior level management (27:6).

3. The data call process is flawed because the using command and AFLC have not typically seen the SOW prior to the data call. This turns the data call into an educational process, addressing progress and milestones schedules of the program, rather than concentrating on the purposes of a data call and DRRB. The result is a poorly conducted DRRB that does not address the issue of reviewing data requests for appropriateness. The end result is often a contract containing duplicate and unnecessary data requests (27:7).

4. The CPT cited conflicting direction from regulations as a problem in preparing RFPs. The CPT cites conflicting DoD directives and instructions, FAR and FAR supplements, agency regulations and organizational instructions as major impediments to the RFP process. Examples the CPT cites are listed below.

a. "Acquisition Streamlining" requires/recommends that program management tailor military standards and specifications for a specific program. However, AFSCR 800-9 discourages tailoring MIL-STD-1567A and any changes must be approved by ASD/CC. Also, AFR 800-9 requires application of MIL-STD-1567A to programs except for competitive firm fixed price contracts, but AFSCR 800-9 does not allow this exception (27:20).

b. FAR Part 7 and supplements identify the contracting officer as being responsible for Acquisition Plan preparation. However, ASD/PM policy for contracting personnel collocated in a program office requires program management to write the plan (27:20).

c. Streamlining initiatives encourage the use of contractor format and accepted commercial practices while the ASD review process enforces the requirements as set forth under the MIL-STDs (27:21).

5. The experience level of those involved in the RFP process was identified as a major weakness. The CPT found that 86% of those involved in the process had less than 2 years SPO experience and had only an introductory course in acquisition. Only 7% of those involved had over 8 years of experience and advanced level training. This lack of experience was complicated further by the 20% turnover of personnel every six months in YW. The CPT concluded that

the inexperience and turnover of personnel greatly impacted the quality of RFPs (27:25).

Data Requirements Streamlining: Engineering Paper Reduction Study

In 1989, ASD/EN performed a study to determine where the engineering effort in systems acquisition could streamline the process and reduce the amount of paperwork. The study included contractor input, analysis of data on selected contracts, and interviews with data managers. The goals of the study were to characterize the deliverable data, drive deliverable data toward zero, and provide leadership for other ASD organizations in their effort to streamline data requirements. The following is a summary of the study group's findings.

1. The study group interviewed contractors for their views on reducing the data requirements. Contractors revealed that the government efforts to price data would be difficult because the government requires an artificial separating out of data prices from work task prices, and contractors do not have this information easily available. Also, contractors have the perceptions that the government does not need or read the reports it requests. Contractors believed the government should reduce the amount of requested data, the frequency of data submittals, the number of copies, and the wide distribution. Contractors suggested the government use contractor formats, request fewer plans,

avoid duplicate requests, and recognize that technical manuals and software data are high dollar cost drivers (2).

2. The study group examined the CDRL items used by ASD/EN and assigned them into three categories. The categories were: a. permanent - which meant the information was needed for future government use, b. perishable - which meant the information was needed only one time, and c. historical - which meant the information might possibly be useful in the future. The group found that of the engineering data requested, 33% were for permanent data, 36% were for perishable data, and 31% were for historical data (2).

3. The study group reviewed the data management process and found that while AFR 310-1, Management of Contractor Data, provided for a DRRB to minimize data requests, data requesters anticipate DRRB resistance. (The report implied that this anticipation of resistance impeded the effort to reduce data.) The group found little incentive for functional levels to reduce data requests. The study group suggested that better training on data management at the functional level would enable a better screening of data requests than is currently done by the DRRB (2).

4. The study group asked the "big question," i.e. What essential data do you need to be formally delivered to you in order for you to do your job? The responses were (2):

a. Delivered data is not required to maintain insight into program technical status.

b. Delivered data is not required for quick reactions to analyzing and resolving technical problems.

c. Special data requests may be necessary to conduct independent assessments.

d. Delivered data is necessary for historical files for future reference.

e. The group found that scrubbing their data requests enabled them to reduce the number of data item descriptions (DIDs) from 225 to 66.

5. ASD/EN concluded that a key ingredient to reducing data was involvement by top level management. They found data can be reduced, and the primary responsibility to do so is first placed with the functional areas in pre-scrubbing data orders before going to the DRRB. They felt this could only be done if data management training were to be emphasized at the functional level (2).

Munition Systems Division (MSD) Acquisition Process Improvement Team

In December 1989, the MSD Acquisition Process Improvement Team (MAPIT) presented their final report. MAPIT conducted a study designed to gather information on problems occurring during the acquisition process and determined steps that could be taken to improve the process. Input to the study consisted of interviews with those

individuals involved in the process (both government and contractor) and analysis of policies and procedures. While MAPIT investigated several areas of the process, the following discussion is limited to their findings concerning data.

1. From their study, MAPIT concluded that the current practice of having a SOW/specification data call should be eliminated. Instead, MAPIT recommended conducting in a concurrent manner the SOW, specification, and CDRL developments, culminating with a system requirements call. This would then alleviate the duplicity and ambiguities inherent with the current data call process. MAPIT also recommended establishing standard data packages, thus allowing review boards more time to evaluate the need for additional data requests. (The standard data packages would not be subject to DRRB scrutiny.) If these steps were implemented, MAPIT estimated the time from SPO resource commitment to contract award could be reduced by 13 weeks from the current 109 weeks and improve the quality of the contract (23).

2. MAPIT recommended the pricing of data items on DD Form 1423 (the CDRL form). To assist management in deciding the relative importance of the requested information relative to it's cost, the team suggested the following price categories be listed on each DD Form 1423 (23):

a. Development costs: (Those costs incurred if the data is not generated as a part of normal business, but is requested by the government.)

b. Technical preparation costs: (Those costs incurred by the contractor to place the data into a usable format. By accepting contractor format, this cost can be minimized.)

c. Administrative preparation: (Those normal administrative costs associated with document assembly.)

d. Reproduction and delivery: (Normally negligible costs.)

3. To reduce the amount of data requested, an MSD "minimum essential data list" was recommended. This list, developed, scrutinized, and agreed to by the functional disciplines, would require no further justification. Time previously spent on justifying items on the minimum essential data list could be used to scrutinize the tailoring and distribution of data requirements and in justifying the remaining data items focused to the particular program. In addition to this minimum essential data list, the study group developed a set of conditions, which when met, would permit the addition of other data items to the minimum list (23).

4. The study group recommended automation of the acquisition functions be made a top priority of MSD. In particular, the Automated CDRL and Tracking System was

recommended. Automation was suggested to partially alleviate problems from reductions in manpower, as well as enhance the quality of the CDRLs and tracking of deliverable data (23).

5. Unclear, ambiguous, unquantifiable, and excessive data requirements were among the problems the group found. The reasons they cited for this included inexperienced and poorly trained personnel. Solutions they recommended were increasing the involvement of senior management and experienced people, providing additional training, and developing a bipartisan RFP review process (23).

Summary of Unpublished Studies

The following is a summary of the previous six studies. Since these studies are not exhaustive nor necessarily directed toward the same end, there is no attempt made herein to statistically analyze their findings. However, the studies do reveal similar problem trend areas and overlap coverage in the recommended corrective actions thereby transcending any investigative differences the individual studies possess. These significant problem trend areas and recommended corrective actions evident in more than one study are summarized below.

a. Highest Significant Trend - The government asks for too much data. This problem was cited by five of the six studies.

b. Highest Significant Corrective Action - Five studies cited the need for more training of personnel involved in the acquisition process. Both the inexperienced and the "experienced" were found to be in need of training on RFP, SOW, and specification preparation, as well as data tailoring.

c. Second Highest Corrective Action - Four studies cited the need for more involvement by senior level personnel (i.e. the program manager) in the acquisition process. The purpose of this was to elevate the perception of importance, but more importantly to get senior level management to recognize the importance of the document preparation process and guide the evolution.

d. Three of the study groups cited the importance of pricing data items. It was acknowledged that pricing data was not easy, and would never be 100% accurate, but the effort offered rewards both in determining the real need for the data and in improving the quality of the data requirements.

e. Two studies cited data as a contract cost driver.

f. The benefits of determining a standard data package that avoided the data justification phase was emphasized in two of the studies.

g. A recommendation for overhauling the data call and DRRB process was made by two of the study groups.

h. ESD and MSD called for automating the acquisition process as much as possible. In particular, CDRL preparation and tracking were identified as areas to automate. (ESD and MSD to a large extent have automated these parts of the acquisition process. The success they have experienced is inferred to be a reason for their endorsement of automation.)

The DOD Career Series Survey

This survey, performed in the fall of 1989, has become known as the DM/CM/EDM survey because of its emphasis on data managers, configuration managers, and engineering data managers. A summary of this survey is included in this thesis because it not only reveals who works with data, but shows how any corrective actions to the current problems will be difficult to implement due to the lack of an easily identifiable work force. The DM/CM/EDM survey was initiated to facilitate the DOD effort to create an acquisition work force. The survey was directed at the civilian personnel since the researchers task was limited to determining the role of civilians in the acquisition work force and the belief that civilians perform most of the DM, CM, and EDM functions. The survey provided information on the numbers of people performing the work of a DM, CM, and EDM in the DOD, since there is no single career series designated to perform these functions. It was important to determine who

really manages data in order to know who to train and/or how to manage this work force, especially as the DOD transitions into digitized data deliveries (14).

In the Air Force, there are 32 civilian career series that perform DM, CM, and/or EDM functions. Of the 2418 Air Force respondees, 1391 perform this work on a part time basis, while 1027 are full time. However, a single career series, the GS-1670 Equipment Specialist, accounts for 1053 of persons performing CM on a part time basis in AFLC. The break out for DM, CM, and EDM by military services is as follows (14).

TABLE 1
Number of DM/CM/EDM Working Full or Part Time
by Service (14)

	Air Force	Navy	Army	Total
Full Time	1027	453	226	1706
Part Time	1391	53	361	1805
Sub-total	2418	506	587	3511

The survey found that it was common for a person to perform the functions of a DM, CM, and an EDM simultaneously (14).

The survey results revealed some significant differences between the way the Navy and the Air Force approach data management. The Navy uses 53 part-time people compared to the Air Force with 1,391 part-time people. This could be because the Navy has a certification program for

its data managers. (Naval Sea Systems Command for DMs and Navy Supply Command for EDMs.) They also have assigned for several years centralized permanent members for their DRRBs on higher dollar programs. By contrast, the Air Force has ad hoc DRRBs with few permanent members and thereby uses more people than the other services. This could be because the Air Force does not elevate the level of importance of data managers as the Navy has done. This inefficiency in the Air Force use of its people will be difficult to defend in the restructuring now being mandated by Secretary Cheney (15). The Air Force recruits data managers primarily out of clerical jobs in grades GS-3, GS-4, and GS-5 (civilian career series 303 which tops at GS-6), converting them to general administrative (career series 301 which tops at GM-13) where promotions are available (14).

From the information available from the DM/CM/EDM survey, it appears the lack of recognizing the data manager function as an important acquisition work force career position could be having very costly negative effects on the Air Force acquisition process. Future research may be warranted to compare Navy versus Air Force contract data costs. If a correlation could be drawn between the grade, experience, authority, and training level of data managers in effectively reducing data costs, the Air Force could potentially reduce acquisition costs significantly by selectively adopting the Navy's approaches to data management in selecting, training, and certifying

(empowering) data managers. Also, the functions and roles of support contractors should be studied to see how the Navy and Air Force utilize these specialists in managing data in the acquisition and logistics arenas.

IV. Results of Auditor Report and Teal Survey Analysis

This chapter is devoted to analyzing the Auditor General's report and the Teal Survey. A summary of each is included, though commonalties and integrated observations are left for Chapter Five. Descriptions of the analysis techniques are included in Chapter Two.

The Auditor General's Report, Project No. 6066416

In 1988, the Office of the Auditor General of the Air Force evaluated Air Force policies and procedures for acquiring and managing data during system acquisition. For this study, data is defined to include administrative, management, financial, technical, scientific, engineering, and logistics information required to manage a contractual effort. (This definition of data is consistent with the concept of data used thus far.) A total of 32 Air Force contracts totaling over \$10 billion were examined for this report. The auditor's report concentrates on three areas: 1. Unessential and uneconomically acquired data, 2. Data tracking, and 3. Data pricing. This thesis will analyze only the unessential and uneconomically acquired data portion of the auditor's report. The auditor's interpretation of the data is included as well as an alternate approach to interpreting the data (3:1).

The Auditor General's View. Twenty-eight AFSC contracts were reviewed, and data were collected on each contract's total dollar value along with a measure of dollars estimated to be in the data costs on each contract. Contract data items were specifically investigated, with emphasis on the justification of the need for the data and the appropriateness of the method of delivery. To accomplish the objective of determining the magnitude of the problem of unessential and uneconomically acquired data, 32 contracts from MSD, ASD, BSD, ESD, and SSD were selected. The only criteria for contract selection were that the contract value had to exceed \$1 million, contain at least 40 data items, and be for research/development or procurement/production. While the contract dollar amount of these contracts was known, some of the data costs could only be estimated due to contracting officers not breaking the data prices out from a negotiated contract price (3:4). With the contract and data costs established, a representative sample of data items was chosen from each contract. (The assumption was made that the data in the sample were representative. While the auditor's report was not explicit about this, there was no mention of limiting the sample to specific data items. In fact, limiting those data items eligible for the sample could yield misleading inferences. In looking at the wide range of sample data prices and the number of data items from each contract, the assumption of a representative sample seemed to be

reasonable.) Those data items in the sample were then examined for unessential and uneconomically acquired data.

The analysis of the sample data only showed that 61 of 411 data items, at a total cost of \$2.6 million, were unessential and 21 of the remaining 350 data items, at a total cost of \$2.6 million, were uneconomically acquired. (Data items found to be unessential were dropped from further scrutiny.) From this information, the auditor's report concluded that out of \$10 billion worth of total contract dollars, \$5.2 million was spent on unessential or uneconomically acquired data (3:1). This is a misleading conclusion, since the \$5.2 million of unessential and uneconomically acquired data was from only the sample. The alternative analysis of this data will address this issue. The possibly more important conclusions from the report as to why the problem of unessential and uneconomically acquired data exists are worth noting and are listed below.

a. Data calls were not issued or even when issued, adequate time was not allowed for responses. Complete information was not provided nor could the auditors retrieve enough information for many of the contracts, however the information below is a summary of the auditor's findings.

1) Of 26 contracts for which information was available, 21 (80%) held data calls (3:7).

2) Of 21 contracts that had data calls issued, information was available for 18 contracts on the time the allowed for responses to the data calls. Times

allowed ranged from six days on two contracts to 42 days on one contract, with the average being 21 days. Eleven contracts allowed less than 30 days response time despite AFR 310-1 requirement for 30 days (3:7-8).

3) Even though 21 of the contracts issued data calls, only 15 DRRBs were convened and of these only three were ruled effective by the auditors (3:10).

4) None of the 28 contracts performed an economic analysis on the requested data even though AFR 310-1. Management of Contractor Data, requires an economic justification (3:14).

b. The Auditor's report cites several instances where their analysis had to be curtailed because of a lack of information. The missing information was usually a lack of cost information. For example, of the 411 data items examined in the sample, the auditor could only identify prices for 319 items (3:7). This inability to determine the actual cost of deliverable data items leaves program managers, contract officers, and auditors vulnerable to spending the taxpayer's dollar in a less than prudent manner.

An Alternate Analysis. Of the 28 contracts reviewed for unessential and uneconomically acquired data, information on data costs were available on only 26 contracts. Therefore, only 26 contracts should be used for analytical purposes and conclusions. These 26 contracts had a total value of \$5.8 billion and a total of 2819 data items

with an estimated value of \$95 million. The auditors took a sample of data items from each contract. The method used to determine how many data items from each contract would be included in the sample was not explained and could not be determined. As noted earlier, it is assumed the samples are representative of the whole and any prejudice of selection was avoided. The sample data items had a total estimated value of \$16.9 million, of which \$5.2 million was found to be unessential or uneconomically acquired (3:16-19). If the sample is representative of the whole, then 31% of the data items (\$29.3 million) on these 26 contracts are unessential or uneconomically acquired, representing \$29.3 million in unnecessary costs to the government. However, since a different number of data items from each contract were examined, the sample data needs to be weighted before such a conclusion can be drawn.

The number of sample data items taken from each contract was unrelated to contract value or the total number of data items on the contract. Therefore, it is necessary to weight the sample data items so any single contract or data item is not allowed undue influence. To accomplish the weighting of the data items the following procedure was followed. First, since all of the contracts were of a different value it was necessary to determine the average value of each contract. This was done by computing a simple average for the 26 contracts involved. Since the total value of the contracts was \$5.8 billion, the average

contract value was \$233 million. Next, an average data value for each contract was determined. Since each contract contained a different number of data items, it was necessary to compute a weighted average. This was done by dividing the number of data items for a contract by the total number of data items in the 26 contracts and multiplying this by the contract's data value. By summing these values for all 26 contracts, the weighted average data costs are computed to be \$5.23 million per contract. Next, the weighted average for the sample data items were computed. The method of computation is identical to the weighted averages computed above. The weighted average of data per sample contract is \$603,418. Similarly, the weighted average of the unessential sample data per contract is \$108,861 and the weighted average of the uneconomical sample data per contract is \$187,240.

With the weighted average information, the percentage of the sample data that is unessential is

$$\$127,535 / \$603,418 = 21\%$$

and the percentage of the sampled data that is uneconomically acquired is

$$\$187,240 / \$603,418 = 31\%$$

Thus, 52% of the data in the sample was unessential or uneconomically acquired. Provided that the sample was representative of the 26 contracts examined, it can be determined that 52% of the cost of the data items in these contracts was incurred unnecessarily. This amounts to \$49.5

million of costs the government could have avoided. In other terms, the Air Force estimated that in fiscal year 1986 over \$2 billion was used to purchase data from contractors (3:1). If the sample is representative of the whole, then in 1986 over \$1 billion was unnecessarily spent on data.

Observations, Comments, & Conclusions. As with any analysis, this one contains what could be considered vulnerable points that cause the results to come into question. However, this analysis most likely underestimates the extent of waste in data acquisition, thus the possible savings of \$1 billion in 1986 is conservative. The determination of unessential data was somewhat limited in scope. Contract data items were reviewed for unnecessary, excessive, or redundant data requirements (3:6), however this was a subjective determination on the part of the auditor. This method of determining unessential data in no way evaluated the accuracy of the data received (especially critical for technical data), or the benefit the government derived from it.

Second, the cost to the government of preparing data requests, processing, validating, storing, retrieving, distributing, and subsequently destroying this data was not included in the reported data costs. Those attempting to determine just how much data really costs the government need to consider these "ownership" costs to the government in addition to the price that is reported on a DD Form 1423.

Considerations such as the two mentioned above lead to the conclusion that the auditor's report, while revealing a substantial waste of \$1 billion, is only addressing one aspect of the high cost of data. With other considerations, the real price of data exceeds the amount the report indicates.

The Teal Survey Analysis

The Teal survey is separated into two primary areas of analysis, coinciding with the survey's two parts. Part One addressed "identification of problems" with the acquisition of data, while Part Two addressed "suggested improvements" to the data acquisition process. While similar analytical tools are used in each part, the analysis of each part is independent of the other. This analysis centers around the responses of AFLC and ASD, and the search for similarities and dissimilarities in their responses to survey questions. Differences in responses are sought since inter-organizational differences could signal that different problems are faced by these organizations. Knowing this should assist in determining what actions to take to alleviate problems in the data acquisition process.

Part One: Problem Identification.

Overview. Part One consisted of 17 problem statements which persons surveyed were asked to respond to using a Likert scale. In order to quantitatively analyze the responses, a value was assigned to each possible

response. The possible responses are listed below, along with the numerical value assigned to each.

STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
5	4	3	2	1

The responses to each problem were first examined by organization to determine if the median response to each question was significantly different from a neutral response. This was done to identify those problems that AFLC and ASD answered as neutral. Since a neutral response reveals little or no information, by isolating those problem statements both organizations were neutral on, this research could focus on those non-neutral problem statements. Note however, that if a particular problem statement elicited a neutral response from only one organization, then the neutral response is worth investigating to determine why one organization was neutral and another was not neutral. After determining neutrality of responses, this analysis concentrated on finding those statements where responses significantly differed from organization to organization. Also of interest, was the ranking of the problem statements from the strongest agreement to the strongest disagreement to determine which problems AFLC and ASD felt the strongest about. By doing this it was possible to rank the problem statements in the order of perceived severity. A reliability test was performed on the problem statement responses and the suggested improvements responses. The

reliability of the problem statement responses was Cronbach's alpha = 0.8792, and the reliability of the improvement responses was Cronbach's alpha = 0.8908. These reliability coefficients are high enough to indicate a likelihood similar responses would be obtained if these questions were asked in a repeat of this survey. (The reliabilities were computed using SPSS-X and the procedure is described in Chapter Two. The problem and improvement analysis used and the results are related in the remainder of Chapter Four.)

Deviations From Neutral. To determine if a problem statement was significantly different from the neutral response, the Wilcoxon signed-rank test (18:344-349) was used to test the response median and compare it to median = 3 (or Neutral). The Wilcoxon signed-rank test was performed on STATISTIX (25:6.7) for each of the 17 problem statements. The results are summarized in Table 2 below. To be 80% confident the responses were different from neutral, P-values < 0.20 indicate the responses significantly differed from neutral. Since only Statement 6 was answered neutral by AFLC and ASD, it will not be given consideration in further analysis and is only included in subsequent tables for informational purposes. Problem Statement 6 states, "Government/contractor efforts expended on data pricing exceed the value added benefits."

TABLE 2

Teal Survey Problem Statement Responses
Significantly Different From "Neutral"
Using Wilcoxon Signed-Rank Test

Problem Statement Number	AFLC		ASD	
	P-value	Different from Neutral	P-value	Different from Neutral
1	.1747	yes	.8025	no
2	.0003	yes	.0004	yes
3	.1178	yes	.1453	yes
4	.0001	yes	.0000	yes
5	.0000	yes	.0000	yes
6	.5422	no	.7413	no
7	.0000	yes	.0001	yes
8	.0000	yes	.0001	yes
9	.0073	yes	.1812	yes
10	.0000	yes	.0196	yes
11	.0350	yes	.1482	yes*
12	.0026	yes	1.0000	no
13	.0001	yes	.0030	yes
14	.0003	yes	.8789	no
15	.0006	yes	.0917	yes
16	.0000	yes	.0004	yes
17	.0002	yes	.0132	yes

yes = a significant difference from the neutral response.
Unless otherwise noted, all yes responses agreed the
statements represented problems.

no = the responses were not significantly different from
neutral.

* Response significantly below neutral, i.e. disagreed
that this statement represented a problem.

AFLC and ASD Differences. Having eliminated those
problem statements not significantly different from neutral,
the analysis turned toward finding those statements where

AFLC and ASD significantly differed in their responses. Note, this is not necessarily limited to dichotomous responses (where one agreed and the other disagreed), but includes significant differences in extent of agreement or disagreement. To determine if the AFLC and ASD responses to each statement were different, the nonparametric Wilcoxon rank-sum test was used (25:675-679). The rank-sum test was performed using SPSS-X (26:809-34). To attain an 80%

TABLE 3
 Test of Differences
 in AFLC & ASD Problem Statement Responses

<u>Problem Statement No.</u>	<u>P-value</u>	<u>Significantly Different</u>
1	.6034	no
2	.7181	no
3	.6442	no
4	.3509	no
5	.6667	no
6	.8288	no
7	.0312	YES
8	.1236	YES
9	.2324	no
10	.0227	YES
11	.0084	YES
12	.0112	YES
13	.2566	no
14	.0074	YES
15	.3623	no
16	.4991	no
17	.4796	no

P-value < 0.20 indicates significantly different responses using Wilcoxon Rank-Sum Test.

significance level for the responses, any P-values < 0.20 indicates a difference in the responses. In other words, there is an 80% confidence that the responses are different. Table 3 shows the P-values generated as a result of testing for equal medians.

AFLC and ASD had significantly different responses to six of the problem statements. With the exception of Problem Statement 11, AFLC and ASD agreed that the survey statements identified problems, but differed significantly in their perceptions of problem severity. On Statement 11, ASD disagreed that this was even a problem, while AFLC agreed this was a problem. The six problem statements are listed below and continue on the following page.

Problem Statement 7. There is a lack of guidance and training in determining, defining, and tailoring data requirements.

Problem Statement 8. There is a lack of guidance and training in determining, defining, and tailoring of regulations, specifications, standards, etc.

Problem Statement 10. There are few effective incentives for contractors to recommend data elimination, tailoring, or alternatives to meet government requirements.

Problem Statement 11. The data acquisition process is inefficient, inconsistent, and/or poorly executed and contributes to poor quality RFPs.

Problem Statement 12. Poor communications exist between the Program Manager, team members, supporting organizations (both internal and external), and contractors, which contributes to identifying data requirements in an untimely manner.

Problem Statement 14. Existing policies and procedures do not incentivize SPOs and staffs to streamline data requirements.

For the six questions listed above, the central tendency of AFLC's answers showed a significant difference (in all cases AFLC exceeding ASD) from ASD responses. Statements 12 and 14 found AFLC suggesting that these were problems, while ASD offered a neutral response.

The implications of the differences between AFLC and ASD on problem statements 7, 8, and 10 may not be immediately obvious since, despite a significant difference in responses, both organizations agree these are problems. Examination of the content of statements 7 and 8, shows these problems deal with preparations to qualify people to work in the data management arena. It can be inferred from the responses that AFLC feels that training of persons in the data acquisition process is more urgent than does ASD. This difference of opinion as to the severity of the problem could influence the amount of formal training a command or division is willing to provide its people.

Problem statement 10 deals with incentives (or lack thereof) for contractors to take the initiative in

streamlining the data acquisition process. AFLC views this as significantly more serious than does ASD, however both agree it is a problem. The implications of this could be quite troublesome if the government is to capitalize on the benefits such incentives could bring. Since ASD has the primary responsibility in the RFP and SOW preparation, it will likely take a concentrated effort on their part to incorporate contractor incentives into RFPs and SOWs. If ASD does not view this as a severe problem, then modifying the process to include contractor incentives is unlikely. AFLC is not in a position in the acquisition arena to exercise controlling authority over the RFP and SOW, and therefore will have to wait for ASD (or AFSC) to take the initiative.

Problem statement 11 is the only statement where AFLC and ASD disagreed as to whether or not it was a problem. ASD did not believe this to be a problem, while AFLC said it was a problem. The problem statement reads, "The data acquisition process is inefficient, inconsistent, and/or poorly executed and contributes to poor quality RFPs." Since ASD respondents are more responsible for these aspects of the process than are AFLC, there is likely a reluctance on the part of ASD respondents to acknowledge any shortfalls on their parts. Assuming there was no prejudice such as this, this is an area where further investigation should take place. The ASD response implies that the data acquisition process is efficient, consistent, properly

executed, and contributes to high quality RFPs. However the ASD responses to statement 5 were in overwhelming agreement. Statement 5 reads, "Program requirements which are poorly defined, unstable, inconsistent, incomplete, or over specified during the RFP preparation phase can lead to inappropriate data requirements." ASD responses to statements 5 and 11 are contradictory. This type of contradiction illustrates the difficulty there is in focusing in on actions to take in future process reforms.

Problem statement 12 reads, "Poor communications exist between the Program Manager, team members, supporting organizations (both internal and external), and contractors, which contributes to identifying data requirements in an untimely manner." This statement evoked a neutral response from ASD and a definite agreement from AFLC. This could be due to the separate roles the two organizations play in the acquisition process. AFLC is a supporting organization and subsequently differs in its perspective. The Auditor General's Report cited earlier in this thesis found that a lack of adequate response time for supporting organizations contributed to an inefficient process (3:8). ASD and those organizations that take the lead in RFP and SOW preparations need to be aware that the other players in the process recognize this communication problem. ASD needs to recognize it also.

Problem Statement 14 reads, "Existing policies and procedures do not incentivize SPOs and staffs to streamline

data requirements." Since ASD responded with a neutral to this statement, it is difficult to determine just what their position is, and to make too many assumptions could be misleading. However, their lack of disagreement assures their position that they do not believe incentives currently exist. It could also signal a belief on the part of ASD respondees that incentives for SPOs and staffs would be of little value. AFLC on the other hand agreed that current policies do not incentivize streamlining. It cannot be assumed however that AFLC believes that streamlining incentives should be implemented for SPOs. From the responses, this is an area where further investigation should take place before any incentive policies are instituted.

The Most Severe Problems. In the following section the problems are ranked according to their median values. (See Table 4.) This shows the relative importance or severity AFLC and ASD placed on each problem. From Table 4, it appears that AFLC and ASD relative ranking of the problems is similar. AFLC and ASD have ranked four of the same problems in the top five, and eight in the top nine. These problems are statement numbers 4, 5, 7, 8, 10, 13, 16, and 17. By examining the content of these problem statements, it was possible to group the problems into subject areas. Statements 4, 5, and 17 all address the issue of the government ordering too much data. The reasons

TABLE 4

Ranking of Problems by Survey Problem No. from
Most to Least Severe by Organization
(Ranked by Median)

<u>ASD</u>	<u>AFLC</u>
5	5
4	7+
8+	8+
7+	10+
16	4
17	16
2	12+
13	17
10*+	13
3	9
9	14+
15	15
6*	2
14*+	3
12*+	11+
1*	1
11+ **	6*

- + AFLC and ASD gave significantly different responses.
* Neutral response.
** Not found to be a problem.
-

for this include poor quality of the RFP (statement 5), the lack of attention to data management issues (statement 17), and a proliferation of data requirements leading to increased costs and wasted contractor as well as government efforts (statement 4).

Problem statements 7, 8, and 13 address training issues. The lack of training and guidance addressed in these statements were cited as some of the top problems encountered in acquiring data. While statements 7 and 8 were found to be answered significantly different by AFLC

and ASD in the previous section of this thesis, they are both ranked in the top four problems. This evidence that both organizations identified these as top problems should diminish the significance of the central tendencies of their answers to be different. This means that despite the differences found between Statements 7 and 8, training is a problem that according to AFLC and ASD deserves immediate attention.

Problem statements 10 and 16 cite the lack of incentives for contractors to take the initiative in eliminating or reducing data as a major problem. The implication here is that the current situation encourages the contractor to not reduce the amount of data the government asks for since the contractor is getting paid for all deliveries. Another implication is that the contractor knows what and where reductions could and should be made, but as long as he is being paid to deliver, there is no reason for him to reduce his income. Since the government is so poor at determining appropriate data costs (as was evident from the Auditor's Report), the contractor can use this "hidden income" as a management reserve. This would be especially true of fixed price efforts, where the high risk is on the contractor to perform the contract within the dollars provided.

Factor Analysis of Problem Statements. So far, the analysis used has resulted in a hypothesis that the most severe problems in the data acquisition area are described by problem statements 4, 5, and 17 (excessive data requested

by the government); 7, 8, and 13 (a lack of training); and 10 and 16 (no incentives to minimize data requests.) The logical groupings were made from intuitively combining statement rank and content. To confirm that there are correlations such as the ones suggested above, a factor analysis was performed on the responses to the problem statements. SPSS-X was used to perform the factor analysis. When factor analysis is applied to the responses of all of the problem statements, four factors were found. The groupings found were:

Factor One: 1, 2, 3, 6, 9

Factor Two: 7, 8, 12, 13, 17

Factor Three: 4, 5, 15, 16

Factor Four: 10, 11, 14

When factor analysis is applied to only the top nine problems, as determined by the median ranks, only two factors were found. The factor groupings are:

Factor One: 2, 4, 7, 8, 13, 17

Factor Two: 5, 10, 16

Since problem statements 7, 8, 13, and 17 are grouped in the same factor for both iterations, it appears there is a correlation in the responses to these problems. The groupings selected in the previous section were a result of examining statement content and attempting to group the questions according to subject area. Since statements 4 and 5, and statements 10 and 16 are in the same factor at least once, this indicates an assurance that the groupings

previously selected are internally correlated. Problem statement 17 was originally grouped with excessive data, but the factor analysis shows a stronger correlation with the training group. While problem 17 deals with obsolete requirements and unnecessary data, the respondees could have attributed these circumstances to a lack of training. The conclusion is that the factor analysis showed the logical groupings of the problem statements from the previous section was reasonable.

Summary. The Teal survey addressed many problems relating to data acquisition. While some of these problems elicited neutral responses from survey takers, and some were found to have significantly different answers from AFLC to ASD, three problem areas clearly emerged from the survey results. One, the government orders too much data from the contractor, and the survey found reasons for this are poor quality RFPs and a lack of attention given to such data management issues. Second, there is a lack of training of government personnel to properly prepare RFPs and SOWs, which naturally leads to the first problem. Third, the government has not given the contractor the incentive to reduce the amount of data. For the government to address the ever increasing cost of data, these problems will have to be examined and solutions to them must be found.

PART TWO: IMPROVEMENTS.

OVERVIEW. Analysis of the Teal survey continues with the second half of the survey which asked the respondees to give their opinion as to the possible benefits of suggested improvements to the data acquisition process. The list of suggested improvements is in Appendix C. Those surveyed were asked to respond to a Likert scale for their answers. This research assigned a numerical value to each point on the scale to facilitate analysis of the responses. The Likert Scale and values assigned are listed below.

VERY HIGH	HIGH	MODERATE	LOW	NONE
5	4	3	2	1

A response of VERY HIGH means the respondee believes the suggested improvement has the potential for significantly improving the current data acquisition process, while a response of none means no improvement to the process can be achieved through this suggestion. The responses to this portion of the survey will be analyzed using the Wilcoxon rank-sum test to determine any difference of central tendency of the AFLC and ASD responses. This will reveal those suggested improvements where AFLC and ASD significantly disagree as to the benefit of a suggestion. It can be assumed that those suggestions where the responses are not significantly different find AFLC and ASD of like mind. Where differences are found, the suggestion is repeated and implications of the disagreement are made. The

30 suggested improvements are also ranked by medians reflecting the relative value each had according to AFLC and ASD. After identifying those improvements where AFLC and ASD have differences of opinion as to possible benefit, and examining the ranking of the suggestions by AFLC and ASD, those improvements found to have the most support will be discussed. A factor analysis is next performed on those problem statements and suggested improvement responses that were shown to be of the most concern to the respondents. This will be done to determine if the improvements that were most strongly suggested correlate with the worst problems.

AFLC and ASD Differences. The Wilcoxon rank-sum was used to determine if the central tendency of the AFLC responses differed from the central tendency of the ASD responses. SPSS-X was used to perform the test and the results are listed below in Table 5. The reader should understand that a significantly different response does not necessarily mean AFLC and ASD hold dichotomous views, but rather a difference here refers to degree of the benefit each thought possible. This information is valuable since identification of these differences gives those working in this area an idea of what differences need resolution.

The improvements AFLC and ASD differed significantly on were suggestions 3, 11, 12, 14, 17, 19, 20, 21, 22, 27, and 28. These are examined following Table 5.

TABLE 5

Test for Differences
in AFLC & ASD Responses to Improvements

<u>Suggested Improvement</u>	<u>P-value</u>	<u>Significantly Different</u>
1	.3102	no
2	.2509	no
3	.0617	YES (ASD)
4	.3791	no
5	.8662	no
6	.2486	no
7	.9461	no
8	.2188	no
9	.9345	no
10	.6686	no
11	.1924	YES (AFLC)
12	.0367	YES (AFLC)
13	.3894	no
14	.0349	YES (AFLC)
15	.5379	no
16	.9805	no
17	.1307	YES (AFLC)
18	.6285	no
19	.0002	YES (AFLC)
20	.0031	YES (AFLC)
21	.0361	YES (AFLC)
22	.0001	YES (AFLC)
23	.8967	no
24	.2261	no
25	.5938	no
26	.6496	no
27	.0978	YES (AFLC)
28	.0552	YES (AFLC)
29	.4544	no
30	.5371	no

P-value < 0.20 indicates significantly different

() Designates organization that felt strongest about the suggested improvement being beneficial.

Improvement 3 (IM3): "Emphasize digital delivery of cost and pricing data, proposal data, and other deliverable data." This improvement drew a high rating from ASD but only moderate support from AFLC. Perhaps AFLC and ASD use deliverable data in different ways, where digital delivery is not quite so attractive to AFLC. Since a possible change to the data acquisition process is in the form of deliverable data, this area should be examined further to ensure AFLC will be able to use the data in digital form.

IM11: "Schedule has been a major reason management has been willing to accept poorly defined data requirements. Management must realistically schedule enough time for data requirements definition." This improvement drew strongest support from AFLC, and it echoes the subject addressed in problem statement 12 where AFLC and ASD offered similar answers. Again, it appears correction of this problem and implementation of this improvement are the primary responsibility of ASD (AFSC).

IM12: "Establish a cost accounting standard (CAS) guideline for pricing data." AFLC thought this suggestion would offer a high payoff, while ASD responded with a low to moderate rating. This suggestion would add standardization to the data pricing, although ASD is questioning the payoff of this action.

IM14: "Develop mandatory training courses for data managers and RFP writers." A high rating was given by AFLC and a moderate to high rating by ASD. This drew generally

large support from both groups, although AFLC anticipates higher payoffs. This need for additional training agrees with the findings of the studies looked at in Chapter Three and the identification of lack of training as a severe problem in the first half of this survey. A future study to find out how much formal training current data managers and RFP writers have would be helpful in determining where and what training to prepare for future managers.

IM17: "Ensure wording is included in SOW to implement the acquisition streamlining clause." ASD gave this only a low to moderate chance of improving the process, while AFLC viewed the chances as being moderate to high. This is a curious response since AFLC agreed in Problem statement 10 that the contractor had few incentives to streamline. Without incentives to streamline, it is doubtful a contractor will take this action regardless of wording in the SOW. ASD's low rating could be a result of past streamlining rhetoric that has yet to have a measurable positive impact on the process.

IM19: "Separately price each data item." ASD gave this suggestion a low rating, while AFLC came in with a high rating on this item. The difference in perceived value of separately pricing each data item should be examined further, especially since both organizations were neutral on the value added benefits of data pricing. (Recall Problem Statement 6.) It should be determined why there is such a sharp contrast in responses. Perhaps ASD has some

experiences not shared by AFLC. Data pricing is difficult though recent studies (such as the ones in Chapter Three) and suggested actions from the Armed Forces Pricing Manual (10:9-29) indicate a move toward this practice. The differences that ASD and AFLC have over this issue should be explored further, before regulations are changed or enforced to demand separate pricing. The data pricing issue should be investigated further to determine if there are categories of data where pricing could yield more benefits than others.

IM20: "Increase approval level for exceptions to separately pricing data for added visibility." Since ASD did not find the idea of separately priced data appealing, they found this suggestion even less worthwhile. With a rating of none to low, ASD found little or no value in elevating the level at which the decision to not separately price each data item would be made. AFLC continued moderate support for involving a higher level of approval authority.

IM21: "Devise automated centralized systems for recording/analyzing data prices." ASD increased its perception of the usefulness of data pricing when the prospect of an automated system for pricing was made available. Perhaps the lack of enthusiasm ASD expressed for data pricing in IM19 was driven by the prospect of manually determining the price of data. An automated system was given a moderate rating by AFLC. The whole issue of pricing data did not meet with a lot of enthusiasm from AFLC or ASD, though AFLC thought it carried more promise than did ASD.

IM22: "Establish a standard data package/draft CDRL that is common to most or all programs within a product division." ASD gave this suggestion no better than a low chance of improving the data acquisition process while, AFLC rated this suggestion a very solid HIGH. This action was taken by ESD and was favorably received (12).

IM27: "Establish a data management training program with industry." While AFLC answered significantly higher than did ASD, they still only judged this improvement to have moderate payoff. In looking at the responses to IM14, where training was held in high regard by both AFLC and ASD, when the prospect of training with industry was approached, both showed skepticism as to the likelihood of offering improvement.

IM28: "Recommend AFSC develop a computer-aided guide on how to tailor data." AFLC again felt a high payoff was available, while ASD offered no better than a moderate prospect. This question was worded in such a way as to not know whether respondees were responding to the usefulness of a computer-aided guide, or the appropriateness of AFSC developing such a guide.

The Most Beneficial Improvements. To put the differences in AFLC's and ASD's answers into yet another perspective, the suggested improvements are ranked, by organization, from the most likely to be beneficial to the least likely. The improvement rankings are listed in Table 6. The rankings were determined by comparing the

medians of each question's responses. The top ten responses from AFLC and ASD are compared for common improvements. (Due to a tie for AFLC responses to suggested improvements 5, 12, and 30, the top twelve responses are taken from AFLC.) These top ranked improvements are looked at further to see if they can be grouped into improvement areas, if the improvements address the problems noted in part one of this survey, and if the improvements suggested correlate to the findings of the studies in Chapter Three. The top suggested improvements that both AFLC and ASD felt would improve the data acquisition process are numbers 4, 5, 10, 11, 14, 29, and 30. (The Teal survey Critical Action Team asked those surveyed to rank the improvements. A simple frequency count determined the rankings (10). See Appendix D for their results. In contrast, the analysis included here attempts to group the most beneficial improvements into common groups and determine a link between the most severe problems and the most beneficial improvements.)

The improvements can be grouped into logical subject areas. Improvements 5, 14, and 29 all call for additional training for those working in the data acquisition area. Since lack of training was found to be among the worst problems, it was logical that suggestions for increasing training would be among AFLC's and ASD's top improvements. The suggested improvements are repeated following Table 6.

TABLE 6

Rankings of Suggested Improvements From
Most to Least Beneficial by AFLC and ASD

<u>AFLC</u>	<u>ASD</u>
14. 11. 10	3. 10
29	4. 29
4	11
13	8. 14. 30
6. 19. 22	5. 16
5. 12. 30	9
9. 15	13. 6
16. 28	15. 25
27	7
17. 18	18. 27
3. 8. 25	26. 28
20	1. 23
2. 7. 21	12. 21
1. 23	17
26	22
24	19
	2. 20. 24

For the text of suggested improvements, see Appendix C.

Improvement 5. Provide an RFP preparation guidance document/computerized system with lessons learned to help in preparation of the RFP.

Improvement 14. Develop mandatory training courses for data managers and RFP writers.

Improvement 29. Provide additional training to those involved in specifying, reviewing, inspecting, and accepting engineering data.

Suggested improvements 10, 11, and 30 deal with determining what data items should be ordered, how they should be tailored, and ensuring adequate time is allowed to do this. All of these have an impact on the quantity of data the government orders. By implementing all three of these suggestions, the quantity of data requested would likely decrease, the quality increase, and subsequently the costs to the government would decrease. It appears that these three improvements would alleviate the severity of the problems identified by problem statements 4, 5, and 17. These improvements are listed below.

Improvement 10. Validate the need for requirements (e.g. standards, specs) derived from referenced documents and require only those that are justifiable. Tailor to program needs.

Improvement 11. Schedule has been a major reason management has been willing to accept poorly defined data requirements. Management must realistically schedule enough time for data requirements definition.

Improvement 30. Primary data user should request data. Problem statements 10 and 16 suggest the contractor may hold the best answers to reducing the high cost of data.

One area where the costs could be reduced is addressed in Improvement 4.

Improvement 4. Require contract proposals to identify data that would be more economically provided in commercial format.

When examining problem and improvement statement content, it appears the respondees have linked the problems to possible solutions. However, as the following section shows, an analysis that depends on ranking the problems and improvements by the strength of the responses does not always assure a correlation exists between the two. The information revealed thus far is important, because it shows where those working in the data management area perceive the problems and solutions to be. However, if action is ever to be taken to address some of these problems, it is important that there be a correlation between the problems and the proposed solutions. If this correlation does not exist, actions taken may not really solve or alleviate the problems.

Factor Analysis of Problems and Improvements. To determine if a correlation exists between the most severe problems and the most recommended improvements, the top problem statement responses and the top suggested improvement responses were examined using factor analysis. The factor analysis found the factors indicated in Table 7. (see Appendix F for the rotated factor matrix.)

TABLE 7

Comparing Methods for Determining Relationships
Between Problems and Improvements

Intuitively Linking Most Severe Problems w/Best Solutions		Factor Analysis of Most Severe Problems & Best Solutions	
<u>Training</u>		<u>Factor One</u>	
<u>Problems</u>	<u>Solutions</u>	<u>Problems</u>	<u>Solutions</u>
P-7	IM-5	P-4	IM-14
P-8	IM-14	P-7	IM-29
P-13	IM-29	P-8	
<u>Excessive Data</u>		<u>Factor Two</u>	
<u>Problems</u>	<u>Solutions</u>	<u>Problems</u>	<u>Solutions</u>
P-4	IM-10	none	IM-4
P-5	IM-11		IM-5
P-17	IM-30		IM-10
			IM-30
<u>Lack of Incentives</u>		<u>Factor Three</u>	
<u>Problems</u>	<u>Solutions</u>	<u>Problems</u>	<u>Solutions</u>
P-10	IM-4	P-10	
P-16		P-16	none
		P-17	
		<u>Factor Four</u>	
		<u>Problems</u>	<u>Solutions</u>
		P-5	IM-11
		<u>Factor Five</u>	
		<u>Problems</u>	<u>Solutions</u>
		P-13	none

P -- indicates problem statement.
IM -- indicates suggested improvement.

If the results of the previous section are compared to the factor analysis results, it can be seen that only

Factors One and Four agree with the intuitive relationships. From this, several conclusions can be drawn.

a. The lack of training has been established to be a problem, and the suggested improvements correlate with the problems. Policy makers should feel confident that investing in additional data manager training would, in the opinion of those working in data management, improve the data acquisition process.

b. Factor Four shows a correlation between the problem of poorly defined data, problem statement 5, and the amount of time allowed to define data requirements, improvement 11. This correlation was also found in the ranking analysis. Again, policy makers should give strong consideration to demanding more time be allowed for requirements definition. It is most likely that better defined data requirements would lead to reduced costs.

c. The lack of incentives for the contractors to reduce data did not correlate with any of the top solutions using factor analysis. Upon examining the list of 30 suggested improvements, there are no improvements that directly suggest contractor incentives, thus one of the most severe problems could not be correlated with any specific actions. This is an oversight of the survey instrument rather than a suggestion that incentives are not available to address this problem.

Summary. In this chapter, the problems associated with data acquisition have been explored. The auditor's report analysis showed how easy it is to discount the cost of data as insignificant. Yet when the contracts were examined using more rigorous techniques, the cost of data swelled from the report's figure of \$5.2 million to a more realistic \$1 billion. As long as the perception is that data costs are insignificant, the urgency of policy makers to take action will not be attained. Data is a cost driver and must be treated as such by program managers. The auditor's report also pointed out problems with the data acquisition process. Data tailoring, data calls, and DRRBs are not effectively implemented by program managers. If the program manager knew the real cost of data, perhaps these functions would be treated more seriously than the auditor's report indicates is now being done.

The Teal survey attempted to find the most serious problems and the improvements that would make data acquisition a more efficient and effective process. A call for increased training of those people working in and around data management was declared a high priority. This coincides with the recommendations of the studies reviewed in Chapter Three. From the survey, it can also be concluded that the quality of government RFPs is a major reason for inappropriate data being ordered. The main reason for this, in addition to the lack of a properly trained work force, is program managers do not ensure enough

time to accomplish a proper requirements definition. This was demonstrated to be a common condition in the auditor's report.

The Teal survey contained several weaknesses that made in-depth analysis of other than the most accented problems and improvements impractical. The survey collected no demographic data on those answering the survey. It would be valuable to know how long each respondee has worked in the data management arena, their pay-grade, their level of formal training in data management, and their frequency of exposure to RFP and SOW preparation. Since these could not be determined, it is not possible to determine if the differences noted between AFLC and ASD are attributable to the differences in the organizations or the difference in the level of data managers the survey may have been distributed to within the organizations. Since the sample size was not large compared to the number of people working in the data acquisition area, there is no assurance that those surveyed were randomly chosen, so the possibility of selectively choosing who would answer was possible. It is for this reason that the differences in the responses of AFLC and ASD were not given a more rigorous treatment. This is also the reason that without further investigation of the differences noted, policies and procedures affecting these areas should not be instituted.

V. Conclusions and Recommendations

The research for this thesis revealed many problems that plague the data acquisition process. While there are numerous opinions as to what the most severe problems are, (many of which are local in nature), this thesis found those problems that permeate throughout the acquisition process. By identifying those areas that everyone in the acquisition arena finds to be problems, it becomes possible to address those problems with corrective actions. Because all of the problems identified were not universally experienced throughout the Air Force or DOD, only solutions to universal problems should be addressed from an Air Force or DOD level. From the research, three major problems exist within the current data acquisition process. Each of these problems is complicated by the other, thus no one solution is likely to alleviate all of the problems. This research showed that those working in the data management area often have different ideas as to what solutions to implement, usually depending on the where they work. The remainder of this chapter addresses the thesis hypotheses, summarizes major findings and their impact, and makes suggestions for further research.

Proliferation of Data

Government program managers do not know how much data requirements actually cost their program. Data prices are

not known, data requirements are poorly written, and excessive data (costing over \$1 billion annually for the Air Force alone) is ordered by the government. These themes were found throughout this research. In addition, program managers do not take the actions required to improve the quality of data ordered, and they do not observe the required data acquisition procedures. Program managers do not ensure data calls are properly conducted, nor do they give data calls or DRRBs the top management attention needed to be effective. Because data is a cost driver for many programs, and because the quality of the data received can affect program success, program managers need to elevate the role of the data manager to a senior management level.

In addition to elevating the role of the data manager, there are actions that can be taken to eliminate some of the confusion surrounding data acquisition. Standard data packages need to be established. These are data items that, after tailoring to a specific contract, can be ordered without justification, thus time can be spent examining non-standard data requests. Data needs to be categorized according to ability to price. Pricing some data items may be cost prohibitive due to the nature of the item, and these should not be priced. However, most data items can and should be priced and program managers should demand prices be delivered. Further research should examine the feasibility of pricing data and attempt to determine pricing categories. Further research on program managers attitude

toward data management would also be useful. If program managers realize data is a cost driver, and that too much data is ordered by the government, then the next step is to determine actions to alleviate these conditions. However, if the program manager does not believe data represents a significant cost, then educating the program manager as to the real costs must precede any actions.

Contractors may hold the key to the problem of excessive data. This research showed those working in the data management arena believe the contractor could and would help the government reduce the quantity and cost of data if they were given the incentive to do so. Currently the contractor is allowed to charge for all data, though he does not necessarily have to give a per item price, since the government often waives this requirement. Since data is an area where the contractor can be vague, even totally obscure estimated costs as "not separately priced," it affords him the opportunity to hedge against cost overruns and is an opportunity to include unchallenged costs. If the contractor were incentivized by the government in some way to make reduction of data in the contractor's interest, real data reduction could be realized almost immediately. Further research needs to be done to determine what incentive actions could be taken to make data reduction a goal of the contractor.

Training

A lack of training of government employees in the art of data acquisition echoed as a problem throughout this research. It appears this lack of training is characteristic of all levels of personnel in all data related jobs. From program managers on down, personnel do not possess the skills required to ensure the government efficiently and effectively acquires data. Evidence suggests program managers do not understand the process, or the significance of the costs, because they have never received formal training in the data acquisition area. It could be this lack of training of program managers that keeps them unaware of the significance of data to their program's success.

Training is universally lacking for those people involved in data acquisition. Virtually all of the studies reviewed in this thesis, including the Teal survey, found training to be neglected. This lack of training could be attributable to many things, though the most likely reason is the variety of people working data and the frequency with which they do so. In the Air Force, the majority of the data management function is performed by personnel working in this area part-time. There is likely a reluctance to send part-time data managers to training. This is an area where additional research should be performed. It would be beneficial to know how much formal training full-time and part-time data managers receive.

Another complication to training data managers is the variety of training needed, both by the managers themselves and by those personnel with whom they interface in determining data requirements. Data managers working on RFP preparation must possess a different set of skills from the data manager concerned exclusively with tracking data on a program. The various people involved in the data call process should all be trained in the importance of carefully selecting only necessary, but quality data. Even those people involved only occasionally in the data call process should receive enough training to understand the process, to learn how to evaluate the importance of the data he/she requests, and to learn how to tailor data requests so only essential data is acquired. Until data managers are recognized as a career field requiring extensive skills, and until they are recognized for the critical role they play in determining a program's success, it is likely available training will not noticeably increase. Just as the Air Force trains personnel before making them pilots or engineers, formal acquisition training should be made mandatory for all working in the data management area. Further research here should investigate the Navy data manager certification program. The success of this Navy initiative could reap dividends for the Air Force also.

The training of data managers and those involved in any aspect of the data acquisition process must involve more than just instituting fancy buzzwords. "Streamlining" and

"TQM" programs are doomed to failure if they are not followed up with adequate training. The outcry for training in the data management area indicates a neglect on the part of senior level management to provide sufficient training. The attitude toward training in the DOD appears to be more concerned with the number of people put through training rather than the quality of that training. For instance, in his book The Defense Management Challenge, J. Ronald Fox points out how the length of training at the Defense Systems Management College (DSMC) is determined not by the time required to disseminate all of the information, but rather by the limit DOD has imposed for temporary duty assignments. This time constraint has forced an abbreviated schedule of courses, thus DSMC has only one course-hour devoted to the area of data requirements (16:227-229). Until the DOD recognizes the importance of quality training in all areas, it is doubtful adequate training will be available to data managers.

With the advances in technology having an ever increasing impact on the acquisition world, the need for training becomes more urgent. The initial stages of CALS are being implemented throughout DOD. This is a sophisticated system that will require extensive skills on the part of the government personnel if the system is to be a success. This will require not only extensive training, but those directly involved with CALS will need to be in more senior positions than data managers currently occupy.

Thus, a designated data management career field, with opportunities for senior level positions are imperative if CALS is ever expected to become a way of doing business.

Problems and Solutions

The data acquisition touches virtually every phase of the acquisition cycle. Many of the people working in data management work only one part of the cycle, and therefore see only a fraction of the problems encountered throughout the entire acquisition process. Each phase has its own peculiar problems along with problems shared by others. With these differences comes different ideas on how to solve those problems. There is often disagreement between those working different phases of the acquisition cycle as to what action should be taken to improve the process. AFLC and ASD did not always agree on just what the problems were and what improvements would alleviate the problems. Policy makers need to be aware of these differences.

Summary

While the area of data management is a complicated network requiring the participation of a diverse group of government and contractor disciplines, there are actions that can be taken to alleviate some of the problems surrounding data management. First, government program managers must be made aware of the high costs of data. Program managers must get involved directly with the data acquisition process. Data costs are a significant portion

of a program manager's budget, and his/her attention to data requests is likely to save dollars and improve the quality of the information a program office receives.

Training of virtually all persons involved in the data acquisition process is essential. Those individuals working this area are responsible for billions of Air Force dollars every year. With the potential for saving over half of these costs, the training efforts offer the prospect of immediate payback. As the data management becomes more sophisticated, the training and competency of data managers must also increase or the technical advances could be compromised because of inadequacies of those operating and managing the system.

Contractors must be offered incentives to reduce rising data acquisition costs. Only the contractor knows where the greatest savings can be realized in data acquisition. The government needs to adopt more of a cooperative effort with the contractors in order to gain their aid in reducing data acquisition costs.

Appendix A: The Teal Survey Raw Data

The following are the responses to the Teal survey problem statements and suggested improvements. The format statement used with SPSS-X was (F2.0,47F1.0). The first two columns were organization identifiers. The organizations' responses included in the survey and their identifiers are:

contractors = 11
 AFLC = 12
 HQ AFSC = 13
 ASD = 14

The next 17 columns are the responses to the 17 problem statements, and the remaining 30 columns are the responses to the suggested improvements. Blanks represent no response.

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1143555545553334554342 3 5 4 3 3 5 111 2 4 34
11443553444334444222 43 4 4 24 4 1 44
113355453422344 4321553141 41 1 44 1 5122 514
114 454455544454445 4434435354344344 22253 334444
113535555553555555334453353531554352121112344445
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123343535525455324433342443325244432 3 21415142
125 434355333444434343454444323555553334552532455
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1243244424233223432 4 4 445444 53141 5
1233344244444424442 4 444 44455445 454 1 424
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12434552444544433444144113 334 33 11 3
  
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123534445445424545413543322 1 5321151113324 3443
12444444444444444222424444443344141433231413444
12 4143433244 4423 545445 4 2 4 43
1233344333333233334
1234334243243443332
135545544254444244554554352445 32253 442115313235
1322145421222232332332443454543144 4432454443344
134423425522243222353534434344 355334223342222451
1345555455444454445332432244443143323222115314252
13233353322223333343 523222 22 5 32 2 3421311241
144425514245153 3442142442555455 55 34 141341353
1423444333442443455424222134142523121111221343141
1445344524441142442113334445551443114211211533355
145555524445534444441453434355 43 5 5113245413323
141 3332341322221313134212131214 1 211111212213
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141454434452422244443542423444 543113111352211113
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144323433333233334 2534 342 3 4 4
14335444434433334433344333 3 2
14232342223322332322
14255543441523454553 3544553425144144112 15343345
144424434445313345322444333243 433443433432333434
142423434443333333 44444444 44 4 4444311444344

11. The data acquisition process is inefficient, inconsistent, and/or poorly executed and contributes to poor quality RFPs.
12. Poor communications exist between the Program Manager, team members, supporting organizations (both internal and external), and contractors, which contributes to identifying data requirements in an untimely manner.
13. Often lessons learned with respect to data, data calls, and the tailoring processes are not documented. If generated they are often not used in the preparation of RFPs.
14. Existing policies and procedures do not incentivize SPOs and staffs to streamline data requirements.
15. Current policies and procedures do not incentivize SPOs and staffs to streamline data requirements.
16. Current policies and procedures do not incentivize the contractor (offerors) to recommend streamlined data requirements.
17. Lack of attention to data management issues has caused obsolete requirements and unnecessary data to be placed on contract.

Appendix C: Teal Survey Suggested Improvements

The Teal survey contained the 30 suggested improvements listed below (28). Those surveyed were asked to respond to the survey using the Likert scale listed immediately below.

VERY HIGH HIGH MODERATE LOW NONE

1. Validate demonstrated contractor capability through CPARS in lieu of requesting management plans in proposals.
2. Establish policy for realistic limits on government requests for alternative/option pricing and cost data.
3. Emphasize digital delivery of cost and pricing data, proposal data, and other deliverable data.
4. Require contract proposals to identify data that would be more economically provided in commercial format.
5. Provide an RFP preparation guidance document/computerized system with lessons learned to help in preparation of RFP.
6. Develop and define a process at each functional organization to determine "minimum essential data" to do their job, with responsibility and accountability placed on requester and requesting organization. In practice, minimizing data is a responsibility of the DRRB rather than that of the data requester or his organization even though the latter officially does have that responsibility also.
7. Emphasize the many alternatives (on-site visits, CAO, DAL, etc.) to reviewing contractor performance/data without necessarily requesting data for formal delivery to government.
8. Adapt "mil-prime" specification concept endorsed by MIL-HDBK-248B, "Acquisition Streamlining," which allows contractor tailoring of government guidance specifications to their design while meeting specified operational/performance requirements.
9. Bring in outside organization (with identified team players) into the RFP development process as early as possible.

10. Validate the need for requirements (e.g. standards, specs) derived from referenced documents and require only those that are justifiable. Tailor to program needs.
11. Schedule has been a major reason management has been willing to accept poorly defined data requirements. Management must realistically schedule enough time for data requirements definition.
12. Establish a cost accounting standard (CAS) guideline for pricing data.
13. Develop an automated AMSDL database for direct downloading to product divisions with periodic updates, key word lookup capability, tailoring guidelines for each data item description (DID) and a DID download capability.
14. Develop mandatory training courses for data managers and RFP writers.
15. Create career paths, recognition programs etc., for data managers.
16. Revise MIL-HDBK-245 to require draft SOWs to clearly state mission performance criteria; operational effectiveness measures; and operational suitability parameters in order to avoid "how-to-manage" procedures.
17. Ensure wording is included in SOW to implement the acquisition streamlining clause.
18. Require the use of data accession list for major systems.
19. Separately price each data item.
20. Increase approval level for exceptions to separately pricing data for added visibility.
21. Devise automated centralized systems for recording/analyzing data prices.
22. Establish a standard data package/draft CDRL that is common to most or all programs within a product division.
23. Establish a senior-level data review to act as a devil's advocate review to challenge data requirements.

24. Implement "sunset law" for automatic expiration in AMSDL and regulations.
25. Prepare an AFSC Data Management Guide.
26. Recommend each product division set up DM matrix organization.
27. Establish a data management training program with industry.
28. Recommend AFSC develop a computer-aided guide on how to tailor data.
29. Provide additional training to those involved in specifying, reviewing, inspecting, and accepting engineering data.
30. Primary data user should request data.

Appendix D: Conclusions of Teal Survey Originators

The following is a summary of the Teal survey findings the Tailoring Data and Data Call Critical Action Team presented to Head Quarters Air Force Systems Command (1).

1. Overall Problem Statement: Tailoring and data call processes need improvement in order to ensure we meet our user's requirements.
2. All of the problems identified in the survey were validated as problems via survey responses. Over 80% of those responding agreed that statements 2, 4, 5, 7, 8, 10, 13, and 16 were problems, while the remaining statements were identified as problems by at least 58% of the respondees. The critical action team (CAT) therefore concluded all 17 statements represented serious data management problems (1:13).
3. The most severe problems (top ten), in order of most to least severe, were statement numbers
5, 7, 9, 4, 8, 1, 10, 12, 3, and 14.
4. Key problems identified by the CAT were (1:15):
 - a. Program requirements poorly defined.
 - b. Lack of guidance/training on data requirements.
 - c. Lack of accountability/responsibility on the data requester.
 - d. Proliferation of data requirements.
 - e. Lack of guidance/training on regulations, specifications, and standards.
 - f. Not enough effort is placed on pricing data.
5. The improvements (top ten) most likely to be beneficial to the data acquisition process were, in order of most to least beneficial, suggested improvement numbers:
6, 14, 10, 3, 4, 11, 29, 5, 8, and 15.
6. The CAT identified the following list of improvements that enhance the data acquisition process (1:17).
 - a. Order the minimum essential data via one DRRB.
 - b. Mandatory training classes for those involved in data management. i.e. Data managers, RFP writers, & data reviewers.
 - c. Validate the need for all data requests and RFP requirements.
 - d. Encourage the use of commercial/contractor format for data delivery.
 - e. Encourage digital delivery of data.
 - f. Schedule enough time for requirements definition.
 - g. Provide additional training.

Appendix E: Kolmogorov-Smirnov Test on Teal Data

The following contains the results of the Kolmogorov-Smirnov (K-S) test on the Teal survey data. The responses of AFLC and ASD to each question were tested for similarities of spread and shape of their distributions. Determining that the spread and shape of the distributions were the close to the same enabled the Wilcoxon Rank-Sum Test to be used for subsequent tests. The P-values of the test are reported. Any P-values less than 0.20 will show different distributions.

PROBLEM STATEMENT	P-value	IMPROVEMENT STATEMENT	P-value
1	.8849	1	1.0000
2	1.0000	2	.5537
3	1.0000	3	1.0000
4	1.0000	4	1.0000
5	1.0000	5	1.0000
6	1.0000	6	.6226
7	1.0000	7	.6534
8	1.0000	8	1.0000
9	.8638	9	1.0000
10	1.0000	10	1.0000
11	1.0000	11	1.0000
12	1.0000	12	1.0000
13	1.0000	13	1.0000
14	1.0000	14	1.0000
15	1.0000	15	1.0000
16	1.0000	16	1.0000
17	.9110	17	1.0000
		18	1.0000
		19	1.0000
		20	1.0000
		21	.2301
		22	1.0000
		23	.1599
		24	1.0000
		25	1.0000
		26	1.0000
		27	1.0000
		28	1.0000
		29	1.0000
		30	1.0000

(P-values are for a two-tailed test.)

APPENDIX F: Factor Analysis of Teal Survey Problems and Improvements

This is the factor analysis results when the top ranked responses of problems and suggested improvements from the Teal Survey are analyzed as a group. Listed below is the SPSS-X program used and the resulting rotated factor matrix is shown on the following page. Only the highest loading factor for each variable is shown in the factor analysis matrix.

```
TITLE          'SPSSX ON TEALE DATA'
FILE HANDLE    DAT1/NAME='TEALEDAT'
DATA LIST      FILE=DAT1 FIXED RECORDS=1/
              ID,PR1,PR2,PR3,PR4,PR5,PR6,PR7,PR8,PR9,
              PR10,PR11,PR12,PR13,PR14,PR15,PR16,PR17,IM1,IM2,IM3,
              IM4,IM5,IM6,IM7,IM8,IM9,IM10,IM11,IM12,IM13,IM14,IM15,
              IM16,IM17,IM18,IM19,IM20,IM21,IM22,IM23,IM24,IM25,
              IM26,IM27,IM28,IM29,IM30
              (F2.0,47F1.0)
SET            BLANK=99/WIDTH=80
MISSING VALUES ID to IM30 (99)
FACTOR        VARIABLES=PR4,PR5,PR7,PR8,PR10,PR13,PR16,PR17,IM4,IM5,
              IM10,IM11,IM14,IM29,IM30/
              FORMAT=SORT BLANK (.3)/
```

FINAL STATISTICS:

VARIABLE	COMMUNALITY	* FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
PR4	.66908	* 1	4.14061	27.6	27.6
PR5	.61711	* 2	2.50952	16.7	44.3
PR7	.78610	* 3	1.72046	11.5	55.8
PR8	.71125	* 4	1.13602	7.6	63.4
PR10	.54890	* 5	1.08858	7.3	70.6
PR13	.77346	*			
PR16	.63201	*			
PR17	.76447	*			
IM4	.52583	*			
IM5	.85727	*			
IM10	.71644	*			
IM11	.84152	*			
IM14	.79664	*			
IM29	.72553	*			
IM30	.62960	*			

VARIMAX

ROTATION 1 FOR EXTRACTION 1 IN ANALYSIS 1 - KAISER NORMALIZATION.

VARIMAX CONVERGED IN 8 ITERATIONS.

ROTATED FACTOR MATRIX:

	<u>FACTOR 1</u>	<u>FACTOR 2</u>	<u>FACTOR 3</u>	<u>FACTOR 4</u>	<u>FACTOR 5</u>
PR7	.83943				
PR8	.81637				
IM14	.73128				
PR4	.56221				
IM29	.56042				
IM5		.76780			
IM30		.76132			
IM10		.71159			
IM4		.68839			
PR16			.74204		
PR10			.72193		
PR17			.62367		
IM11				.90394	
PR5				.61773	
PR13					.83113

FACTOR TRANSFORMATION MATRIX:

	<u>FACTOR 1</u>	<u>FACTOR 2</u>	<u>FACTOR 3</u>	<u>FACTOR 4</u>	<u>FACTOR 5</u>
FACTOR 1	.66173	.45278	.40172	.37296	.23797
FACTOR 2	-.47491	.72883	-.24519	.36473	-.22387
FACTOR 3	-.50704	-.01764	.86073	-.02659	.03218
FACTOR 4	-.15839	.33522	-.13062	-.48406	.78177
FACTOR 5	-.23323	-.38873	-.14349	.70203	.53015

For more information on factor analysis and rotated factor matrix, consult Emory's Business Research Methods (13:402-407), and Kachigan's Statistical Analysis (19:377-401).

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VITA

Captain Daniel C. Brink was born on 10 August 1952 in Rochelle, Illinois. He graduated from Rochelle Township High School in Rochelle, Illinois in 1970. After two years of attending Kishwaukee Community College, he enlisted in the U.S. Navy in 1972 and served four years. In 1977, he enrolled in Northern Illinois University where he received a Bachelor of Science degree in Finance in May 1982. In March 1983, he entered OTS at Lackland AFB, Texas and received his commission in June 1983. He was assigned to the School of Engineering, Air Force Institute of Technology, Wright-Patterson AFB where he received his Bachelor of Science degree in Aeronautical Engineering in 1985. He was then assigned to the Aero-Propulsion Laboratory, Wright-patterson AFB and during this assignment he attended Squadron Officer School at Maxwell AFB, Alabama. In 1988, he was assigned to the National Aero Space Plane Joint Program Office, Wright-Patterson AFB, Ohio and served as a project officer until entering the School of Systems and Logistics, Air Force Institute of Technology in May 1989.

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