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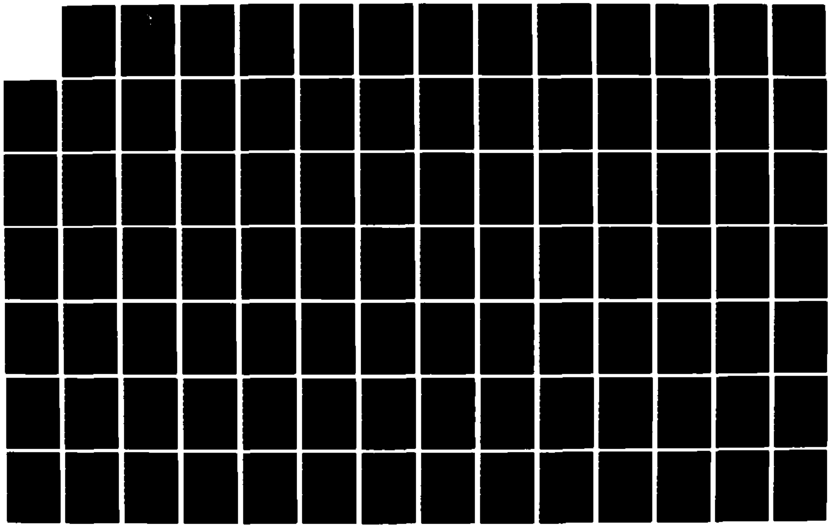

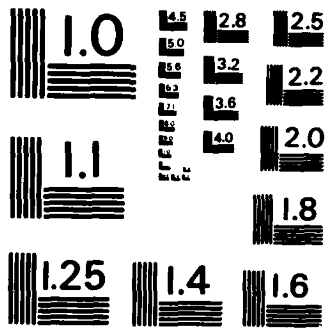

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AN ANALYSIS OF THE SUPPORT EQUIPMENT ACQUISITION PROCESS AND METHODS OF IMPROVEMENT DESIGNED TO REDUCE ACQUISITION COSTS WITHIN AIR FORCE SYSTEMS COMMAND

THESIS

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THESIS

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

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In Partial Fulfillment of the

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Master of Science in Logistics Management

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Abstract

In recent years of high federal deficits and an increase in the defense budget, the Department of Defense has received a great deal of publicity concerning the acquisition cost of weapon systems, spare parts, and support equipment. The acquisition of support equipment is big business, and consumes a large portion of the defense budget. In 1984, Air Force Systems Command (AFSC) spent $1.8 billion on the procurement of support equipment.

In the past, support equipment has not received the management attention it deserves, but this attitude is changing. People are beginning to realize that support equipment is one of the major factors affecting the maintainability and reliability of the fielded weapon systems. The purpose of this research effort is to examine the support equipment acqusition process within AFSC. The research is important because of the large dollar amounts invested yearly in support equipment, not only for acquisition, but for maintainence of the inventory. Only through an understanding of the support equipment process can one begin to improve the system.

The research considers support equipment from three perspectives. The first presents support equipment from the broad perspective of the Integrated Logistics Support (ILS) concept. Secondly, the support equipment acquisition process is considered in the larger framework of the weapon system acquisition process. Only with early planning and concurrent development with the prime weapon system, can one be assured

of delivering support equipment with the initial operating capability of the system. Lastly, the "specifics" of the support equipment acquisition process are considered, to determine how support equipment is acquired within AFSC. The sources to accomplish the research objectives; the Air Force support equipment regulations, a literature review, and interviews with support equipment experts within AFSC at the Aeronautical Systems Division (ASD), Wright-Patterson AFB, Ohio.

Tremendous resources, both in manpower and money, must be dedicated to acquire support equipment. Therefore, every federal manager has the responsibility to improve the support equipment acquisition process in any way possible. The research concludes by presenting three methods; multi-year contracting, breakout procurements, and local manufacture, presently being used within AFSC to reduce support equipment acquisition costs and lead times.

An Analysis of the Support Equipment Acquisition Process and Methods of Improvement Designed to Reduce Acquisition Costs within Air Force Systems Command

I. The Research Problem

Introduction

Since the early 1950's, tremendous technological developments have emerged in the aerospace industry. The developments have been most dramatic in the mission of Air Force Systems Command (AFSC), which is to "advance aerospace technology, apply it to operational aerospace systems development and improvement, and acquire qualitatively superior, cost-effective, and logistically supported aerospace systems (1: 94)." AFSC accomplishes this mission by the design, construction, testing, and the acquisition of weapons and equipment for the Air Force operational commands, as well as Air Force Logistics Command (AFLC). Systems command will manage approximately $37.9 billion in FY '84, and currently administers over 29,000 active contracts valued at approximately $180 billion (1: 94).

The impacts of the technological advancements have greatly increased, and at the same time hindered, the abilities of the Department of Defense to carry out its mission. However, these developments have dramatically increased not only the initial acquisition costs of the systems, but the operations, maintenance, and logistics support costs. Review of the current acquisition literature has shown that support equipment is one of the major logistics costs involved in the acquisition of major weapon systems. "Approximately 5-15 percent of the acquisition costs of any major weapon system can be attributed to support equipment as well as a significant percentage of our operating costs (8: 16)." Also, support equipment accounts for a large share of the life cycle costs of weapon systems.

What is a support equipment item? A support equipment item includes "all equipment required to make a weapon system, command and control system, support system, subsystem, or end item of equipment operate in its environment (19: 673)." Support equipment should be interpreted to include all tools, test equipment, automatic test equipment (only when equipment is accomplishing a support function), and all hardware and software required to perform organizational, field, and depot level support functions. Support equipment encompasses the entire spectrum, from a slightly modified hand tool to a multi-million dollar test station. Typical maintenance activities utilizing support equipment include servicing, calibration, trouble-shooting, repair, and overhaul.

Support equipment is classified in two functional groupings. The first is test, measurement, and diagnostic equipment; including automatic test equipment (ATE), and precision measuring equipment. Also included in this functional grouping is all the calibration equipment needed to maintain the other support equipment items. For this reason, calibration equipment is sometimes called, support equipment for support equipment. The second type of support equipment is ground support equipment, including jacks, stands, tow bars, and generators. However, support equipment does not include any vechiles, shipping containers, or housekeeping items (4: 3).

Significance of Problem

The recent years of federal deficits and increases in the defense budget has caused the Department of Defense to receive a great deal of publicity concerning the acquisition of major weapon systems, spare parts and other support items. The acquisition of support equipment is big business, and consumes a significant portion of the federal budget.

The Air Force has a tremendous amount of money invested in support equipment inventories. Table I is a presentation of the value of the current Air Force support equipment inventory.

Table I: Value of the Support Equipment Inventory ($ Billions) (25: 9)

Mission Area	On Hand	On Order	Total
Aircraft	5.6	.6	6.2
Missle	.4	.1	.5
Other	2.0	.2	2.2
Total	8.0	.9	8.9

In addition to the money currently invested in support equipment as presented in Table I, Figure 1 illustrates the future funds currently programed for support equipment acquisition. The programed support equipment funds presented in Figure 1 will more than double the cost value of the support equipment inventory (25: 10).

In 1984, AFSC spent $1.8 billion on the procurement of support equipment (1: 94), greater than half of the total Air Force support equipment expenditures. Therefore every federal employee has the responsibility to do everything possible to procure all support equipment

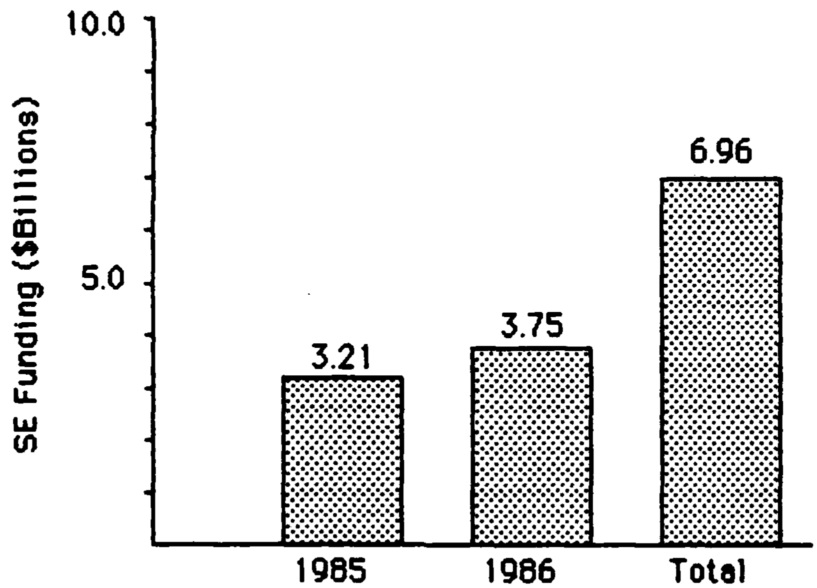

Figure 1: Programmed Support Equipment Funds (25: 10)

items in the most efficient and cost effective manner possible.

Ironically, despite the large dollar amounts spent annually on support equipment, the Support Equipment Acquisition Review Group reports there are severe shortages of support equipment. The report states, "all commands are reporting support equipment shortages, with a cummulative value of over $1.5 billion (25: 1)." However, it was emphasized that the lack of support equipment is not impacting the peacetime mission. The report further stated, "extensive workarounds and personal ingenuity are being used to acomplish the mission in spite of the shortages (25: 1)."

Problem Statement

As the technology of weapon systems continues to evolve, the support equipment required to maintain these weapon systems has become significantly more complex. The complexity has caused an increase in the total number of support equipment items in the Air Force inventory needed to maintain the sophisticated weapon systems. Table II is a presentation of the numbers of support equipment currently in the inventory. Not included in this total are the additional 20,000 support equipment items that are locally procured (25: 9). The number of support equipment items is constantly changing as newer weapon systems are added to the Air Force inventories.

Table II: Size of the Support Equipment Inventory (25: 10)

Mission Area	Line Items	Inventory
Aircraft	49,884	987,800
Missle	3,554	34,442
Other	12,176	1,069,526
Total	65,614	2,091,768

Please note. The number of line items presented in Table II represents the total number of different support equipment items in the inventory. Additionally, the inventory column depicts the total number of support equipment items including duplicate quantities of support equipment line items in the Air Force inventory.

In the past, a great deal of emphasis has been on producing the best possible system on the edge of frontier of technology, with little regard to providing a logistically supportable weapon system. Support equipment, and logistics concerns in general, have been overlooked in favor of greater systems performance, but this way of thinking is beginning to change. Upper levels of the Department of Defense have begun to realize the importance of logistics. Department of Defense Directive 5000.1, dated 29 March 1982, places equal emphasis on weapon system supportability and readiness as with performance. DOD Directive 5000.1 states, "resources to achieve readiness will receive the same emphasis as those required to achieve schedule or performance objectives. As a management precept, operational suitability of deployed weapon systems is an objective of equal importance with operational effectiveness (14: 2)." Support equipment is one of the major elements that helps achieve weapon system supportability.

One major problem in the weapon system acquistion process has been a general lack of understanding of the entire logistics process, and support equipment in particular. The aspiration of this research effort is to provide an overview of the support equipment acquisition process within AFSC. The study will include the functions of the acquisition process beginning with support equipment identification, development and procurement practice into an understandable and concise presentation.

Scope and Assumptions of the Research

As previously mentioned, the acquisition of support equipment consumes a significant portion of the weapon system acquisition costs as well as the future life cycle costs. The responsibility for support equipment acquisition lies solely with the program manager. The program manager is given full authority to assure the most prudent acquisition techniques are applied, given the funding levels, need dates, available manpower, and other factors. In a typical System Program Office (SPO) within AFSC, the support equipment acquisition authority is delegated from the Program Manager to the Deputy Program Manager for Logistics (DPML), and to his staff. Figure 2 depicts the delegation of the support equipment acquisition responsibility within AFSC.

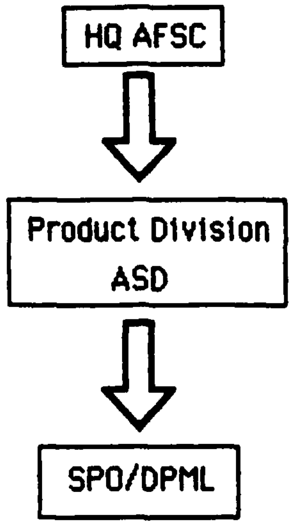

Figure 2: AFSC Support Equipment Delegation

Support equipment is procured in three basic ways within AFSC. The first way, and by far the most commonly used, is to direct the prime contractor to provide all weapon system peculiar support equipment as contractor furnished equipment (CFE), and the equipment is initially managed by the SPO. CFE is defined as "items acquired or manufactured directly by the contractor for use in the system or equipment under contract (16: 3)." When the government purchases a piece of support equipment as CFE, the contractor provides a myriad of other services included in the purchase price under the terms of the major weapons system contract. The contractor is required to provide the technical expertise, configuration control, logistics support, and a number of other management techniques. While the contractor provides a large spectrum of support functions, it is not without a price. The added costs for support equipment management adds significantly to the price of a support equipment item. The focus of this research effort will examine the CFE support equipment process currently in use by AFSC, because it represent the most common acquisition strategy.

The second method used to procure support equipment is to acquire the support equipment items on independent contracts as government furnished equipment (GFE). GFE is defined as " items in the possession of or acquired directly by the Government and subsequently delivered to or otherwise made available to the contractor for integration into the system or equipment (16: 2)." If a piece of support equipment is procured as GFE, the government is responsible for providing all the technical and managerial functions previously provided by the contractor as part of a CFE acquisition. While the cost savings can be substantial, this process is not without its problems. This method will be examined in greater detail in Chapter IV. There is no physical difference between CFE and GFE support equipment. The process of converting support equipment from CFE to GFE is merely shifting the responsibility for on-time delivery, functional performance, and technical interface from the contractor to the government (16: 3).

The third method to acquire support equipment is through the Air Force Logistics Command (AFLC) system. This method is primarily used to procure common items which are cataloged in the federal supply catalog and used on other weapon systems. The support equipment acquisition process used within AFLC is complicated in its own right, and is therefore beyond the scope of this research effort.

Research Objectives

The intent of this research effort is to present an objective examination of the support equipment acquisition process and functions (support equipment identification, development, and procurement), and not to draw any conclusion concerning the efficiency or effectiveness of the current acquisition methods. The research project has two research objectives:

1) To identify how support equipment is acquired within AFSC including all functions (support equipment identification, development, and procurement) , and

2) To identify alternative acquistion methods identified by the Support Equipment Acquistion Review Group, and other methods currently being used within AFSC to reduce support equipment acquisition costs.

Research Questions

To provide a focus for the research project, the two following research questions are posed:

1) How is support equipment procured within AFSC? From this research question, the following subsidiary questions are:

a. How is the support equipment acquisition process related to the major weapon system acquisition process?

b. What is a Support Equipment Recommendation Data (SERD), and what is the SERD process?

After successfully answering the first research question, and an understanding of the support equipment acquisition process has been obtained, the second research question is posed:

2) What alternative acquisition methods can be used to reduce support equipment acquisition costs within AFSC? From this research question, the following subsidiary questions are:

a. What are some alternative acquistion methods being used within AFSC?

b. What are the advantages and disadvantages of each alternative method?

c. Under what circumstances is each method applicable?

Please note: The majority of support equipment is procured within AFSC by the Aeronautical Systems Division (ASD) at Wright-Patterson AFB, Ohio. Therefore, the support equipmment acquisition procedures followed at ASD will be studied in order to make inferences about the procedures within AFSC.

Knowledge of the support equipment acquisition process within AFSC will satisfy the intent of the research. Also alternative support equipment methods recommended by the Support Equipment Acquisition Group and others will have been reviewed, and substantiated by analysis of contract costs.

General Research Plan

The general research plan developed in this section is to facilitate the attainment of an orderly and systematic research project. The research effort is divided into two phases. Each phase corresponds to a single research objective and the associated research question. The general flow of the research effort is illustrated in Figure 3, page 12.

Phase One will concentrate on obtaining an understanding of the support equipment acquisition process in AFSC. The knowledge base will consist of three sources: (1) a literature review of the information available on the support equipment acquisition, (2) the Department of the Air Force support equipment regulations, and (3) personal interview with experts in the support equipment acquisition community. A number of general research questions will be asked of each interviewee, but the majority of the information will be obtained through the free flow of information during the interview process. The interviews will be important to the successful research project because they will provide an opportunity to fill in the knowledge gaps and supplement the information provided in the Air Force regulations and the literature review. Phase One completion will answer Research Question One, and the two subsidiary questions. As a result, Research Objective One is fulfilled, which is to gain an understanding of the support equipment acquisition process within AFSC.

Once an understanding of the support equipment process has been obtained, we are ready to begin Phase Two. Phase Two will attempt, through interviews and data analysis, to examine alternative support equipment acquisition methods currently being used in AFSC to reduce support equipment acquisition costs. The objective of Phase Two is best stated by Major General Monroe T. Smith in the introduction of the final Support Equipment Acquisition Review Group report, the "Air Force objective in acquiring support equipment is to obtain only what is absolutely necessary to field supported weapon systems at fair and

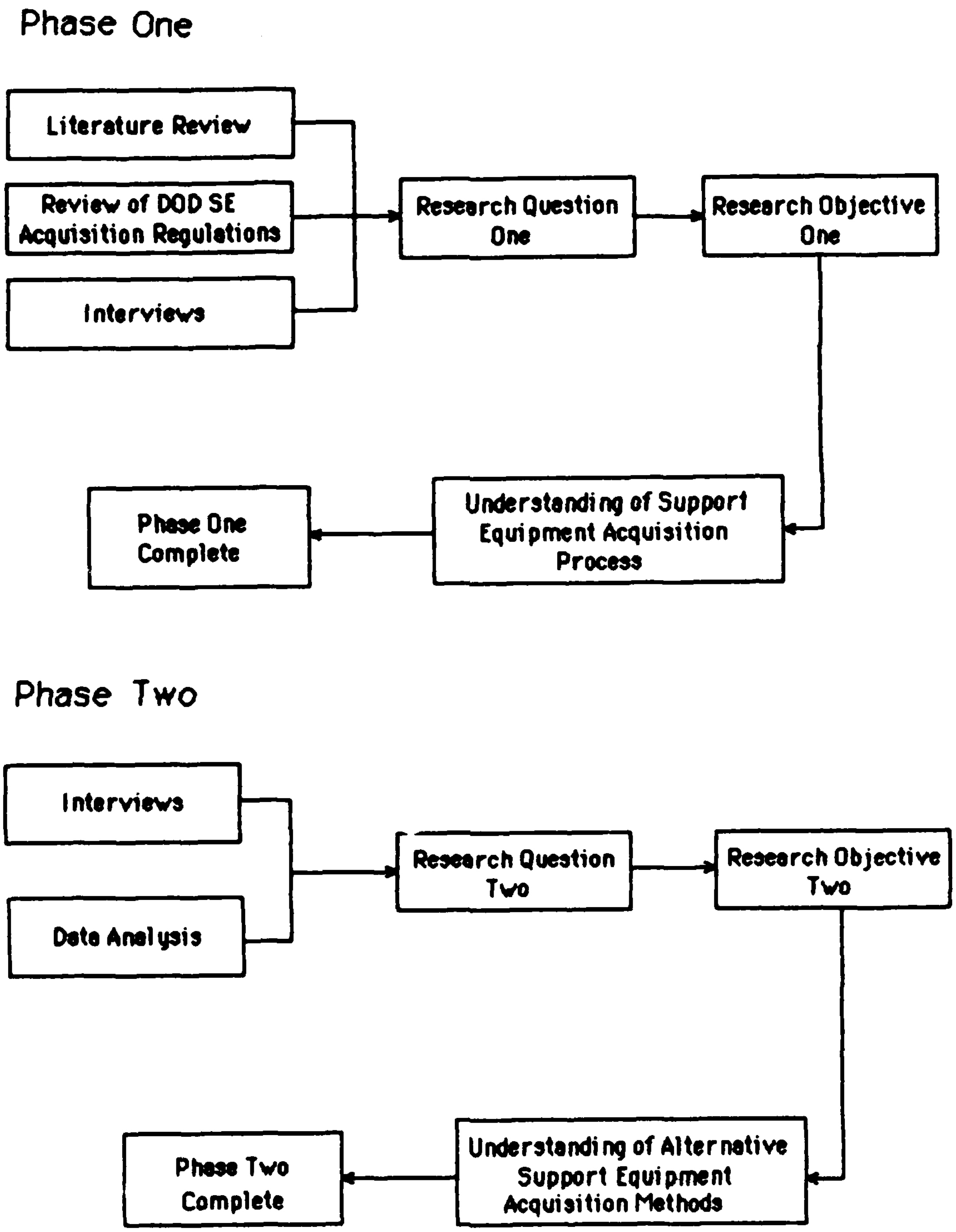

Figure 3: General Research Plan

reasonable prices (25: 1)." Phase Two will investigate the alternative support equipment acquistion methods recommended by the Support Equipment Acquistion Review Group, and other methods currently in use in AFSC. At this point, research objective two and research question two will have been completed, marking the end of Phase Two.

Review of the Literature

In accomplishment of the literature search, resources of the Air Force Institute of Technology, the Defense Technical Information Center (DTIC), the Defense Logistics Studies Information Exchange (DLSIE), and Federal Legal Information Through Electronics (FLITE) were examined. Also reports available locally at Aeronautical Systems Division (ASD), principally the Final Report of the Support Equipment Acquisition Review Group were utilized. Additionally, the principle Air Force Regulations and documents are listed in Table III. The regulations in Table III were reviewed in order to obtain the complete understanding of the support equipment acquisition process.

Organization of the Study

The research study will be presented in the remaining four chapters. Chapter II will examine the support equipment process from the general veiwpoint of Integrated Logistics Support (ILS), and how it relates to the major system acquisition process. Specific planning for support equipment must be initiated during each of the major acquisition phases, to assure on time deliveries. It will further examine the key decisions and documentation required to assure parallel support equipment development and deployment with initial operating capability of the weapon system.

Table III. Principle Air Force Support Equipment Documents

Document	Title
1. ASDP 800-22	Acquisition Management Illuminator for System Program Offices
2. AFPI 71-685	Aerospace Ground Support Equipment Identification/Selection/Acquisition/Provisioning Document for USAF Contracts
3. AFLCR 65-5	Air Force Provisioning Policies and Procedures
4. AFSCR/AFLCR 800-5	Support Equipment Acquisition Management
5. AFLCM/AFSCM 800-4	Optimum Repair Level Analysis
6. AFR 800-12	Acquisition of Support Equipment

Chapter III will examine by the specifics of the support equipment acquisition process. Specifically from the point the contractor identifies a particular piece of support equipment, and a support equipment recommendation data (SERD) is written, through the extensive evaluation and approval cycle within the Air Force.

Chapter IV will examine a number of innovative acquisition methods recommended by the Support Equipment Acquisition Review Group and other methods currently being used within AFSC to help reduce support equipment acquisition costs. While the regulations are very specific and sometimes inflexible, there are techniques available to acquire support equipment in the most cost effective manner possible. This chapter will present the advantages and disadvantages of each method, and an examination of data presenting the potential costs savings. These savings will be demonstrated using actual support equipment cost data. It will conclude by presenting the circumstances under which each is most effective.

Chapter V concludes this research effort and will summarize the findings, draw conclusions, and make recommendations for further research.

II. Overview of the Support Equipment Acquisition Process

Introduction

The purpose of this chapter is to address the first research objective: To determine how support equipment is acquired within AFSC (Chapter One, page 9). This chapter will examine the process from two different perspectives, beginning with a broad overview, and narrowing to specifics. We will begin by considering the implications of support equipment within the framework of the Integrated Logistics Support (ILS) concept. Support equipment is one critical element of ILS which must be considered to assure a logistically supportable system.

The second perspective is to consider the parallel development of support equipment within the weapon system acquisition process, and to answer the first subsidiary question to research question one. (Chapter One, page 9). In the past, support equipment and logistics have taken a secondary role to the enhancement of the weapon system, but this attitude is beginning to change. Major General Monroe T. Smith, chairman of the Support Equipment Acquisition Review Group, stated, "support equipment is complex and diverse. It is critical to the mission of all weapon systems: aircraft, missile, communciation/ electronics, and space. Yet it frequently does not receive the same priority and attention given to the weapon system (25: i)." Only through early planning and careful management during each phase of the weapon system acquisition process can one be assured of deploying support equipment with the initial operating capability of the system. This perspective will present the major support equipment milestones in each acquisition phase to assure timely support equipment delivery.

The support equipment acquisition process is very complex and cumbersome. Only through an understanding of support equipment in the general terms of ILS and the weapon system acquisition process is a more specific examination possible in later chapters. This chapter is intended to build a foundation upon which to understand the support equipment acquisition process, and to satisfy the first research objective.

Support Equipment as an Element of Integrated Logistics Support

The principle test of effectiveness of a weapon system is the capability and availability to perform the required military mission. Support equipment and the Integrated Logistics Support (ILS) concept have a significant impact on determining the reliability and maintainability of a weapon system. For this reason support equipment and ILS are worthy of consideration. Only through early planning of support equipment and ILS can a supportable system be fielded. The following will examine support equipment in the framework of ILS.

What is ILS? ILS is defined a number of different ways in the government acquisition regulations. ILS is defined in DOD Directive 4100.35 to be, ". . . the composite of all support considerations necessary to assure the effective and economical support of a system for its life cycle. It is an integral part of all other aspects of system acquisition and operation. Integrated logistics support is characterized by harmony and coherence among all logistics elements (23: 74)." More specifically, ILS is defined in Air Force regulation 800-8 as, ". . . dedicated to acheiving the optimum performance-schedule-cost support relationship during . . . all phases of a system life cycle (23: 74)."

The ILS concept has a number of objectives. The first objective is to influence system design and requirements stressing simplicity and reduced logistics requirements. A second objective of the ILS concept is that it must be applied throughout the acquisition cycle to assure the systems are designed to meet the operational requirements. ILS must, "insure that adequate support facilities, support/test equipment, and personnel skills are satisfied early enough to provide them for timely fielding (24: 64)." All to often support equipment is not considered until the production/deployment phase. By this time, it is too late, and expensive interim contractor support (ICS) is required to field the weapon system on time. "The lack of timely and systematic planning adversely affects operational availability and the cost of ownership (13: II-2)." A third objective is the importance of trading-off the operational and support requirements from the earliest phase of the system development. The last, and probably the most important objective of ILS is to assure the logistic support elements (Table IV) are integrated into a total logistics system. The objective of the "integrated" approach is, "to increase both the cost-effectiveness and mission readiness of a system and equipment support (6: 7)." This implies that any changes to one of the logistics support elements will affect the others, and therefore must be considered.

ILS is a concept which is concerned with the "definition, optimization, and integration achieved by systematic planning, implementation, and management of logistic support resources throughout the system life cycle (13: II-1)." ILS is the "vechile that injects support concerns into the system acquisition process (24: 57)." Early ILS planning and analysis should help determine the system configuration by specifying supportability constraints and design parameters. An optimum balance must be made between the system performance and life cycle costs. The life cycle cost of a system, as defined by DOD directive 5000.28 is, "the total cost to the government of acquisition and ownership of that system over its full life. It includes the cost of development, acquisition, operation, support, and where applicable, disposal (7: 7)."

The weapon system acquisition process is composed of four distinct phases, each with their peculiar goals and requirements. Each phase will be examined in greater detail later in the chapter. In order to field a logistically supportable system, ILS must be considered in each phase of the acquisition process. Early in the process, ILS is a design influence, but in the later stages, the contractor begins development of each ILS element. During some point in the weapon system acquisition process, the emphasis must change from design influence to the development of the ILS elements. Figure 4 illustrates the timing of ILS in the weapon system acquisition process.

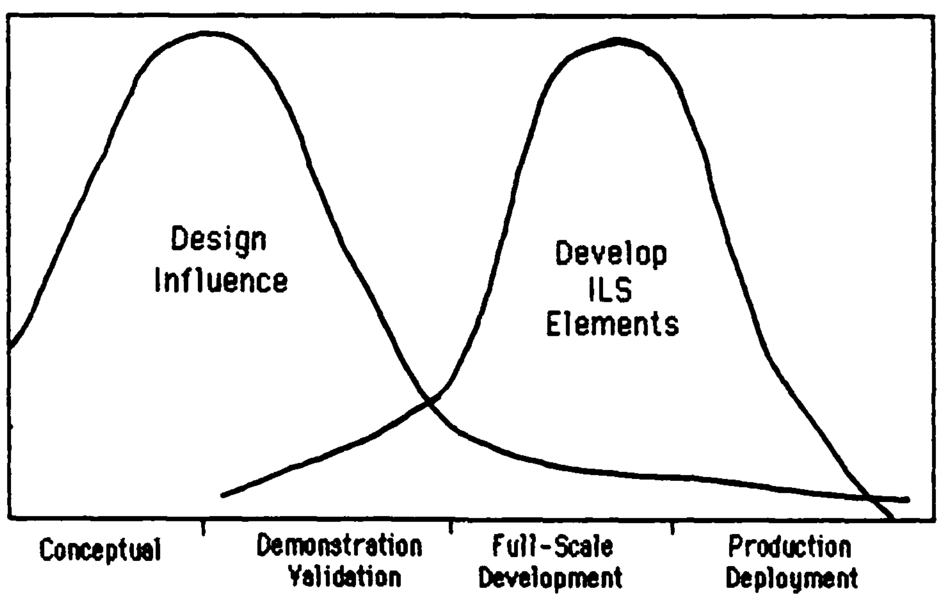

Figure 4: ILS Roles in the System Acquisition Process (24: 63)

The SPO must plan, acquire, test, and deploy the ILS elements concurrently with the system development. This is accomplished by, "the selection and verification of the preferred support concept followed by a comprehensive analysis, identification, and evaluation of the logistics resources necessary to operate, maintain, and sustain the end item (24: 62)." The exact timing of the ILS elements are not the same for all programs, and must be tailored to the exact program situation.

The concept is realized by the proper integration of all the logistics support elements, as presented in Table IV.

Table IV: Ten Elements of ILS (6: 36)

- Maintainability and Reliability
- Maintenance Planning
- Support and Test Equipment
- Supply Support
- Transportation and Handling
- Technical Data
- Facilities
- Personnel and Training
- Funding
- Management Data

As shown in Table IV, support equipment is only one of many important elements in the ILS framework.

Logistics support must be a major consideration in the weapon system acquisition process. DOD Directive 5000.1, Major System Acquisition, states, "logistics supportability shall be a design requirement as important as cost, schedule, and performance (14: 59)." However, these four parameters are very much interrelated and changes have an impact on each other. "An equally significant but less obvious inference is the ILS factors actually affect the other three design requirements; e.g., logistics affects cost, performance, and scedule (24: 59)."

Since logistics costs represent approximately 50 to 60 percent of a systems life cycle costs (7: 15), the proper planning and execution of the ILS program can be a potential source of cost savings. Also, performance, which is determined by the systems operational effectiveness, is often times dependent upon the logistics elements. In some cases, the adequacy of training, technical data, support equipment, spare parts, and others have a direct affect on the system performance. Lastly, meeting the schedule of an initial operational capability date is contingent upon the availability of the ILS resources. In conclusion, ILS can have a significant impact on not only system supportability, but also the cost, performance, and schedule.

This discussion was presented to gain an understanding of the ILS framework from a broad perspective, of which support equipment is only a small, but important element. The next portion of this chapter will examine the role of ILS in general, and support equipment more specifically, in the weapon sytem acquisition process.

Support Equipment in the Weapon System Acquisition Process

An important objective of ILS is to insure logistics is considered and planned throughout the weapon system acquisition process. This point is true for all elements of ILS, and is especially true for support equipment. "The acquisition of support equipment in support of a major weapon system is a highly complex process and should be enmeshed with the acquisition process for the system itself (8: 16)." This portion of Chapter II addresses the first subsidiary research question, "How is the support equipment acquisition process related to the major weapon system acquisition process? (Chapter I, page 9). The AFSC business strategy for an acquisition program is outlined in AFSCR 70-2, but very little is said about support equipment. As a result, "direction does not exist that would cause the program manager to address a support equipment acquisition strategy at the very start of the program acquisition (25: 31)." The examination will present the specific provisions which must be included in each phase to assure on-time support equipment delivery. One point to note, an indepth presentation of each acquisition phase is not possible, but the attempt is only to present the major documents and decisions in each acquisition pahse. Therefore, a basic understanding of the weapon system acquisition process is necessary.

The Air Force regulations are quite specific and extensive concerning support equipment acquisition. AFR 800-12, Acquisition of Support Equipment, states:

> "support equipment must be developed and used as part of the system and be responsive to system needs. In this context, the need for each item of support equipment is a function of the operational scenario, the prime equipment considerations, the operations and support plans, repair levels, personnel, environment, and similar factors. Support equipment is governed by the system constraints of time, money, state-of-the-art, contract, and similar factors (9: 4)."

Each system acquisition is different, and therefore the process must be tailored to meet the specific circumstances of each program. The Air Force objectives for the development and acquisition of support equipment are threefold, (1) to provide the most cost-effective support equipment for the system, (2) to assure appropriate design and support interfaces between the mission equipment and the support equipment, and (3) to provide support equipment in a timely manner [9: 6].

Prior to beginning a discussion of the weapon system acquisition process, a definition is important. Weapon system acquisition is defined as, "a sequence of specified decision events and phases of activity directed to achievement of program objectives in the acquisition of Defense Systems and extending from approval of mission need through successful deployment (17: 1)." Figure 5 is a simplified depiction of the weapon system acquisition process.

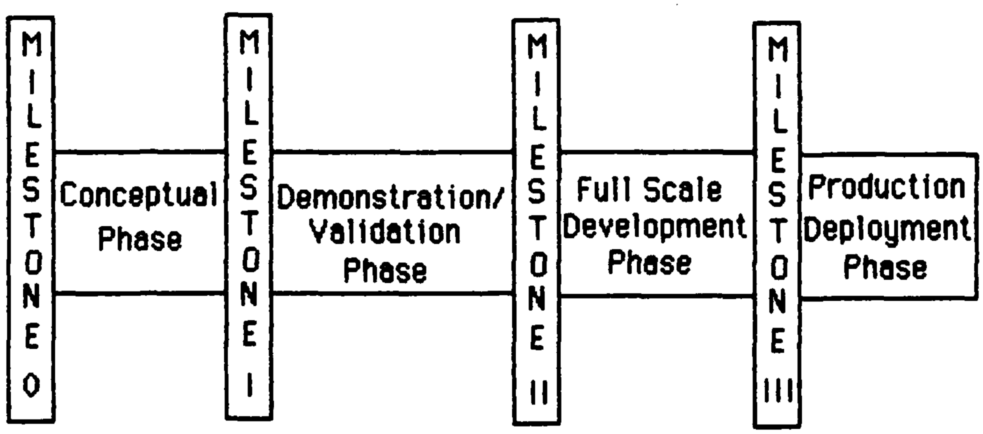

Figure 5: The Weapon System Acquisition Phases

The weapon system acquistion process is made up on a number of seperate an distinct acquisition phases. Each phase, begining with the Conceptual Phase through the Production/Deployment Phase, has a distinct purpose and goal which must be met. The successful completion of each phase is marked by a milestone decision. The milestone decisions signify the end of one acquisition phase and the beginning of another.

The definition includes more than just the mission equipment; also included is all the accessory components; such as facilities, technical data, support equipment, and so on. Programs developed by DOD range in size from small, relatively low dollar value, to very large expensive programs. From this point on, the discussion will concentrate primarily on "major" weapon system acquisition programs, however, the same principles apply to all acquisition programs to varying degrees. This is a good starting point to begin the examination of the parallel development of support equipment in conjunction with the weapon system acquisition process.

As the definition of a weapon system acquisition points out, the process begins with an identification of a mission need. The entire purpose of the acquisition process is to satisfy the shortcomings in the operational capability. The major Air Force commands are continually involved in mission area analysis to identify deficiencies in the current and future systems in order to counter the threat. If a threat is identified which can not be dealt with by utilizing an existing system, a Statement of Operational Need (SON) is prepared by the major command. The SON is coordinated with AFSC and AFLC, and sent to HQ USAF for disposition. HQ USAF reviews the SON and the other comments, and determines whether an acquisition program is necessary. Depending on the potential size of the program, the Secretary of the Air Force may approve the program or prepare a Justification for Major System New Start (JMSNS). A JMSNS is required for all major programs, estimated to exceed $200 million in research, development, test and evaluation, and/or $1 billion in production funds (20: 11). On less than major programs, designated Air Force Designated Acqusition Programs (AFDAP), the approval authority rests with the Secretary of the Air Force.

The JMSNS is submitted with the services annual Program Objective Memorandom (POM), which the services use to request program funding. The program must compete for funds with all other Air Force programs, based on the priority rating of the Planning, Programing, and Budgeting System (PPBS). The PPBS is "an integrated system for the establishment, maintenance, and revision of the Five-Year Defense Program (FYDP) and the DOD budget (19: 524)." Once the program is funded, this marks the Milestone 0 decision.

The Milestone 0 decision marks the beginning of the Conceptual Phase of the weapon system acquisition process. In order not to lose track of the purpose of this discussion, Figure 6, page 26, will be used to present an overview of support equipment development within the weapon sytem acquisition process.

Conceptual Phase. The conceptual phase, often referred to as the Concept Exploration Phase, is primarily concerned with the identification and exploration of alternative solutions to meet the validated threat identified by the major commands (23: 2). Once proper funding has been allocated against the program, the Program Management Directive (PMD), is issued. The PMD is, "the marching orders to the various commands. They are program-tailored and used throughout the entire acquisition cycle to intiate, approve, modify, and terminate program requirements (17: 7)." Once the PMD has been issued, the SPO is formed, the program

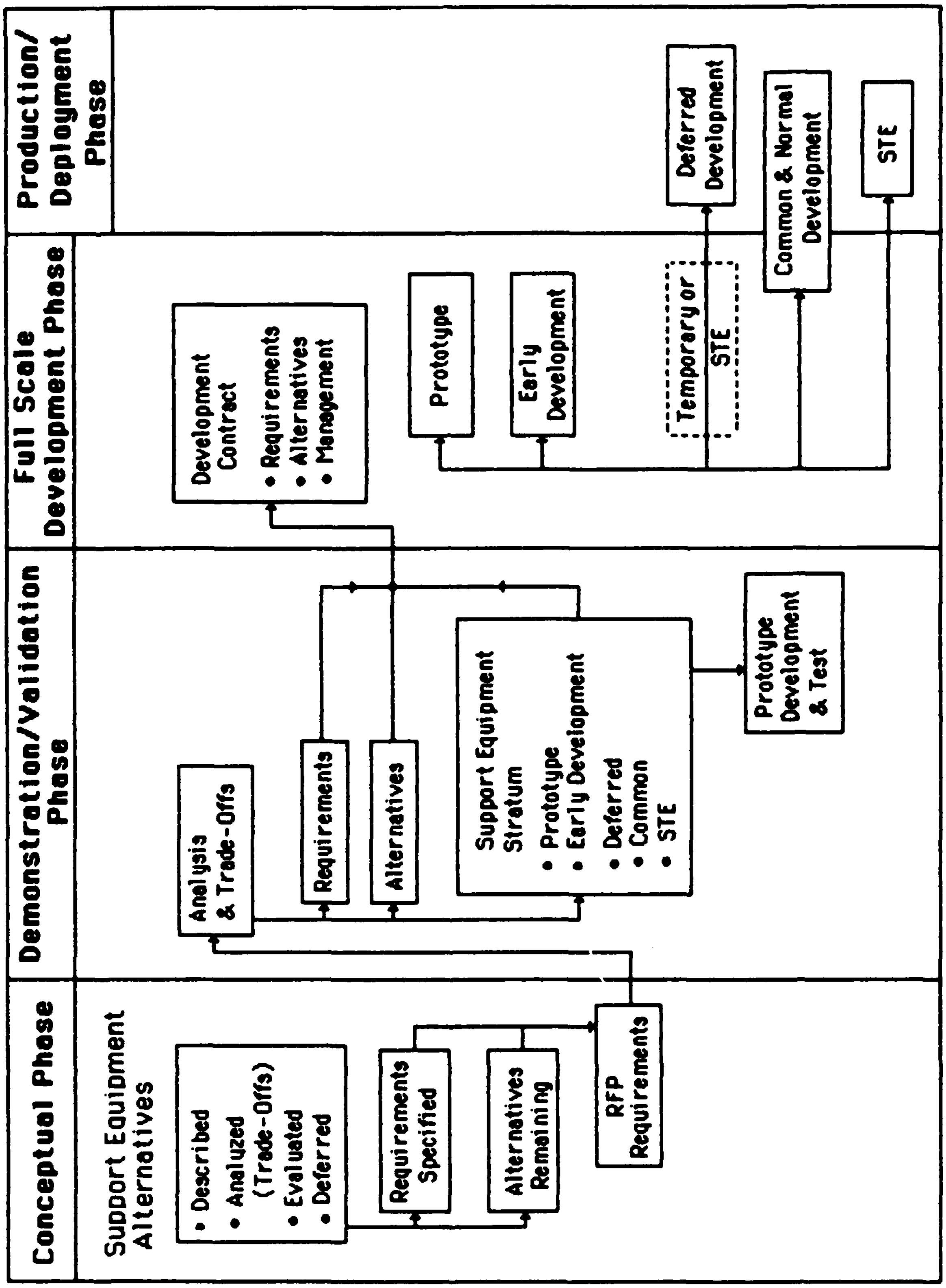

Figure 6: Overview of the Support Equipment Development and Acquisition Process

manager assigned, and other other resources are dedicated to the system development process.

The major activity during the conceptual phase is the establishment of the technical, military, and economic bases for the program through system feasibility studies. The major outcomes of the conceptual phase is to determine whether or not the program should continue (13: IV-22). The major document developed during the conceptual phase is the Progam Management Plan (PMP). The PMP defines, "the integrated time-phased tasks and resources required to complete the weapon system acquistion (23: 2)." A critical element of the PMP is an initial examination of the ILS concept. Included in the ILS concept is the preliminary analysis of the support equipment alternatives.

The preliminary support equipment alternatives must be described, analyzed, evaluated, or deferred during the conceptual phase. Each program should require a support equipment development and acquisition plan. The plan should have the following characteristics, "the plan begins in the conceptual phase; it is evolutionary in nature in that it describes major support equipment alternatives to be examined and provides a documented summary of the decisions and rationale (9: 6)." An important point to remember is that the system design is very uncertain, and the support equipment alternatives are dependent upon the system engineering decisions. The support equipment requirements must be communicated to the potential contractors in the solicatation document. The solicatation document is the Request for Proposal (RFP) which is sent to industry later in the weapon system acquisition process. A RFP is,

> " the solicitated contract between the Air Force and the contractor on a contemplated procurement. It is the medium by

which a contractor is introduced to the job desired by conveying a complete understanding of the work to be performed and to determine the capability and price of the contractors efforts. RFP's contain language, terms, and conditions necessary to obtain information from prospective bidders (19: 587)."

The requirement for support equipment must be communicated to the contractors as early as possible in the system development.

The RFP is structured in such a way as to encourage competition and innovation by all responding contractors. The contents "focus mainly on the operation as needs to be resolved, cost and schedule thresholds, operating environment, and performance and logistics supportability objectives (17: 8)." Since the RFP focuses on the performance and technical requirements of the system being defined, support equipment is seldom considered. Also, a business strategy for support equipment is frequently not thought of at this time. Often times recommendations on how to evaluate the RFP in terms of support equipment is not considered (25: 31-32). Once the RFP is completed, a copy is distributed to industry to solicit responses to satisfy the mission needs. After a predetermined amount of time, the proposals are received and evaluated by a Source Selection Authority, and the best alternative(s) chosen. The evaluation is based upon cost, schedule, logistics supportability, and technical performance of the system.

HQ USAF prepares a System Concept Paper (SCP), which documents the results of the Conceptual Phase. The SCP is reviewed by the Air Force Acquisition Review Council (AFSARC) and finally the Defense Acquisition Review Council (DSARC). The DSARC, "is an advisory council established by and functioning for the Secretary of Defense (SECDEF) to appraise the SECDEF of the program status and readiness of a major defense system prior to proceeding to the next phase of the acquisition process (19: 206)." The DSARC reviews the progress of the program to this point, and provides a recommendation to the Secretary of Defense whether to proceed to the next phase, called the *Secretary of Defense Decision Memorandom* (SDDM). The SDDM "documents the SECDEF's milestones including approval of goals and thresholds for cost, schedule, performance, and supportability against which the program must be managed and will be evaluated (20: 20)." An affirmative decision by the Secretary of Defense constitues the Milestone I decision. This concludes the Conceptual phase and starts the Demonstration/Validation phase of the weapon system acquisition process.

Demonstration/Validation Phase. With the selection of alternative methods to satisfy the operational need, the Demonstration/Validation phase is concerned with refining the alternatives. The refinement process is accomplished through, "extensive studies and analysis; hardware development if appropriate; and limited test and evaluations (17: 11)." The objective of this phase is to reduce the technical risk and the cost associated with each alternative while at the same time re-validating the threat. The ultimate goal is to decide on one or more solutions, and decide which alternative, if any, will proceed into the Full Scale Development phase. A selection of an appropriate alternative is accomplished in three ways.

The first method is by design definition "paper" studies. In this approach, the SPO compares paper products; system specifications, definition of performance requirements, initial hardware configuration, refined cost estimates and current schedule projections. A source selection board evaluates and selects the best proposed solution (23: 3).

A second method of selecting a design alternative is through system prototyping. Each contractor selected begins a prototype fabrication phase, which will allow for the system performance objectives to be met. The fabrication need not resemble the final operational system, but the performance characteristics must be met in order to compare the competing systems. At this point, the systems are compared, or a "fly-off" is conducted to select the best system design(s). The third method is a combination of the first two methods, design definition and system prototyping.

During the Demonstration/Validation phase, the preliminary integrated logistics support plan (ILSP) is prepared. The ILSP is a task oriented plan which specifies the development, test, and evaluation of the contractor's support elements, including support equipment (13: IV-6A). Also, a baseline schedule must be included detailing the integration of the contractors support elements, including support equipment considerations.

As the system begins to develop and mature, so does the definition of the support equipment. The proposed support equipment becomes one more factor upon to which to evaluate the system, and can at times influence the final system design choice. During the Demonstration/Validation phase, the proposed support equipment must be continually analyzed and trade-offs must be made. The requirements must be continually evaluated against the different alternatives due to the high cost of developing and acquiring support equipment. Careful consideration must be made to consider the stratification (different levels) of support equipment, each type of support equipment has different development lead times and require varying levels of management attention.

AFR 800-12, Acquisition of Support Equipment, defines five different types of support equipment in the stratum, as shown in Table V. It is important to consider each type of support equipment during the development process, because of the different leadtimes and costs. The first type of equipment is prototype support equipment. Prototype support equipment is usually peculiar to the system it supports, and is very expensive. The support equipment, "must be developed simultaneously with the development of the mission system because of the high technological interfaces, long leadtime for development, and an early requirement date for support (9: 6)." Prototype support equipment is sensitive to the design changes in the system, and requires intensive management attention by AFSC, supported by AFLC and the using command. Management attention is extremely important due to the significant impact it has on the operating system readiness and support costs. During the Demonstration/Validation phase, it is not unusual to have development and test of a piece of prototype support equipment. Often times the support equipment must evolve as the system hardware develops. An example of prototype support equipment is the computerized avionics test stations, like the Avionics Intermediate Shop (AIS), and the microwave or digital test stations. These test stations are used to analyze the "black box" avionics on the F-15 and F-16 aircraft.

The second type of support equipment is early development equipment. Early development support equipment is identical to prototype support equipment except that it is developed independent of the operational system. As a result, early development support equipment is not extremely sensitive to design changes in the operational system. An example of early development support equipment is the food service elevator on the C-5A aircraft. The only interface with the prime system would be the dimesions of the access door, which is not likely to change during system development.

The third class of equipment is the deferred development support equipment. This class of support equipment is highly sensitive to system design changes, but the development leadtime is relatively short. Therefore, the development of this support equipment is deferred until the design of the operational hardware is stable. Other alternatives, such as work-around methods, contractor support, or other less effective equipment, is utilized until the deferred support equipment is delivered. An example of this type of support equipment would be a test station designed to check out system components, such as an emergency power unit, or bleed air valve on a C-130 aircraft.

The fourth type of equipment is normal development and common support equipment. This class represents most of the items required to support new defense systems. These items do not have high development and acquisition costs, and the sensitivity to system design changes, or leadtime requirements is minimal. Examples of this type of support equipment are the common wrenches and fixtures.

The fifth and final type of support equipment is special test equipment (STE). STE is "developed or acquired for the principal purpose of maintaining quality assurance over the prime system during development or production (9: 7)." STE is used mainly on the production line in the contractors plant, and is later turned over to AFLC to be used or depot repair level once the system production is conclude. Table V is a consolidated look at the principal characteristics of the types of support equipment discussed in the previous pages.

Table V: Principal Characteristics of Support Equipment Stratified for Acquistion Management

Support Equipment Strata	Cost	Change Sensitivity	Lead Time	Need	Alternatives
Prototype	High	High	Long	Early	Generally Complex Contractor Support
Early Develop.	High	Low	Long	Early	Generally Complex Contractor Support
Deferred Develop.	High	High	Short to Long	Met by Alter-natives	Contractor Support Work arounds ,other Available equipment
Common/ Normal	Low	Low or None	Short to Medium	Early	Most Support Equipment Items
STE	Low/ High	Low	Short	Late	Normal Contractor Support, or STE

On a system level, the Demonstration/Validation Phase is concluded once the alternative solutions have been validated and demonstrated, and the technical, cost, supportablity, and schedule risk have been identifed (17: 11). Once the contractor(s) is selected, a decision coordinating paper (DCP) and an Integrated Program Summary is prepared by HQ USAF, coordinated up the chain of command, through the DSARC to the Secretary of Defense for the Milestone II decision, and a SDDM. This is considered the major decision point in the weapon system acquisition process because a positive decision to proceed at this point almost always guarantees a production decision. An affirmative decision by the Secretary of Defense signals the end of the Demonstration/ Validation phase and the beginning of the Full Scale Development Phase. This is the phase when the system design begins to take shape as well as the logistics support concepts.

<u>Full Scale Development Phase</u>. Once the system design has been validated and the logistics concept chosen, the program progresses into the Full Scale Development Phase. During this phase, the operational and support system is designed, fabricated, tested, and evaluated. The Full Scale Development phase marks the beginning of system testing, it's goal is to produce a fully tested, preproduction prototype system (23: 3). Other results of this phase are the development of all engineering documentation necessary to enter the production phase. Also the test results are used to determine if the system meets the operational requirements orginally specified.

The major support equipment development planning begins in the Full Scale Development phase with the issuing of the development contract. Usually the support equipment development contract is included as part of the larger system development contract. Occasionally, contracts are issued with other contractors for the development of support equipment. The support equipment development contract has three main provisions. It specifies the support equipment requirements, the different alternatives, and the contractors management structure.

Upon issuance of the development contract, the prototype and early development support equipment efforts must be initiated in order to have support equipment to support testing and the initial deployment of the system. This support equipment must be developed in the Full Scale Development phase because of the long development leadtimes, and the dependence on the sytem design. Temporary STE is also fabricated during this phase as a means for "gearing up" for the production phase. The fabrication of deferred development and normal/common support equipment is delayed until the production phase. This equipment may be delayed because the development leadtimes are relatively short, and the final support equipment design is not dependent upon the system maturity.

In terms of the operational system, once the final design is stable, and the test results determine the system(s) meet the stated operational effectiveness, the Full Scale Development phase is complete. In the case of dual development up to this phase, a decision is made concerning which system to bring into the production phase. The DCP is once again updated, and the approval cycle begins from HQ USAF. However, sometimes the production decision is delegated to the Secretary of the Air Force provided the program is proceeding on schedule. The selection of the desired system by the Secretary of the Air Force (or the Secretary of Defense when necessary) to proceed into the production phase constitutes the Milestone III decision, and signifies the end of the Full Scale Development phase. Now the proven system and the logistical elements will be produced and delivered to the using command.

Production/Deployment Phase. The Production/Deployment phase "includes the production of all system hardware, spare, support equipment, data, software, etc. (17: 13)." During the Production/Deployement phase, all hardware is verified against the specification requirements and the production engineering efforts are initiated (23: 4). The logistics support resources are also verifed much in the same way as the system hardware. The system and the logistic elements are produced and acquired in accordance with the requirements of the production contract.

This signifies the high point of the weapon system acquisition process, the production items are delivered and used by the operational units. Turnover is the act by which the using command offically accepts responsibility for the system from the implementing commnad [19: 718].

During the Production/Deployment phase, the support equipment production and deployment proceeds concurrently with the system deliveries. The deferred development, common/normal development support equipment and the STE which was delayed in the Full Scale Development phase is produced. The goal is to develop the support equipment in time to be deployed with the operating system. Only through these efforts will the weapon system be totally supportable by the Air Force, without contractor support, at turnover. In the Production/ Deployment phase, the "test, operational and support plans and resources are evaluated for achievement of their prescribed goals (13: IV-5)." An important goal of this phase is to continue to evaluate the system and its support elements to assure the initial operating goals are met, and the threat satisfied. All engineering deficiences identifed must be evaluated and corrected, and careful attention must be given to the impacts on the support equipment and the other logistics support elements.

Once the production phase is essentially complete, and the system has matured, the management responsibility is transferred from the implementing command (AFSC) to the supporting command (AFLC). This process is offically known as Program Management Responsibility Transfer (PMRT). All items concerned with the system also PMRT, including the support equipment, technical data, spare parts, and more. This marks the end of the weapon system acquisition process.

Summary

This concludes the end of Chapter Two, and the partial completion of Research Objective One, To determine how support equipment is acquired within AFSC. This chapter laid the foundation upon which to examine the specifics of the support equipment acquisition process to be presented in Chapter Three. Support equipment was examined in terms of the concept of ILS and its relationship to the weapon system acquisition process. It is obvious that support equipment is one of the major determinants of system supportability and operational effectiveness, and must be considered early on in the system acquisition process. Without this early attention, serious problems and increased costs will result in later stages of the acquisition process.

Without this ground work of Chapter Two, the specifics of the support equipment acquisition process in Chapter Three would be meaningless. Chapter Three will concentrate on the specifics of the support equipment acquisition process, to determine how support equipment is identified, selected, approved and developed within AFSC.

III. The Specifics of the Support Equipment Acquisition Process

Introduction

The research project to this point has been an attempt to examine the support equipment acquisition process from a number of different perspectives. The first look was support equipment as a principle element of ILS, which is critical to determining the reliability and maintainability of a weapon system. The second perspective was an overview of the support equipment acquisition process as overlayed in the weapon system acquisition process. One point is clear, only through early planning and consideration of support equipment in each phase of the acquisition process is a supported system possible at turnover to the using command. This purpose of this chapter is to examine the "specifics" of the support equipment acquisition process within AFSC.

The acquisition of support equipment requires the coordination and cooperation of many different Air Force commands. Only through the teamwork of the different commands can the support equipment be procured in the most expedious and cost effective manner possible. The first section of this chapter will examine the Air Force commands roles and responsibilities necessary to acquire and deploy support equipment.

The remainder of the chapter will focus on how support equipment is acquired within AFSC, from the identification, selection, development, and approval cycles, to the deployment of the support equipment. A large majority of support equipment aquired within AFSC is procured by Aeronautical Systems Division (ASD) at Wright-Patterson AFB, Ohio. Therefore, the support equipment acquisition procedures followed at ASD will be studied in order to make inferences about the procedures within

AFSC. Personal interviews with support equipment specialists at ASD, in conjunction with the support equipment regulations, will be used to examine the present methods of procuring support equipment in AFSC. The interviews are intended to supplement the formal research and not to criticize the present support equipment acquisition methods. This chapter will conclude by presenting the results of the interviews.

Air Force Support Equipment Responsibilities

The roles and responsibilities of the different Air Force agencies concerned with the acquisition of support equipment are well defined and delineated. Air Force Regulation 800-12, the Acquisition of Support Equipment, identifies four primary commands which are responsible for the acquisition of support equipment. The purpose of this section is to examine the responsibilities of each command in acquiring support equipment.

The first major Air Force agency is Headquarters USAF. HQ USAF, "formulates, establishes, and maintains Air Force policy on the acquistion of support equipment and coordinates this policy with related engineering and logistics support functions (9: 2)." HQ USAF acts as a policy formulation agency which monitors the concepts and the application of the support equipment acquisition policy through the program management reviews and reports (9: 2). HQ USAF reviews the PMP and the ILS plan which are submitted for coordination and review to assure they comply with the current support equipment policies. A last responsibility of HQ USAF is to act as a focal point for the Air Staff and the other agencies concerned with support equipment acquisition and management practices.

The next major command responsible for the acquisition of support equipment is the implementing command. In the context of this research project, and in terms of the weapon system acquisition process, the implementing command is AFSC. AFSC headquarters must prescribe, monitor, review, and provide guidance on support equipment acquisition for each program and project in accordance with the policies and principles stated in AFR 800-12 (9: 3). The specific support equipment acquisition responsibilities are delegated from HQ AFSC to the implementing product division. The delegation is presented in Figure 2, page 7. The budgeting, funding, and procurement of new and weapon system peculiar support equipment is the reponsibility of AFSC. The specific support equipment responsibility is delegated to the DPML in the weapon system SPO. The SPO is, "responsible for the specific support equipment identification, selection, procurement, and configuration; coordinate these items with the supporting and operating commands (9: 3)." Another responsibility is to assure the compatability of the support equipment with the prime mission equipment it supports (9: 3).

The next major command which is responsible for the acquisition of support equipment is the supporting command. In this context, the supporting command is AFLC. AFLC, "prescribes, monitors, reviews, and provides guidance on management of support equipment under its cognizance in accordance with the policies and principles stated in AFR 800-12 (9: 3). Other responsibilites of AFLC is to support the implementing command in selection of the support equipment, and to determine the most cost-effective quantities, locations, mixes, and need dates for the support equipment (9: 3). AFLC is primarily responsible for budgeting, funding, and procurement of standard and common support equipment validity and conduct on-going operational tests and evaluation.

The fourth and last Air Force command responsible for the acquisition of support equipment is the using command. The using command supports AFSC and AFLC in the selection of support equipment items. Also, the using command must assist AFLC in determining the most cost effective quantities, locations, mixes, and need dates for the support equipment planned to be used by the using command. The support equipment is but one element which allows the using command to accomplish its mission through improving the operational capability of the weapon system.

One point is clear, the Air Force commands involved in the acquisition of support equipment must work together. The involvement of the different commands is a very effective system of checks and balances designed to assure only necessary support equipment is developed. This teamwork is one element which will assure only the most cost effective support equipment, in the necessary quantities, and at the lowest cost, is deployed with the weapon system. The next section will begin to examine the specific steps necessary in the development of support equipment.

Support Equipment Analysis

As the system begins to evolve and the design becomes more stable, the logistics support concept also develops. Included as part of the logistics support is the development of the necessary support equipment items. The first major step toward defining the support equipment requirements is the logistics support analysis (LSA). A LSA is,

> " a process by which the logistics support necessary for a new system/equipment is identified. It includes the determination and establishment of logistics support design constraints, consideration of those constraints in the design of the "hardware" portion of the system, and analysis of design to validate the logistics support

> feasibility of the design, and to identify and document the logistic support resources which must be provided, as a part of system/equipment, to the operating forces (19: 400)."

The LSA "is the technical (analytical) driving force of the ILS program. LSA is really doing of ILS (24: 62)." A LSA is required on all acquisition programs, and it results in the decision on the scope and level of logistics support. The LSA utilizes a wide variety of techniques, but the emphasis is placed on the results of trade-off analysis, support modeling, level of repair analysis, life-cycle cost projections, manpower impact assessment, and task analysis (24: 63). Each of these techniques must be used to analyze the ILS elements seperately, to assure the most cost effective logistics support program possible.

Once the LSA for the system has been performed, and the system maintanence concept developed, the support equipment acquisition process begins. The first step is to perform an Optimum Repair Level Analysis (ORLA) for each component of the system. An ORLA is,

> " a trade study conducted by the contractor as part of the system/equipment engineering analyis process. ORLA provides contractors and prospective contractors with a basis on which to evolve the optimum approach to repair recommendations concurrent with the design and development process (19: 497)."

The ORLA results in recommendations on the most cost effective repair level for each component evaluated. The evaluation determines the cost of off-equipment maintenance (repairs seperate from the prime system) by evaluating the alternatives of either discarding when the item fails, discarding at the intermediate (field) level, or at depot level. Once the maintenace level of each component is determined, the contractor submits a maintenance concept for each item needing repair, sometime referred to as a reparable. A reparable is "an item which can be reconditioned or economically repaired for reuse when it becomes unserviceable (19: 581)." For each reparable, the contractor is required to provide the necessary support equipment, technical order, spare parts, and other logistics elements needed to return the asset to a mission ready state.

Once the ORLA has been accomplished and the maintenance concept developed and approved, the contractor begins to prepare the support equipment recommendation data (SERD)s needed for the repair of the reparable component. The contractor is required to prepare a SERD on each item of support equipment required to satisfy functional requirements, with an exception of common hand tools, production tools, and items common to all Air Force bases (10: 41-3). The common tools are included in the standard hand tool list, and becomes the authority upon which the items may be requisitioned if additional quantities of the item is required.

Support equipment identification, selection, and design must be accomplished on the basis of the weapon system it supports. The support equipment acquisition process must be concerned with providing cost effective support, on a life cycle basis, to the mission equipment (9: 2). Support equipment acquisition must recognize the leadtime requirements, and the need for organic support upon delivery of the system to the user. However, special care must be taken to prevent commiting to a support equipment design prior to a stable system design. This will help eliminate the expensive modification and unnecessary cost at a later date. Interim contractor support or other alternatives must be considered, and in fact may be more cost effective than developing support equipment early in the acquisition process.

Support Equipment Planning

Upon contract award, the contractor has 60 days to submit the support equipment plan in accordance with data item descriptions (DID)s DI-A-3014 and DI-A-6102 to the SPO. A DID is a report, document, or drawing defined as a data requirement by a specific description in a standard format required by contract (19: 195). Approval of the support equipment plan is required before the contractor can begin preparation of SERDs. The support equipment plan,

> "will include a systematic review and analysis of the functional aspects of the system/end articles and establish the levels of maintenance, type of data to be prepared, personnel qualifications, and type of SE required, thus serving as a source of information affecting design. This document serves as a communication and planning medium between the system/end item designers and SE designers (10: 41-3)."

Once the plan is approved by the SPO, 30 days after submittal, the contractor may begin to develop and submit SERDs to the Air Force for review. However, a problem identified by the Support Equipment Acquisition Review (SEAR) Group, is the lack of proper support equipment planning. In fact, "the only SE plan found by the SEAR Group was one prepared by the Aeronautical Systems Division in 1977. In practice, no one has an official, long-range plan to follow in the procuring of SE (24: 22)."

The SERD

A Support Equipment Recommendation Data (SERD) is,

> "the recommendation for SE required to support each and every CFE contract end item and GFE down through the lowest recoverable assembly, including training equipment and SE for

SE. It provides sufficient engineering data for review of the function requiring support together with the recommendation for developing or acquiring an item to satisfy one or more functions. The SERD also provides availability, allowance, and logistic support information/decision regarding the SE item recommended (11: 2-3)."

A SERD is prepared in accordance with DID DI-S-6176. The requirement for this DID must be included in the weapon system contract. DI-S-6176 is very specific in the format for each SERD submitted to the Air Force. Each SERD is identified by a five digit number. The first two digits specifies the system component the support equipment is designed to support. Attachment A is a copy of a SERD submitted by General Dynamics-Fort Worth Division in support of the F-16 fighter aircraft. The SERDs for all weapon systems in the Air Force are basically the same in format, with two parts, the Figure 1A and Figure 1B, as specified by AFLCR 65-5. Table VI depicts the standard format of the Air Force SERD.

Table VI : The Air Force SERD

- Figure 1A
  - Part I
  - Part II
  - Support Equipment Diagram

- Figure 1B

- SERL

However, SERDs can vary quite dramatically in size depending on the complexity of the support equipment item. A SERD for a relatively simple hand tool may be only several pages, where as a SERD for a computerized test station may be hundreds of pages. The remainder of this section will describe the purpose of each section.

<u>Figure 1A</u>. The first portion of the SERD is the Figure 1A. The Figure 1A is totally contractor prepared, and provides the initial engineering data for review by the Air Force. It consists of two sections, Part I and Part II. Part I provides the functional analysis, and gives a precise description in technical terms of the component requiring support. Part II describes the equipment required to satisfy the functional requirements in Part I, and identifes the actual manufacturer and part number of the particular support equipment item. The selection of the specific equipment to satisfy the Part II requirement is the essence of the support equipment acquisition process. Often times included in the Figure 1A is a preliminary diagram of the item being recommended. The diagram is not a detailed engineering drawing, but only meant to assist the Air Force in the initial review of the item.

<u>Figure 1B</u>. The second portion of the SERD is the Figure 1B. The Figure 1B is prepared by the contractor with information furnished by the government. It provides the availability, logistics support and reprocurement data for the equipment being recommended. The Figure 1B contains a great deal of other information. Some of it includes the name of the prime system being supported, the contractor's name, contract number, the stock number and part number of the item, the lead time, and

the organizational requirements. More specific detail can be obtained by reviewing the Figure 1B which is included as part of Appendix A.

The SERL. The support equipment requirement list (SERL), which is also known as the AFLC/AFSC Form 9. It is probably the most important product of the SERD. Included in Appendix B is a copy of a SERL. The SERL conveys a great deal of information. It specifies the SERD number, part number, the national stock number, and the particular revision number. The SERL also conveys the requirements the Air Forces levies on the contractor for the particular SERD, such as configuration management, design, testing, review and inspection, technical and provisioning data, and other requirements. The more complex the support equipment item, the greater are the SERL requirements in terms of specifications, design reviews, and so on.

Once the Air Force has conducted the support equipment review process (to be presented later), these comments are consolidated and transmitted to the contractor on the SERL. The SERL serves the purpose of being the final approval document of the SERD process, and is signed by a representative of SPO engineering and logistics functions. The SERD may be either approved, conditionally approved, or disapproved through transmittal of the SERL. It is not unusual for a SERD to be revised and resubmitted a number of times before the Air Force approves the SERD. The signed SERL is transmitted to the contractor resulting in disposition of the SERD. Once the SERL is sent to the contractor, it begins the pricing and development process. The SERL initiates a number of actions by the government, including cataloging action of the support equipment, inclusion of the support equipment in the applicable table of allowance

(TA), facility planning, and a variety of other functions.

The following will examine in more detail how the contractor develops a SERD prior to submittal to the Air Force.

Contractor Support Equipment Screening Process

Selecting support equipment to satisfy the function requirement entails a careful screening process. The screening is necessary to determine the suitability of the various sources to accomplish the required functions, and to avoid support equipment proliferation. The Support Equipment Acquisition Review Group has shown through examination of the federal stock catalogue that the screening process is not working effectively, and resulting in unnecessary support equipment proliferation. The examination has shown, "we have 35 models of hydraulic test stands made by 10 different manufactures performing six basic functions. In the commerical test equipment area, our inventory of 24,815 oscilloscopes is comprised of 145 different models (25: 19)." To make matters worse, of the 145 models, 103 have been identifed to have poor reliability performance. The cost of support equipment proliferation is also very substantial. "Without buying the hardware, the Air Force pays over $14.5 million just to catalog, manage, and provide technical orders for the 103 model (25: 21)." It is clear that careful support equipment screening at the beginning of the program is essential.

Prior to submitting SERDs to the Air Force, the contractor is required to screen all support equipment recommendations as defined in DOD 4100.38M and DI-V-7016, Provisioning and Other Preprocurement Screening. AFR 800-12 states, "the selection of support equipment must be a result of a cost-effective trade study based on life cycle cost impact, and include analysis of support equipment sources (9: 2)." The support equipment sources are listed in Table VII, in order of selection priority.

Table VII: Support Equipment Selection Priority

- o GFE in Government Inventory
- o Commerical Off-the-Shelf Equipment
- o Modification of the Above items
- o CFE developed items

The first source of support equipment is GFE support equipment which is currently defined by government specifications with a known source of supply. The procurement of this source of equipment is the most desireable for a number of reasons. First of all, this equipment is currently stock listed in the federal supply inventory and included in MIL-HDBK-300. Secondly, an item manager (IM) has been assigned, which results in greater coordination and better management. Lastly, by purchasing GFE equipment, procurement costs are lowered. This is true because the non-recurring development costs, cataloging, and logistic support costs were paid when the support equipment was originally developed. An example of this type of equipment would be a universal engine stand developed by one program and can be used for a number of different systems.

The second type of support equipment is commercial off-the-shelf support equipment. This includes the equipment which is commercially available or that procurement data is available. The procurement costs would be lower because the equipment is already designed and tested. However, additional costs for stock listing and cataloging, preparing technical data, etc. makes it less attractive than GFE equipment,'but more attractive than the other sources. An example of this type of support equipment would be a commerical handling equipment which was developed in the commercial world but can be used to satisfy a military requirement.

The third source of support equipment is the modification of existing GFE or commerical off-the -shelf equipment. The benefits are identical to GFE and commerical equipment, but additional costs are also involved. Not only are the cataloging and logistics costs included, but additional engineering effort is needed to design the interfaces between the unmodified equipment and the system hardware. An example would be a digital test stand which can be modified through the use of a weapon system peculiar interface test adapter to check out the system component.

The fourth and final source of support equipment is to develop CFE equipment. This equipment is weapon system peculiar, and no other sources of equipment can be located to perform the functional requirement. This equipment is usually developed by the prime contractor or purchased from a subcontractor and delivered to the Air Force. Developing CFE support equipment is by far the most expensive means of procurring support equipment. This is because of all the additional non-reocurring cost which are included in the first unit cost. An example of this type of support equipment would be a fixture designed for repair of a particular weapon system, such as a F-16 wing box or a B-1B landing gear. Table VIII illustrates the comparison of the different sources of support equipment.

Table VIII: Comparison of Support Equipment Sources

Source	Procurement Complexity	Lead Time	Development Costs	Responsible Command
GFE	Low	Short	Low	AFLC
Off-the-Shelf	Low to Medium	Short to Medium	Low	AFLC/ AFSC
Modified	High	Medium to Long	Medium	AFLC/ AFSC
CFE	High	Long	High	AFSC

Support Equipment Decision Process

Up to this point, we have discussed the different sources of support equipment. This next section will examine the process by which the contractor uses in selecting the support equipment items to be submitted to the Air Force. Figure 7 is a simplified presentation of the CFE/GFE Support equipment selection process. It depicts the decision tree the contractor uses to select support equipment, and will be used to illustrate this discussion.

The Air Force directs the contractor to select common support

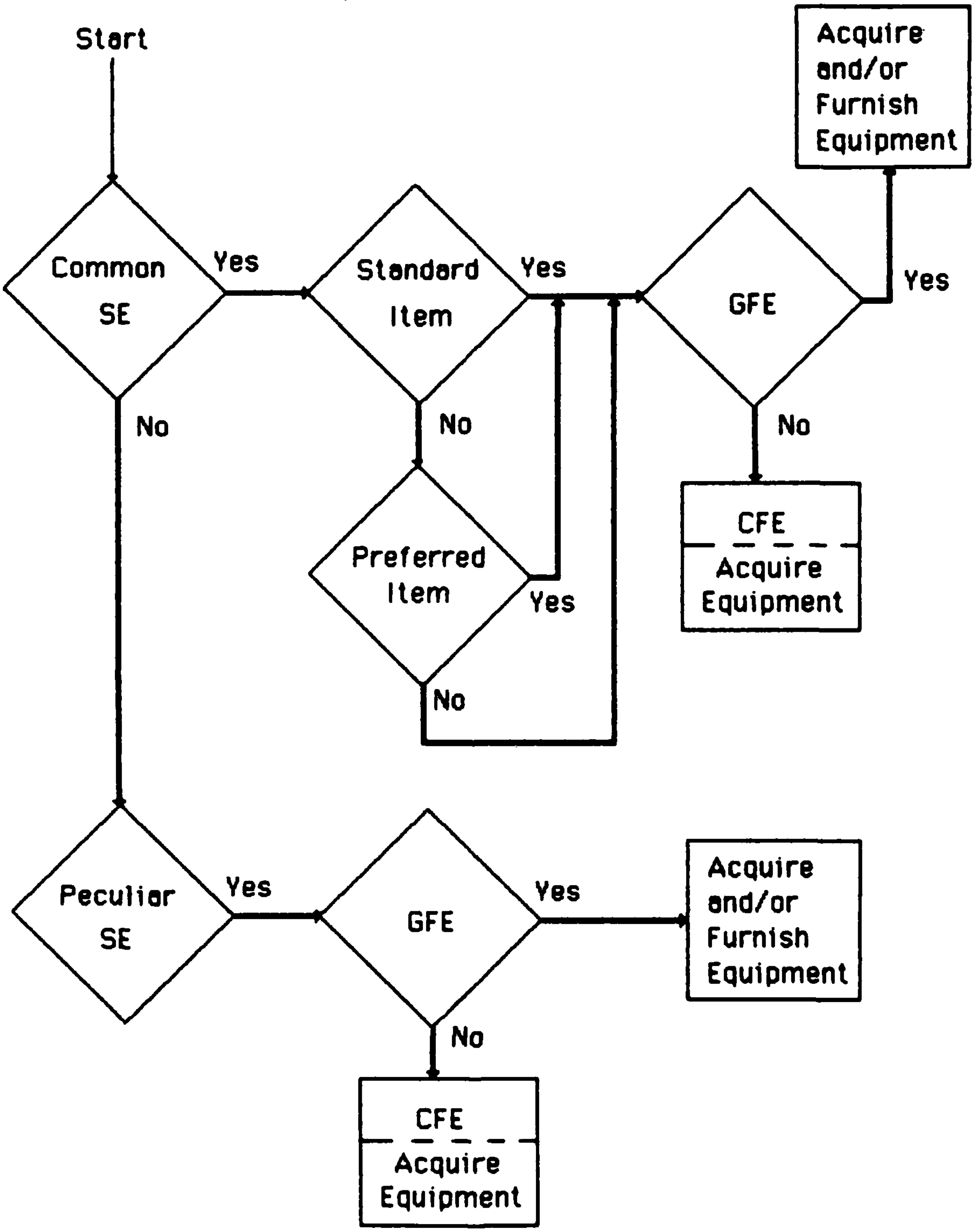

Figure 7: GFE/CFE Support Equipment Selection Process

equipment to the maximum extent possible. This is because of the reasons presented earlier, such as no non-recurring development costs, an existing support structure, etc. When the contractor begins the screening process, the first decision point is determine if a piece of common support equipment is available to satisfy the functional requirement. If so, the contractor must determine if it is a standard item. A standard item is "one specifically developed or acquired to fulfill multiple Air Force requirements and designated as a standard item by HQ USAF (25: 8)." If the item is a standard piece of GFE support equipment, a GFE SERD is written and submitted to the Air Force for review and approval. The funding, and procurement of standard GFE items is the responsibility of AFLC. If a standard item can not be found, the contractor must pursue a CFE solution to fulfill the requirement.

However, if the item is not standard, the contractor must determine if it is a preferred item. A preferred item is "one that was not specifically developed or acquired to fulfill multiple Air Force requirements but has, been subsequently identifed as having the potential (25: 9)." At this point, a GFE SERD is written and submitted to the Air Force.

The second branch of Figure 7 presents the CFE equipment selection process. If a common support equipment is not available, a peculiar support equipment item is necessary. A peculiar item is "one that is totally dedicated to and developed for the weapon system it supports (25: 9)." The next decision is whether a GFE item can be found to satisfy this requirement. If not, a CFE SERD is prepared and submitted to the Air Force. Again, if a GFE item is available, a GFE SERD is written and submitted.

This has been a rather simplifed depiction of the support equipment screening process the contractor conducts in submitting SERDs to the Air Force. The process involves screening the federal supply catalogs and government specifications to determine if a support equipment item is available. If not, the contractor must either develop the support equipment in house or search the industry for a support equipment developer. Often times, if the system component is being developed by a subcontractor, the prime contractor levies the requirement to develop the necessary support equipment on the vendor as part of the contract.

The following section will examine the Air Force support equipment review cycle, often referred to as the SERD process. It will examine the SERD process from the initial submittal of the SERD by the contractor, through final approval by the Air Force.

The SERD Process

The SERD process refers to the internal Air Force review from the point of SERD submittal by the contractor through final SERL or Form 9 approval. The Support Equipment Acquisition Review Group estimated the "Air Force reviewed 34,531 and 32,589 SERDs through this process in CY 1982 and CY 1983 respectively (25: 7)." It is obvious from the magnitude of the numbers of SERDs processed yearly, that the acquisition of support equipment requires a systematic and orderly approach to SERD processing. Figure 8 is a graphical approach to SERD processing. The presentation will be fairly simple and if greater detail is required/needed, consult the support equipment documents in Table 3 (Chapter One, page 14).

The SERD process begins when the contractor submits a SERD concurrently to SPO logistics, SPO engineering, and the System manager (SPM/EAIM ALC). Only through the coordinated efforts could the SERD

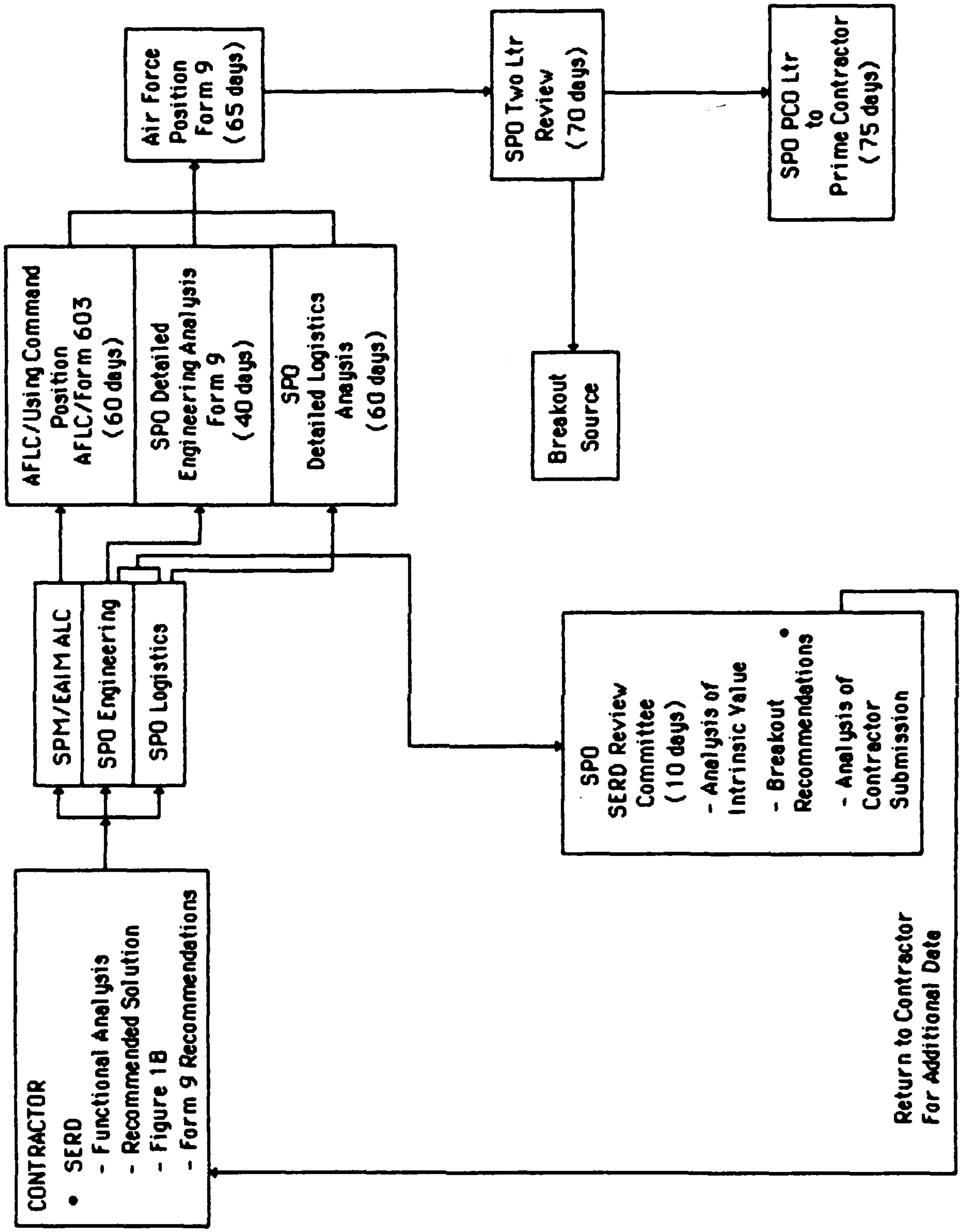

Figure 8: Air Force SERD Processing

process be possible. A discussion of the primary roles and responsibilities of each of the three organizations involved in the SERD process will follow.

The organization primarily responsible for the processing of SERDs is the SPO logistics organization. In major weapon system SPOs, a division is dedicated solely to the management of support equipment. The major task is the overall responsibility for processing all SERDs (both GFE and CFE), and to conduct a detailed logistics analysis on each support equipment item. Other responsibities are to maintain a complete SERD history file, to provide contracting with a price/intrinsic value recommendation, and to convene and chair the support equipment conferences.

The contractor will request the buying activity to hold a SE guidance conference 45 days after receipt of the SERDs. The conference "will provide initial supplemental guidance to the contractor. The contractor should be provided with additional informantion which may aid in developing the SE plan, recommendations for common/standard SE selection, management, and support, etc. (10: 41-1)." Additionally the conference should include a table top analysis of each SERD as part of the contractor submission, and provide disposition to the contractor on each SERD item. The conference should also look at the intrinsic value of each support equipment item and consider breakout recommendations. Attendees at the support equipment guidance conference at a minimum should include SPO representatives from the logistics, technical data, and engineering groups. Other attendees should be representatives from the AFSC SE staff as required, AFLC cataloging and standardization branch, the System manager, the equipment allowance branch (TA monitors), HQ

Aerospace Guidance and Metrology Center (calibration), and the using commands. The using command is a key player in these conferences because they are the one which have to accomplish the mission using the recommended equipment. Any up front input by the using command will help develop better, more reliable support equipment.

The SPO support equipment engineering group also have a significant responsibility in the SERD process. Their major responsibility is to be the technical focal point, and to do a detailed engineering analysis on the support equipment items. Other duties are to insure the Part I functional analysis requires support, and to determine the technical feasibility of the recommended support equipment in Part II of the SERD.

The third organization responsible for the processing of SERDs is the system manager, SM/EAIM ALC. The system manager is a broad term to describe the AFLC command personnel at the Air Logistics Center. The system manager includes the provisioning and cataloging activity, the engineering and reliability branch, the production management branch, and the material management directorate. Their principle responsibility is to consolidate the AFLC position on each item of support equipment, on such things as technical feasibility, procurement matters, calibration requirements, technical data, and more. The system manager provides the comments on AFLC Form 603 to the SPO, to be used in preparing the SERL submission to the contractor. The AFLC Form 603 contains a great deal of information, such as the part number, the stock number, the recommended quantities needed, any using command comments about the SERD, and a final recommendation to the SPO about the SERD. The SPO makes the final decision concerning each support equipment item, but not without the AFLC and using command comments.

Once the comments have been received by SPO logistics, engineering, and other SPO organizations (configuration management, contracting, and manufacturing) and the AFLC Form 603 comments have been received by the system manager, the SERL or Form 9 is prepared. The SERL states the final SPO position on the support equipment item. The SERL may either approve, conditionally approve, or disapprove the SERD. The SERL is signed by a representative of SPO logistics and engineering functions, and sent to the program manager for review. The program manager once again examines the potential for alternative acquisition methods. A number of these alternative methods will be presented in Chapter Four. The final SERL is transmitted to the contractor to begin support equipment development. The SERD then begins the pricing cycle and development process in the contractors plant. On the Air Force side, the signed SERL begins the cataloging and planning functions as deemed necessary. In the event the SERD is GFE, the government must begin actions to procure the item. This marks the end of the SERD process.

The final section of this chapter will present the results of interviews with a number of support equipment specialists at Aeronautical Systems Division. The interviews will be an attempt to gain a complete understanding of the support equipment acquisition process in AFSC by obtaining first hand information on the SERD process from the specialists.

Results of Interviews with Support Equipment Specialists

The research project thus far has concentrated on obtaining an understanding of the support equipment acquisition process through the Air Force regulations and the current literature. However, this only presents half the picture. The following will present the results of interviews with support equipment experts within AFSC at Aeronautical Systems Division (ASD). The purpose of the interviews was to gain a complete understanding of the support equipment acquisition process. The support equipment acquisition process at ASD will be examined because the acquisition delegation flows from HQ AFSC to ASD as depicted in Figure 2, page 7. Representatives of the major weapon systems SPOs at ASD; the F-16, F-15, B1-B, and Aeronautical Equipment SPOs, were interviewed. Appendix C is a list of the people interviewed.

Prior to the interviews, a list of basic questions were prepared to conduct the interviews. This was to assure each interviewee was asked the same questions. In order to facilitate a clear presentation, responses to the questions will be presented in order. The interview results, along with the examination of the regulations and literature, will help answer the first research objective: To identify how support equipment is acquired within AFSC.

Each interview began by explaining the purpose, goals and intentions. It was stated that the interviews were for information only, and not to draw any conclusions on the present acquisition methods used by each weapon system program office. The results of the interviews are as follow:

Question 1: How is the SPO organized for the acquisition support equipment?

Each of the SPO's are organized essentially the same. The support equipment functions are located in the directorate of logistics, responsible to the DPML. The focal point for support equipment within ASD is the support equipment SPO, ASD/AEG, Deputy for Aeronautical

Equipment. They support the major weapon system SPOs by providing advice and assistance. The major goal of all the support equipment divisions at ASD and in AFSC is to provide the most effective support equipment possible and incur the lowest possible life cycle costs as they perform their missions.

Question 2: What is the extent of the support equipment acquired in the SPO?

The magnitude of the support equipment acquired by ASD is substantial. Estimates of total quantities of support equipment is presented in Table IX.

Table IX: ASD SERD Quantities

System	Approx. Total	Percent (%) CFE	Percent (%) GFE
F-16	3,800	75	25
B-1B	5,000	85	15
F-15	3,000	80	20

Please note, the B-1B contractors are not required to submit SERDs in support of any GFE systems, these requirements are only identifed by letter. This helps to reduce the cost associated with the preparation, approval, tracking, and maintenance of the SERDs. However, this is not true of the other weapon systems, they require submittal of SERDs to support GFE systems.

Question 3: What is the interface between the weapon system SPOs and the contractors?

The large majority of support equipment purchased at ASD is procured as CFE equipment from the prime contractor(s) as part of the weapon system contract. The F-16 and F-15 programs procure the majority of their support equipment from a single prime contractor.

However, the B-1B is different. The B-1B is built by three contractors, Boeing, Eaton, and Rockwell as the lead associate. As a result, the B-1B SPO has SERDs being submitted by three different contractors. This causes some unique problems, all of which are being worked by the B-1B SPO.

The mission of the Aeronautical Equipment SPO is unique. They are responsible for acquiring all support equipment common to a number of different weapon systems. An example would be an aircraft tow bar. Instead of all weapon systems using a different, unique tow bar, the AE SPO is designated to develop a tow bar which all aircraft can use, thus saving development costs and increasing standarization. They compete the acquisition of their support equipment throughout the industry.

Question 4: Briefly describe the SERD process.

The SERD process used by the weapon system SPOs at ASD was basically the same as presented earlier in this chapter. All SPOs appeared to be following the Air Force regulations on SERD processing. To briefly recap. The process begins when the contractor(s) submit SERDs to the Air Force for review. Each command reviews the SERD, and provides comments to the system manager. The system manager consolidates the comments and submits them to the SPO on AFLC Form 603. The SPO then prepares a SERL for final disposition, to direct the contractor to begin development of the support equipment item.

In the case of the AE SPO, the process is quite different. Once a requirement is identified, a request for proposal (RFP) is written, and distributed to all prospective bidders. The bidders all submit a proposal to satisfy the functional requirement as specified in the RFP, and the final design is evaluated and selected by a source selection. Once the contractor is selected, the contract is negotiated, and the equipment is produced.

Question 5: How is support equipment put on contract?

All the support equipment is put on contract basically the same way at ASD, with the exception of the Aeronautical Equipment SPO. The AE SPO purchases a support equipment item as outlined in question 4 above.

In the major weapon system SPOs, the SERL is approved and transmitted to the contractor to begin the pricing cycle. After 45 days, the contractor submits a contract change proposal (CCP) to the SPO. The CCP is evaluated, negotiated, and a contract modification is issued, putting the support equipment on contract. However, some differences must be noted.

The B-1B SPO requires that each support equipment CCP be boarded before the configuration control board (CCB) for final approval. However, the F-16 support equipment CCPs are exempt from being boarded. This is because it causes delays of 60-90 days to the authorization cycle. The F-15 also has a different method for authorizing support equipment. The F-15 SPO no longer has a development contract (excluding the F-15 C/D effort) for the airframe and support equipment. As a result, if the contractor identifies a new piece of development support equipment, the contractor must submit an advanced change study notice (ACSN). Once the ACSN is approved by the SPO and returned to the contractor, an engineering change proposal (ECP) is prepared and submitted. The ECP is then boarded before the CCB for final approval. Only the urgent requirements are purchased as part of the ECP. This method of procuring support equipment adds tremendously to the administrative lead time for the item. The remainder of the quantities, and any others, are consolidated and purchased on a fiscal year procurement.

Question 6: In light of the recent publicity concerning support equipment overpricing, what has the SPO done to reduce acquisition costs?

This question sparked the greatest amount of discussion during the interview process. It appears that all the SPOs interviewed have dedicated a great deal of time and effort to improve the support equipment acquisition process. This was accomplished by devoting greater management attention and the institution of alternative acquisition methods; such as multi-year procurements, breakout procurements, and local manufacture. These methods will be addressed in great detail in Chapter 4.

They are alarmed not only with the high cost of the support equipment, but the tremendous lead times, which is delaying organic support of the weapon systems. All support equipment managers are concerned with this problem and are doing everything possible to put an end to it, through instituting the policies listed above. However, they all felt the problem was not as bad as is preceived by the media, and the facts were not presented fairly and accurately.

Question 7: What current alternative support equipment methods, if any, is your SPO using to reduce support equipment acquisition costs?

All SPOs reported using alternative support equipment methods to help reduce support equipment costs and lead times. Probably the biggest single initiative currently being used is breakout procurement. Breakout procurement is a method currently being used to procure non-complex support equipment items. It is primarily being used by purchasing these items from small disadvantaged contractors. However, the goal of breakout procurement is to eventually compete every SERD to obtain the best prices. However, this method is not without its problems. This will be presented in detail in Chapter 4. The F-15, F-16, and B-1B SPO all report using this method.

Multi-year contracts and local manufacture are examples of other acquisition strategies currently being used by the F-16 SPO to reduce support equipment costs. These are very successful strategies, but a limited in application. These will also be discussed in greater detail in Chapter 4.

The B-1B SPO has a number of different programs in work to reduce support equipment costs. A great deal of energy is being dedicated to identifying joint requirements with other systems and using existing equipment to the greatest extent possible. For example, the B-1B and the F-16 have basically identical radar systems, so the B-1B and F-16 support equipment managers are working together to modify existing F-16 support equipment to the repair B-1B radars. The potential for cost savings is tremendous.

Another program being used by the B-1B is an intrinsic value review. In this process, B-1B contracting and the configuration control change manager get together and review each contract change proposal (CCP). They evaluate each item to assure the government is paying a fair price for each item in the CCP. The results of each review goes through the ASD director of contracting/manufacturing, as well as the commander.

In closing, the interviews revealed the support equipment managers are doing everything possible to reduce support equipment costs within AFSC. The details of these particular methods will be presented in Chapter 4.

This concludes the formal interview questions which was asked of each interviewee. The interviews have proven to be a valuable addition to the research effort by supplementing the formal research.

Summary

This chapter has presented an overview of the support equipment acquisition process with in AFSC. This chapter has answered the first research objective. The presentation was a result of the formal Air Force support equipment regulations and the literature review as well as the interviews with support equipment managers within ASD. This chapter examined the support equipment planning, indentification, selection, decision process, and approval of SERDs to assure timely delivery with the weapon system.

Chapter Four will examine a number of alternative support equipment acquisition methods currently in use at ASD to reduce costs. A number of these methods were identifed by the Support Equipment Acquisition Review Group, and others were discovered during the interview process.

IV. Alternative Support Equipment Acquisition Methods

Introduction

The Department of Defense has received a great deal of criticism regarding the high cost and inefficiencies of the major weapon system acquisition process. Included in the criticism is the high cost of the logistics support elements, especially support equipment and spare parts. Hardly a day passes without the media claiming fraudulent pricing and wasteful spending in the acquisition of support equipment, with headlines of $9609 allen wrenches and $7600 coffee pots (5: 124).

Historically, the support equipment acquisition process has been inefficient and cumbersome, due to the stringent regulations and guidelines limiting the innovation of the support equipment managers. However, this trend is changing due to the shrinking equipment budgets and the realization of the tremendous costs involved in the acquisition and maintenance of support equipment.

This chapter will address the second research objective: To identify alternative acquisition methods identified by the Support Equipment Acquisition Review Group, and other methods currently being used within AFSC to reduce support equipment acquisition costs. In order to accomplish this objective, research question two will have to be answered (Chapter One, page 10). This chapter will examine three methods currently being used within AFSC to reduce support equipment acquisition costs. The three methods are multi-year contracting, breakout procurements, and local manufacture of support equipment. It will begin with a brief historical review of each method, followed by an examination of the benefits, disadvantages, and the circumstances under which method shows the greatest potential. The research has shown that each method can not be successfully applied in every situation. The trick is to determine when to use each method for the maximum results. Additionally, for each method, actual support equipment cost data will be presented as a means for substantiating the benefits for each method. The presentation of the ideas in this chapter will be the major contribution to this research effort.

The Support Equipment Acquisition Review Group

In the early 1980's, the problems of support equipment and spare parts acquisition became public knowledge. As a result of these problems, the Support Equipment Acquisition Review (SEAR) Group was founded. The SEAR Group was formed at the request of the Secretary of the Air Force for Research, Development and Logistics. The SEAR group was,

> "chartered to perform an indepth study of the entire spectrum of support equipment acquisition. It was to address all functions in weapon system design, development and production, including requirements determination, stanardization, procurement practices, and the impact of these activities on competition and post production support (25: 3)."

The bottom line is to field supported weapon systems and achieve fair and reasonable prices.

The SEAR group was chaired by Major General Monroe T. Smith, the commander of the Air Force Aquisition Logistics Center (AFALC). The group was composed of five panels; policy, procurement, financial management, procedures, plans. Other functions included a Management Informantion and Control Systems element as well as special staff support. Representatives of AFSC, AFLC, TAC, MAC, ATC, AFCC, AFLMC, and industry participated in the proceedings to provide input to help study and improve the support equipment acquisiton and support process.

The SEAR group reviewed previous reasearch papers, briefings and reports, regulations, and 168 previous studies, to help understand the process. Also extensive interviews were held to supplement the research. As a result of the research and the interviews, 19 support equipment management issues were identified for resolution. Table X is a listing of the 19 issues.

Table X. Support Equipment Management Issues

1. SE Planning
2. Organization
3. Acquisition Strategies
4. Program Direction
5. MIL-HDBK-300
6. Activations and Conversions
7. Calibration
8. System Engineering Requirements
9. LSA and SERD Requirements
10. Design Requirements
11. Support Requirements
12. Funding Requirements
13. Tecnical Order Requirements
14. Contractor Incentives
15. Training Requirements
16. Pricing
17. Small Contract Cost Details
18. Acquisition Phase Management Information and Control Systems (MICS)
19. Air Force Equipment Management System (AFEMS)

As a result of the 19 management issues the SEAR group submitted 107 recommendations for resolution. One of the 19 areas, Acquisition Strategies, will be addressed in this chapter. Two recommendations, the use of multi-year contracting and breakout procurements were proposed as ways of improving the support equipment acquisition process.

Multi-year Contracting for Support Equipment

Multi-year contracting is a relatively new idea, and has been used primarily for the procurement of goods and services, and under special circumstances, for weapon system acquistion. However, in recent years multi-year contracts have been used in the procurement of support equipment and spare parts. First, a brief historical look at the use of multi-year contracts.

The Navy was the early pioneer in the use of multi-year contracts in the large shipbuilding contracts, because the quantities were relatively large and the risk of cancellation very low. Additionally, multi-year contracts were relied upon heavily to achieve rapid buildup of production capacity for critical items to support the Vietnam war (3: 142). As we went into the 1980's, the present methods of procurring weapon systems on an annual basis became too expensive and lengthy for the Department of Defense. Something had to be done to reform the weapon system acqusition process. As a result, the Acquisition Improvement Program was instituted by Deputy Secretary of Defense Carlucci. It defined 32 initiatives designed at "shortening the acquisition process, increasing readiness, providing cost savings, and strengthening the industrial base (14: 1)." The use of multi-year contracts was one of the 32 initiatives designed to improve the process. The leaders of the Department of

Defense have recognized the merits of multi-year contracting because, "the technique fosters efficient ordering and production, enhances industry standing in financial markets, and promotes sound capital investment decisions (21: 15)." These merits will ultimately lead to cost savings.

A Multi-year contract, as defined by the Federal Acquisition Regulations,

> "means contract covering more that 1-year's but not in excess of 5-year's requirements, unless otherwise authorized by statute. Total contract quantities and annual quantities are planned for a particular level and type of funding as displayed in the 5-year development plan. Each program year is annually budgeted and funded, and at the time of award, funds need only to have been appropriated for the first year. The contractor is protected against loss resulting from cancellation by contract provisions which allow reimbursement of costs in the cancellation ceiling (26: 17.101,17-1)."

The use of multi-year contracts in the acquisition of support equipment has become a recognized strategy to reduce proliferation and costs because of enhanced standardization. The expanded use of multi-year contracts has been supported in a number of reports, and has gained the indorsment of the Joint Logistics Commanders Panel, the Air Force Management Analysis, and most recently by the SEAR group. GAO report LCD-80-30 on support equipment stated, "One way to control proliferation and increase standardization is through multi-year contracting requirements. . . . multi-year requirements contracting enhances standardization because the same item can be delivered to the services each year for duration of the contract (25: 36)." However, not all support equipment items are candidates for multi-year procurement. A number of criteria must be met for the successful application of multi-year contracts.

Criteria for Multi-year Contracts. The criteria for multi-year contracting of support equipment are identical to those of major weapon system acquisitions. Multi-year contracts are applicable when one or more of the following criteria are satisfied.

(1) Benefit to the Government. The use of multi-year contracts must show considerable benefit to the government in terms of cost savings, schedule improvement, or standardization. "Each proposed multi-year contract should be evaluated on its own merits, weighing the margin of savings against the added risk and other uncertainties. The savings should be high enough to offset any additional risks of entering into a multi-year contract (22: 4)."

(2) Stable Design/Configuration. The design of the support equipment item must be stable, and the configuration baselined. All the design, development, and qualification testing should be complete. This will eliminate the costly modifications in the out-years of the contract resulting from design changes.

(3) Stable Requirement. The need for the support equipment must be stable throughout the terms of the contract. There must be a requirement for the support equipment items programmed for the life of the multi-year contract. Any decreases in the requirements can often times increase the unit cost of the support equipment item, and reduce the potential savings of the multi-year contract.

(4) Stable Funding. The Department of Defense must be committed to the program to insure sufficient funds will be available to complete the multi-year contract. In the case of cancellation, the government is liable

for the total amount of the cancellation ceiling imposed on the contract. The funding for the support equipment is often times driven by the priority of the weapon system it supports. "A turbulent funding history for a weapon system may suggest an unstable requirement or wavering support, making it inappropriate for multi-year contracting (22: 5)." In this case, multi-year contracting of the support equipment is not warranted.

(5) Degree of Cost Confidence. Prior to the approval of a multi-year contract, the buying agency is required to present estimated cost data proving a substantial cost savings to warrant the increased risk. The estimates for the contract cost must be realistic.

(6) Degree of Confidence in Contractor Capability. There should be significant confidence in the contractor's performance in terms of meeting the delivery schedule. The contractor should have the necessary resources to deliver all other support items in accordance with the contract. However, the contractor need not have produced the support equipment items to be awarded the contract.

Benefits of Multi-year Contracts. The benefits of multi-year contracts can be substantial, as was determined by the SEAR group. They concluded, "the benefits of multi-year contracting can be considerable, and the maximum use of this contracting concept should be employed to achieve maximum support equipment standardization (25: 37)."

The use of multi-year contracts has the potential for tremendous cost savings. The principle cost savings can be realized by reducing the short term costs, while improving the contractors ability to perform in the long run. A contractor is able to make large raw material and subcomponent purchases to cover the total program requirements instead of making small yearly purchases. Not only will the use of multi-year contracts result in lower per unit costs, but will also avoid the expensive administrative costs associated with the stop/start of annual contracts. As a result, the contractor is able to pass along the cost savings in the form of lower support equipment acquisition costs.

Another source of cost savings attributable to multi-year contracting is program stability. The contractor is able to stabilize the workforce, which will result in greater production efficiency in the outyears of the contract. Therefore, multi-year contracts will result in a more consistent production quality and reduced waste.

The cost data, presented in Table XI, is a sample of ten F-16 items from a support equipment multi-year contract. It compares the annual and multi-year contract costs of support equipment, and determines the percentage of cost savings attributable to this alternative acquisition method. This information was obtained during the interview process at the F-16 program office. The facts presented show a significant cost savings attributable to multi-year contracting. The average cost savings for the ten support equipment items in Table XI is 24 percent.

Another benefit of multi-year contracting is the increased standardization of the support equipment. The contractor is able to purchase large quantities of identical piece parts and materials, which results in a standard end item. The benefits of standardization can be most realized in the logistics support area. A standard support equipment item lowers the training, technical data, and spare part requirements.

The benefits of multi-year contracts are substantial, as illustrated in Table XI, but the risks can be equally large if the techniques are incorrectly applied. Multi-year contracts are a collection of techniques

Table XI: Cost Comparison of Support Equipment

Noun	Cost ($) Annual	Multi-year	Diff.	% Savings
Pressure Assy Adapter	2,897	1,939	+ 958	33
Extractor Tool	2,700	1,564	+ 1,136	42
Compressor Spring	556	267	+ 289	52
MLG Assy Fixture	2,025	1,280	+ 745	36
Guide Bushing	206	176	+ 30	15
Test Fixture	6,311	5,798	+ 513	8
Interconnector Adapter	1,338	1,227	+ 111	8
Simulation Test Set	9,039	7,324	+ 1,715	19
Protractor Riggin	1,345	1,152	+ 193	14
Radar Cover	528	441	+ 87	16

rather than a rigidly defined method. Any potentailly beneficial situation may become a disadvantage if the multi-year contract is misapplied.

Disadvantages of Multi-year Contracts. A major disadvantage of multi-year contracts is the risk associated with contract cancellation. Though the risk of cancellation is relatively low, critics feel the high cancellation costs, coupled with other less significant disadvantages, give reason to avoid using multi-year contracts. The setting of the cancellation ceiling is also a problem. Often an improperly set cancellation ceiling may result in higher per unit or contract costs. This is because a contractor may be forced to add contingency fees to the support equipment costs to cover the shortfalls of an improperly set cancellation ceiling. However, the cancellation ceiling is not a disadvantage until the multi-year contract is actually cancelled. As long as each support equipment item meets the selection criteria, the risk of cancellation is minimal.

Another disadvantage of multi-year contracts is the reduced flexibility. Since multi-year contracts are long term commitments (up to five years in some cases), they reduce the controllable portion of the support equipment budget. The controllable portion of the budget is the amount not mandated under law or obligated by contract. Often times changes in technology is ignored because of multi-year commitments. The risk of "changing our minds" is too great.

The weapon systems and support equipment of today are constantly pushing the state of the art. As a result, the hardware is changing frequently. Special contract provisions are included in multi-year contracts to cover changes, but problems arise when the change is beyond the scope of the contract. In this case, the contractor gains the leverage in renegotiating the price. The government is in a "take it or leave it" position, the contractor is able to dictate the price. This erodes the initial cost savings of the multi-year contract.

Another problem arises with changes in multi-year contracts. As stated earlier, one benefit of multi-year contracts is to allow the contractor to make large component purchases up front to cover the term of the contract. In the event of a change, these parts may become obsolete. The contractor will recoup the cost of these parts during the renegotiation of the contract. This is an example of a potential advantage becoming a disadvantage.

Lastly, due to the complex nature of the solicitations and proposals resulting from multi-year contracts, and the excessive approval cycle, the administrative lead times may be greater than for successive single year contracts. A multi-year contract for support equipment at ASD requires HQ AFSC approval prior to authorization. This approval can result in time consuming documentation. If not properly anticipated, these lead times could adversely affect the production schedules and deployment of the system and support equipment.

Multi-year contracts have proven to be a valuable tool in the acquisition of support equipment, and can result in significant cost savings under the right circumstances. The evidence has shown the good outweighs the bad, provided a multi-year contract is utilized properly. The SEAR group identifed another support equipment acquisition strategy which has shown promise in the last few year, breakout procurement. The following will examine breakout procurement as it is currently being applied at ASD.

Breakout Procurement

The policy of breakout procurement in the acquisition of support equipment is identical to component breakout in the acquisition of weapon systems. Therefore, the policies and procedures are the same. Component breakout, or breakout procurement of support equipment, is,"a special contracting method in which the Department of Defense purchases a weapon system or major end item component directly from a manufacturer or subcontractor, or through competitive procurement, and furnishes the component to the prime contractor as government furnished equipment for incorporation into the end item (18: 80)." By procuring the end item, or support equipment, the government is able to save the indirect cost and profits charged by the prime contractor to procure the item. Primary consideration for breakout procurement should be given to the items which provide the greatest potential cost savings at the least amount of risk.

The policy of the Department of Defense is to breakout a component or support equipment:

> "(1) whenever it is anticipated that the prime contract for a major weapon system or other end item will be awarded without adequate price competition (a) if substantial net cost savings will probably be achieved and (b) the action will not jeopardize the quality, reliability, performance, or timely delivery of the end item and
>
> (2) whenever substantial cost savings (regardless of whether the prime contract or component being purchased by the prime contractor is on the basis of price competition) will result from (a) greater quantity purchases or from factors such as (b) improved logistics support through reduction in the variety of spare part and (c) economies in operations and training will be achieved through standardization of design (25: 17.7202-2)."

The thrust of the Department of Defense policy is to achieve the greatest substantial cost savings over the life of the equipment item. If the benefits are substantial and the risks are relatively low, the component should be broken out.

Like multi-year contracting, component breakout/breakout procurement is a fairly new idea. As the weapon systems and support equipment became progressively more sophisticated, the prime contractors discovered they did not have the capability to furnish all the component parts of the system and the necessary support equipment. As a result, the prime contractor sought the assistance of subcontractors and vendors to supply the parts and support equipment. The prime contractor assumed the role of the integrator as opposed to sole producer as was the case in the past. However, this new role was not without a price. The prime contractor adds material costs, material overhead, subcontractor costs, as well as second tier profit factor to the government's total cost of the weapon system and support equipment. This results in what appears to be excessive overpricing, but in fact are allowable costs according to the government acquisition regulations.

Table XII is the cost breakout of the famous allen wrench, costing $9,609. It is included to illustrate the added costs on a piece of support equipment, and to point out the need to reform the acquisition process for simple, non-complex support equipment items. In response to the exorbidant costs of support equipment items, breakout procurements and local manufacture (to be discussed later) were instituted to help reduce costs.

Support equipment breakout is accomplished in two ways by AFSC. The first method is to award a contract directly to the support equipment manufacturer and by-pass the prime contractor. However, the hope is that once the first unit is purchased from the prime contractor, a competitive procurement can be used for any additional quantities. The second method, and far most common, is to award contracts to small disadvantaged businesses for the manufa cture or procurement of non-complex support equipment. The Air Force is still working with the prime contractor to determine the requirements, but the hardware is purchased from another business. Surprisingly enough, they don't object to breakout, "because it helps them avoid some of the heavy overhead they

Table XII: How a $17 Item becomes a $9,609 Item

VENDOR COST		PRIME CONTRACTOR COSTS	
MATERIAL	$ 17	COST FROM VENDOR	$5,025
ENGINEERING		PRIME CONTRACTOR COSTS	
DESIGN	1,707	RESEARCH/ENGINEERING	1,034
SUSTAINING	765	LOGISTICS	132
TECH DATA	388	ENGINEERING OVERHEAD	553
		QA SUPPORT	28
MANUFACTURING	750	QA OVERHEAD	30
PACKAGING	28	MATERIAL OVERHEAD	202
INSPECTION	16	OTHER CHARGES	7
		TRAVEL ENGR	81
OTHER COSTS		GRAPHICS SERVICES ENGR	35
ENGINEERING TRAVEL	30	LOGISTICS SUPPORT O/H	22
QUALITY ASSURANCE	15	PROGRAM OFFICE O/H	22
TEST	193	OVERTIME PREMIUM	14
COST OF MONEY	97	DIRECT FRINGE	505
		PRODUCT LIABILITY	6
GENERAL AND ADMINISTRATIVE	450	GENERAL AND ADMINISTRATIVE	528
PROFIT	749	PROFIT	1,205
SELLING PRICE	5,205	TOTAL PRICE TO USAF	$9,609

now incur in the paperwork associated with numerous small orders (2: 262)." Table XIII is a presentation of some of the major breakout contracts currently at ASD.

The following section will present the criteria for use, the benefits and the disadvantages of a breakout strategy for the procurement of non-complex support equipment items.

Criteria for Use of Breakout Procurement. In order for breakout procurement to be successful in the acquisition of support equipment, the

Table XIII: Breakout Procurement Contracts at ASD (2: 262)

System	Firm	Amount ($)
B-1 B	Enginetics Corp.	4.9 mil
Airlift/Trainer	Arral Industries, Inc.	.2 mil
F-15	Ver-Val Enterprises, Inc.	6.5 mil
	Digitron Inc.	4.5 mil
F-16	Ver-Val Enterprises, Inc.	4.0 mil

following criteria should be met.

(1) Cost Savings. The breakout procurement should result in substantial cost savings for the government. Prior to considering a breakout procurement, a realistic estimate of the cost savings should be made, according to the component breakout guidelines in the regulations. However, establishing the cost estimate is not an easy task, but is essential to a successful breakout. Without such an estimate, the chance of making a poor breakout decision is increased.

(2) Stable Configuration. The support equipment item being evaluated for a breakout procurement must have a stable configuration. The design of the support equipment and the system hardware should be finalized. A breakout procurement should only be made if the decision does not jeopardize the quality, reliability, performance or timely delivery of the support equipment item.

(3) Technical Risk. The technical risk of a breakout procurement should be low. An assessment of the risk is essential, and an analysis of

the technical, operational, and logistics support areas must be considered prior to a breakout decision.

Benefits of Breakout Procurements. The major benefit of a breakout procurement is the potential for cost savings. The government procures the support equipment item directly from the subcontractor or from a disadvantaged business, thus eliminating the middleman role of the prime contractor and associated charges. The example of the allen wrench in Table XII, proves the charges can be substantial. ASD expects to save about 25 percent on non-complex support equipment by breaking it out of the prime contracts and awarding it to small disadvantaged businesses (2: 262). Col. David W. Krahenbuhl, Deputy for Contracting and Manufacturing at ASD, said that "in addition to their ability to maintain quality, machine shop-type firms have less overhead than major manufacturers and thus can offer greater savings on the same production lots of equipment (2: 262)." Presently, breakout is being used primarily for non-complex items. However, it is occasionally used under certain circumstances for the procurement of more complex items. Table XIV presents the savings attributable to breakout procurement for several F-16 support equipment items.

Another advantage of breakout procurements is the shortened lead times. An ordering agreement is negotiated between a weapon system program office and the firm(s), which allows the Air Force to order between a minimum and maximum dollar amount over several years. As a result, when a requirement for a breakout procurement exists, the items can be ordered quickly. An order for a support equipment item through a prime contractor can take a minimum of two years, most of which is

Table XIV: Cost Savings of Breakout Procurement

Noun	Cost ($) Prime Ktr	BP	Diff.	%Savings
Fuel Tank Certifier	78,676	48,124	30,552	38
Environmental Covers	588	90	498	84
Fuel tanks tester	521	90	431	82

attributable to the administrative lead time. For the same item, the small business is able to deliver in less than half the time.

Disadvantages of Breakout Procurement. The major disadvantage of breakout procurement in the acquisition of support equipment is the limited scope of application. Breakout procurement is currently being used primarily in the acquisition of relatively inexpensive, non-complex items and for second units. Therefore, the opportunity for substantial cost savings is limited, due to the low cost of each item. However, any cost savings is note worthy in terms of the defense budget.

The primary reason breakout procurement is not used more often is because the risk is so great. By breaking out the support equipment item, the government assumes all the technical, schedule, and cost risks, and assumes the role of developer and integrator. Presently, the government pays the prime contractor to manage the entire process, and provide the support equipment as CFE. They are responsible for every aspect of the support equipment acquisition process; the technical interface between the system and the equipment, the logistics support considerations (calibration, technical data, spares, etc.), configuration management, testing, contractual activities, and a myriad of other tasks. If the government were to attempt this method, the entire process would be so manpower intensive, and would require thousands of more people to manage the process. For example, the F-16 program currently has approximately 2,800 contractor furnished support equipment SERDs, acquired and developed by General Dynamics-Fort Worth, involving hundreds of different subcontractors. If the government were to attempt to breakout these items, it would require management of 2,800 support equipment acquisition processes concurrently. The government would become responsible for all the associated tasks mentioned above, such as technical interface, logistics considerations, configuration management, testing, and others. A major criticism of the acquisition process of today is that it is so cumbersome and time consuming. An incorrect breakout procurement would only proliferate this problem.

In conclusion, a breakout procurement can be a very valuable tool, given the right circumstances. Therefore, careful consideration should be made prior to a breakout decision to assure all the criteria are met. Currently the F-16 program office is using breakout procurement to buy follow-on quantities of support equipment items. Therefore, all the contractor tasks would have already been accomplished; a stable, proven design, and the logistics support elements are already in place. This has shown significant cost savings, but it is not without its problems.

The final alternative method being used within AFSC for the acquisition of support equipment is local manufacture.

Local Manufacture

Local manufacture is the "fabrication of items at either the depot or intermediate maintenance level (19: 396)." In the past, local manufacture has been used primarily for the fabrication of simple aircraft parts, such as the F-4C high pressure hose. However, in response to the publicity concerning the acquisition costs of non-complex support equipment items, local manufacture has become an alternative method. The local manufacture process is nearly identical to the breakout process, except the items are fabricated by government personnel in government machine shops instead of small private businesses. The use of local manufacture has not been used in proceeding years because it was against DOD regulations. DOD facilities and equipment were not allowed to compete against civilian firms for government contracts. However, as a result of the claims of overpricing, the regulation has been changed. DOD 4000.19-R, dated 28 March 1984, states,

> "DOD Components shall request interservice support from another DOD Component or federal agency on a reimbursable basis when the capabilities exist or can be made available and that means of support will increase economy and effectiveness to the overall advantage of the Department of Defense (12: B-1)."

Local manufacture has been used most successfully by the F-16 program office. Currently the F-16 program office is using an interservice support arrangement with the 4950th Test Wing, Wright- Patterson AFB, Ohio, for the fabrication of non-complex support equipment items. They currently have approximately 75 items being fabricated.

General Dynamics-Fort Worth submits SERDs to the SPO with a recommended Part II solution of local manufacture. Once the SERD is

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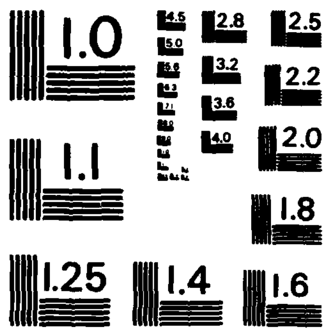

MICROCOPY RESOLUTION TEST CHART
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approved as local manufacture, General Dyamics prepares the engineering drawings and sends them to the 4950th Test Wing for first unit fabrication. After the initial fabrication of the support equipment, the item is returned to General Dynamics for testing, or tested by the Air Force directly when possible. When the item passes the initial testing, the necessary quantities are fabricated by the 4950th Test Wing and sent to the field for support of the F-16 aircraft. As part of the agreement, General Dynamics includes a copy of the drawing in the technical data. With a copy of the drawing, the field units can manufacture the support equipment item as the need arises.

Criteria for Use of Local Manufacture. The criteria of use of Local manufacture are identical as for breakout procurement. AFLCR 65-5, Air Force Provisioning Policies and Procedures, states, SE items will not be designated as local manufacture unless the following five conditions apply:

(1) Cost effective analysis must verify decision.

(2) Material required and manufacturing data must be available.

(3) The process of manufacture must not require unauthorized tools, equipment or skills.

(4) Quantities required do not impose an undue workload.

(5) Item can be locally manufactured/modified by need date (10: 41-1).

The fabrication of an item must demonstrate increased economy and effectiveness to the overall benefit of the Department of Defense, as specified by DOD 4000.19-R. If not, local manufacture is not a suitable acquisition method. The support equipment item must have an urgent need which can not be satisfied by any other method.

Benefits of Local Manufacture. The primary benefit of using a local manufacture is the potential for significant cost savings. The cost savings are realized by utilizing the government facilities, by reducing the overhead head costs, and all the administrative and clerical costs involved in the acquisition of support equipment. The program office sets up a fund site, which the 4950th Test Wing uses in a reimbursable method to cover the cost, and retains a small percentage for the upgrade of equipment. Table XV presents ten support equipment items currently being locally manufactured by the 4950th Test Wing in support of the F-16 aircraft.

Table XV: Cost Comparison of Local Manufacture

Noun	Cost ($) CFE	LM	Diff.	% Savings
MLG Door Spline Wrench	112	64	+ 48	42
Leak Check Panel	873	119	+ 754	86
ECS Test Set Cable	209	64	+ 145	69
Protective Cover Assy	122	16	+ 106	86
HUD Quick Check Panel	597	58	+ 539	90
ISA Wrench Socket	110	40	+ 70	63
Brake Valve Assy Cable	553	105	+ 448	81
Control Valve Cable	406	85	+ 321	79
LG Valve Pin	159	14	+ 145	91
EPU Purge Adapter	3,107	378	+ 2729	87

It compares the price charged by General Dynamics and the cost to local manufacture the identical item by the 4950th Test Wing. The cost savings attributable to this method of acquiring non-complex support equipment is substantial. The average cost savings for the ten items presented is 77 percent. One point of interest, the famous allen wrench presented in Table XII which would have cost the Air Force $9609 was locally manufactured by the 4950th Test Wing for less than $50 dollars.

Another benefit of local manufacture is the reduced lead times. Once the drawing is presented to the 4950th Test Wing, the item can be fabricated in a matter of weeks. These lead times can be reduced so dramatically because there is not formal interservice contract, but only an agreement. Initiating local manufacture of an item of support equipment requires minimal effort in comparison to a CFE support equipment acquisition. This virtually eliminates the administrative lead times, from months to weeks.

Disadvantages of Local Manufacture. As was the case with breakout procurements, the primary disadvantage of local manufacture is the limited scope of application. This method can basically only be used on non-complex support equipment items. This is a major limiting factor of this method. Also, before a local manufacture method can be used, the government must prove beyond a resonable doubt that it is in the best interest of Department of Defense and results in a overall advantage.

Summary

The Department of Defense has received a great deal of bad publicity concerning the high cost of support equipment. A great deal of time and energy has been devoted by the SEAR group in an attempt to remedy this situation. This chapter has presented a number of alternative support equipment acquisition methods proposed by the SEAR group designed to reduce support equipment costs. It is clear these methods are in fact successful, based on the data presented, provided they are applied under the proper circumstances. The goal of every federal manager should therefore be to recognize the particular circumstances of each procurement action and apply the proper support equipment acquisition strategy when possible.

V. Conclusions and Recommendations

Overview

This research effort was undertaken to examine the support equipment acquisition process within AFSC and alternative acquisition methods designed to reduce acquisition costs. This is important because support equipment acquisition in AFSC is big business. It accounts for 5-15 percent of the acquistion costs of a major system as well as the operating costs. However, though very critical to system performance, support equipment acquisition is one of the least understood processes.

To accomplish this task, the reseacher developed a general research plan consisting of two phases identified in Chapter One, pages 10-12. Phase one corresponds to the first research objective: to identify how support equipment is acquired within AFSC including all functions; support equipment indentification, development, and procurement. This research objective was examined in Chapters Two and Three. The first phase was accomplished by a literature review, an examination of the support equipment regulations, and interviews with support equipment experts. Phase two corresponds to the second research objective: to identify alternative acquisition methods indentified by the Support Equipment Acquisition Review Group , and other methods currently being used within AFSC to reduce support equipment acquisition costs. This research objective was examined in Chapter Four. The second phase was accomplished by interviews with support equipment experts and a data analysis, as well as supplementary information obtained in the literature review.

This chapter is to provide a synopsis of the results of the research effort. A summary of the research questions will be presented for each research objective, followed by the conclusions. As a way of summarizing the entire research effort, Chapter Five will conclude by presenting areas of further study in the support equipment area and the contribution of the study.

Research Objective One

The first research objective was accomplished by considering the first research question: How is support equipment acquired within AFSC? Also considered were a number of subsidiary questions to the first research questions. The questions are:

(a) How is the support equipment equipment acquisition process related to the major weapon system acquisition process?

(b) What is a Support Equipment Recommendation Data (SERD), and what is the SERD process.

The support equipment acquisition process was considered in Chapters Two and Three from a number of different perspective, beginning with a broad overview, and narrowing to specifics. Support equipment was first considered within the framework of intergrated logistics support (ILS), and then within the weapon system acquisition process. Finally, the specifics of the support equipment acquisition process were examined extensively from requirement determination through delivery.

Conclusions to First Research Objective

This section examined the major conclusions of the first research objective from the three perspectives considered above.

The first perspective is support equipment as an element of integrated logistics support (ILS). In the past, logistics has taken a secondary role to system performance, cost, and schedule. With the rising operations and support costs of weapon systems, this attitude has begun to change. DOD Directive 5000.1 mandated that logistics be of equal importance with cost, schedule and performance. The leaders in the Department of Defense began to realize that logistics supportability is in fact a major determinant of system performance. A high performance system is of little value if it can not be maintained in the field. ILS is the concept that makes logistics happen. It is an interrelated and intergrated system of ten elements which determine the logistics supportability of a system. Support equipment is one of those ten elements. Support equipment, in conjuction with the other elements, is a major contributor of mission effectiveness, and thus worthy of consideration.

The second perspective was to consider support equipment development which parellels the system acquisition process. Support equipment delivery is not automatic and requires a great deal of management attention and financial resources dedicated to its development. The support equipment development process begins in the conceptual phase of the weapon system acquisition process as an input to the request for proposal and the preparation of the support equipment plan. As the system design begins to mature in the later phases of the weapon system acquisition process, so does the support equipment design. There are five different categories in the support equipment stratum as outlined in AFR 800-12, Acquisition of Support Equipment. They are prototype, early development, deferred development, and common/normal support equipment and STE. Each type of support equipment has its own peculiar requirements and requires varying degrees of management attention and development leadtimes. The key is for each support equipment manager to recognize this fact, and take the necessary actions to assure concurrent delivery.

As the weapon system acquisition process progresses from each phase to the next, it must undergo upper management scrutiny in a number of reviews and audits. Each review examines the system performance, cost, schedule and logistics supportability. Support equipment and the other logistics elements are major determinants of an affirmative decision in the review process. The cost effective acquisition of support equipment and the other logistics elements often times becomes the deciding factor in selecting a final weapon system design.

Support equipment is one of the major contributor to system reliability and maintainability; and therefore, development must be considered in each phase of the system acquisition process to assure support equipment delivery with the initial operating capability of the system. This conclusion is supported by AFR 800-12, Acquisition of Support Equipment. The support equipment must be developed and used as part of the system and responsive to the system needs. The only way to accomplish this goal is to devote substantial management attention to the support equipment development during the weapon system acquisition process.

The third and final perspective was to examine the "specifics" of the support equipment acquisition process. This will present the final goal intended to satisfy the first research objective: To determine how support equipment is acquired within AFSC. The procedures at ASD will be examined because it acquires the largest portion of support equipment within AFSC.

Once the support equipment plan is approved by the government and the system stabilizes, the contractor begins to submit SERDs. The SERD is the vechile through which the contractor identifies the support equipment to the government. Under the terms of the contract, the contractor is responsible for reviewing the federal supply catalog and submit stocklisted or GFE support equipment items to the greatest extent possible. This will allow for the lowest possible support costs because the development costs would have been paid on a previous contract. Other associated costs would also be reduced by using GFE items, such as technical data preparation, spare parts, and training. However, if a GFE item is not available to satisfy the functional requirements, the contractor prepares and submits a CFE SERD in accordance to the procedures addressed in Chapter Three.

Once a SERD is submitted to the Air Force, it goes through an intensive evaluation and review cycle, sometimes called the SERD process. The SERD is distributed by the contractor to the implementing, using, supporting, training, and all other cognizant commands for review and comments. Often a support equipment review conference is convened and chaired by the SPO to review the contractor's recommended support equipment items. The final Air Force comments are consolidated by the SPO and transmitted to the contractor for action. If the SERD is approved, the contractor begins in-house pricing action, and submits a price quotation to the SPO. The price is negotiated, and then a contract modification is awarded. The support equipment item is then developed and delivered to the using command to support the weapon sytem.

The SERD process is a very detailed and requires the input of many hundreds of people to make it work. The Support Equipment Acquisition Review Group estimated that approximately 32,500 SERDs were processed through the SERD process in 1983. The importance for every person to understand the SERD process is evident. This is to assure the most cost effective and timely delivery of support equipment to the using command.

Research Objective Two

The second research objective was accomplished by considering the second research question: What alternative acquisition methods can be used to reduce support equipment acquisition costs within AFSC? Also considered were a number of subsidary questions to the second research question. These questions are:

(a) What are some alternative acquisition methods being used within AFSC?

(b) What are the advantages and disadvantages of each alternative method?

(c) Under what circumstances is each method applicable?

Chapter Four considered a number of alternative acquisition methods proposed by the Support Equipment Acquisition Review Group and other methods currently being used within AFSC.

Conclusions to Second Research Objective

This section will examine the major conclusions to the second research objective.

Support equipment acquisition consumes a large portion of the AFSC budget. In 1984, AFSC spent $1.8 billion for support equipment, and an even greater total is spent Air Force and DOD wide. Therefore, it is the responsibility of every federal manager to use the most prudent acquisition methods possible.

As a result of the adverse publicity concerning the acquisition of support equipment, the Support Equipment Acquisition Review (SEAR) group was formed. The SEAR group was chartered to perform a study of the entire support equipment spectrum, and make recommendations for the improvement of the system. The SEAR group recommended the use of multi-year contracts and breakout procurements as a means of lowering support equipment acquisition costs. These methods, including local manufacture, were examined in great detail in Chapter Four. Presented was the criteria of use, benefits and disadvantages of each method.

Multi-year contracting has been successfully used for the acquisition of major systems for a number of years. Recently, multi-year contracts have been used for the procurement of support equipment and spare parts. Multi-year contracts are a means of procuring more than one year's requirements on a single contract. However, multi-year contracts are not applicable to all support equipment acquisitions. Specific criteria must be met before it can be used. The use of multi-year contracts must be benefical to the government, the support equipment design, requirements, and funding must be stable, and must have high confidence in the contractor's cost and production capability. The benefits of multi-year contracts can be great, such as cost savings, program stability, increased standardization, and shorter lead times. In the data presented in Chapter Four, a sample of ten F-16 support equipment items procured on a multi-year contract, demonstrated a 24 percent cost savings. The disadvantages can be equally great, such as high cost associated with cancellation, excessive administrative lead times, and reduced program flexibility. Therefore, when considering the use of multi-year contracts for the acquisition of support equipment, great care should be taken to assure the criteria are met, and the benefits are weighed against the disadvantages.

The second alternative acquisition method considered in Chapter Four was breakout procurement. The policy of breakout procurement is identical to component breakout in the acquisition of weapon systems. Breakout procurement is the procurement of the item directly from the subcontractor and bypassing the prime contractor, thus eliminating all the "middleman" costs. Breakout procurement is used primarily two ways within AFSC. The first is by awarding a contract with the support equipment manufacturer and avoiding the prime contractor. Secondly, breakout procurement is accomplished by awarding a contract to a small disadvantaged business for the manufacture or procurement of non-complex support equipment items. Breakout procurement should only be used when there is a potential for cost savings, a stable configuration, and low technical risk. The benefits are substantial in terms of cost savings and reduced lead times. A disadvantage of breakout procurement is that the government assumes all the responsibility and risk associated with the acquisition of the support equipment item. The present method is to pay the prime contractor to manage the entire support equipment acquisition process, including engineering, logistics, configuration management, contracting, etc. Under breakout procurement, the government becomes the prime contractor responsible for these tasks. Many feel the government doesn't have the expertise and manpower necessary to totally breakout the majority of the support equipment items. Until this changes, the government will continue to pay subtantial costs for support equipment. Another disadvantage of breakout procurement is the limited scope of application. It is a fairly new technique for support equipment acquisition, and the "bugs" need to be worked out of the process. Currently it is only being used for non-complex and follow-on procurements, where the potential for cost savings is minimal.

The third and final method considered in Chapter Four was local manufacture. Local manufacture is the fabrication of the support equipment items in a government machine shop. Until recently, local manufacture of support equipment was against Air Force policy, but this has been changed in light of the overpricing publicity. Local manufacture can now be used only if it will increase economy and effectiveness to the overall advantage of the Department of Defense. The use of local manufacture has a number of criteria, such as a potential for cost savings, material must be present, must not require unauthorized tools, quantities must not cause undue workloads, and the local manufacture can be accomplished by the need dates. The F-16 program office is currently using the 4950th Test Wing to manufacture a number of support equipment items. The major benefits of local manufacture is the potential for cost savings, and reduced lead times. In a small sample of support equipment items being manufactured by the 4950th, a 77 percent cost savings is realized. Also, the support equipment leadtimes are greatly reduced, primarily by eliminating long administrative lead times. As was the case of with breakout procurement, local manufacture is limited in scope to non-complex items, thus eliminating the potential for large cost savings.

The support equipment acquisition process within AFSC is very large and cumbersome and requires extensive management attention and financial resources. It is the responsibility of every support equipment manager to work within the system to acquire support equipment in the most cost effective manner possible. Chapter Four presented three alternative support equipment acquisition methods; multi-year contracts, breakout procurement, and local manufacture, designed to reduce support equipment acquisition costs. The facts presented clearly demonstrate that these methods are valuable tools in reducing costs. However, each method is very limited in scope and applicable only to certain situations. The key for each manager is to recognize the criteria of each method and apply it when possible.

Areas of Further Study

The support equipment acquisition process is very dynamic and has began to receive greater management attention in the last few years. There are many areas of the support equipment acquisition process in need of further study. Some suggested areas are as follows:

a. The Support Equipment Acquistion Review Group identified 19 management issues and corresponding recommendations dealing with the support equipment acquistion process. These 19 management issues are listed in Table X, page 67. A more detailed presentation of these issues may be obtained by referring to page 17 of the Support Equipment Acquisition Review Group Final Report, dated July 1984. Any one of these management issues could be an area of further study.

b. The acquisition of support equipment is accomplished primarily by two commands in the Air Force, AFSC and AFLC. This study has been an examination of the support equipment acquisition process within AFSC. Further research could be conducted to compare and contrast the support equipment acquistion methods within AFLC with those in AFSC.

c. A ground rule of this study was not to criticize the present methods of procuring support equipment within AFSC, but to present an examination of the current methods. However, present methods have received a great deal of criticism. A research effort could be designed to examine the problems with the present system and ways to reform it.

d. Many of the alternative acquistion strategies presented are limited in scope. A research effort could be conducted to examine the application of these methods to complex, development support equipment items, where the potential for substantial cost savings is much greater.

e. Support equipment overpricing is a significant issue. Many people claim that support equipment is not overpriced, but a product of the rules and regulations the system works under. A study could be conducted to examine the support equipment overpricing issue, as identified by a Hearing before the Committee on Governmental Affairs, United States Senate, on November 2, 1983. The concerned the Purchasing of Spare Parts and Support Equipment.

f. AFSC presently procures a great deal of support equipment items as part of Foreign Military Sales (FMS) and co-production programs. The acquisition of support equipment in support of foreign governments presents problems of its own, such as peculiar shipping requirements, power requirements, etc. A study could be conducted to examine many of these problems and ways to improve the system.

Contribution of the Study

The support equipment acquisition process is considered a mystery to many people not involved in the support equipment acquisition process. They feel support equipment appears as if by magic. However, the acquisition of support equipment requires a tremendous amount of effort, not unlike the weapon system it supports. This research study has presented the support equipment acquisition process in a concise, understandable manner. This research effort was a compulation of the support equipment regulations, a review of the literture, and interviews with support equipment experts within AFSC.

A heightened awareness of the various aspects of the support equipment acquisition process will aid management in formulating and applying effective policy is the acquisition of support equipment. For this reason, the research project has made a contribution to the enhancement of the field of acquisition management.

Appendix A: The SERD

- Figure 1A

- Figure 1B

GENERAL DYNAMICS
Fort Worth Division

SUPPORT EQUIPMENT
RECOMMENDATION DATA (SERD)

DOCUMENT NO. 16PR011
CONTRACTOR General Dynamics
CONTRACT NO. F33657-75-C-0310
END ARTICLE IDENT F-16 A/B
FIG 1 PAGE NO. 1
REVISION NO. Original
DATE 14 November 1977

PART I Functional Analysis

The requirement exists at the intermediate and depot level of maintenance to accomplish unscheduled bench checkout and adjustment of the P/N 16P1881-3 Adjustable Position Throttle Switch Assy. This item is a sun/planetary gearbox with an input lever and output switches. During unscheduled maintenance it is necessary to set the various throttle switches in relation to the lever arm prior to installation in aircraft. This is accomplished by positioning lever arm at the appropriate angular setting and adjusting the switches to the required switch actuation settings so that appropriate system signals are obtained. Switch assembly characteristics include the following:

Location: Immediately forward of the throttle, left side.

Size: 3½" x 2½" x 2½"

(Continued on Page 2)

PART II Recommended Solution

Recommend that P/N 16A23037-1 Protractor - Throttle Switch be developed for this purpose. The protractor will include attachment hardware and an idle rig pin.

Physical description: See sketch.

Design specification: 16PS003 General AGE Specification

Applicable Tests: First Article Form-Fit-Function Check which will also satisfy system compatibility tests.

Associate Equipment: SERD 42510 Multimeter

NOTE: Final unapproved ORLA analysis establishes a maintenance concept indicating a requirement for angular measurements at intermediate and depot levels.

ITEM NO.	ITEM NAME
23037	PROTRACTOR - THROTTLE SWITCH

FWP 4774-6-75

Figure 1a

PART I Functional Analysis (Continued)

Configuration: Two sets of (3) switches are mounted horizontally and actuated via a gear train driven by a down pointing lever which is linked to the throttle quadrant. A 3/16 diameter hole for (idle) rig pin is located in the lower body of the assembly and a matching hole is located in the link lever. Three (3) #10 horizontal holes in a triangular pattern pass through body of the assembly.

Lever arm/switch setting angles (measured from idle):

Max. Overtravel:	57°-30'	(± 15')
Max. Power:	50°-00'	(± 15')
Fire Control Computer (FCC):	35°-00	(± 15')
Back Up Control (BUC):	10°-00	(± 15')
Parking Brake (PB):	7°-30'	(± 15')
Elect. Comp. Assy (ECA):	1°-30'	(± 15')
Service Life Monitor (SLM):	-1°-0'	(± 15')
Overtravel:	-13°-45'	(± 15')

ITEM NO.	ITEM NAME
23037	PROTRACTOR - THROTTLE SWITCH

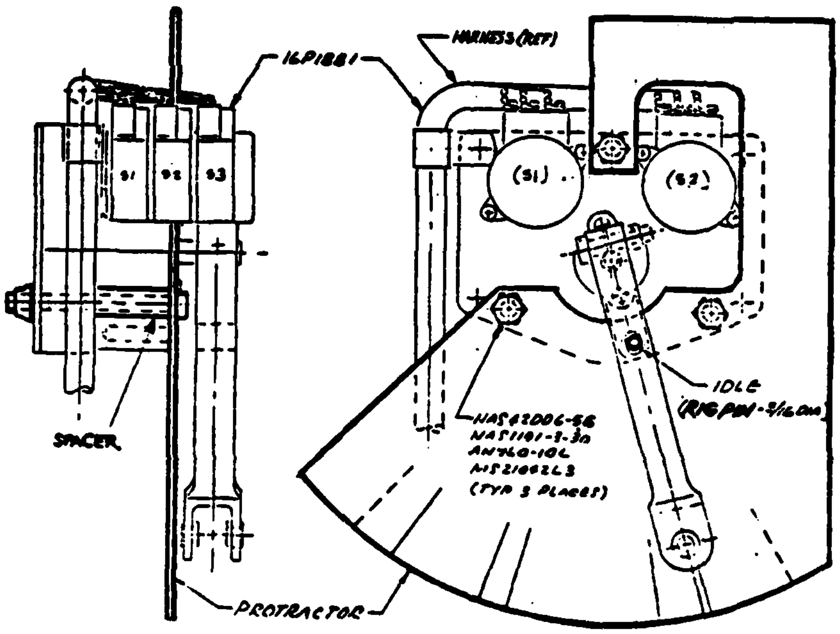
FWP 4774-4-75

Figure 1a

GENERAL DYNAMICS
Fort Worth Division

SUPPORT EQUIPMENT RECOMMENDATION DATA (SERD)

DOCUMENT NO. 16PR011
CONTRACTOR General Dynamics
CONTRACT NO. F33657-75-C-0310
END ARTICLE IDENT F-16 A/B
FIG 1 PAGE NO. 3
REVISION NO. Original
DATE 14 November 1977



WT.: 1 LB. MATERIAL: ALUM. SIZE: $\frac{1}{8}$ x 7 X 6

PROTRACTOR

ITEM NO.	ITEM NAME
23037	PROTRACTOR - THROTTLE SWITCH

FWP 4774-4-75

Figure 1a

FWP 4774A-4-75

SUPPORT EQUIPMENT RECOMMENDATION DATA (SERD)

DATE:	DOC. NO.	PAGE NO.
14 November 1977	16PR011	4

END ARTICLE	CONTRACTOR	CONTRACT NO.	QUANTITY	REV. NO.	CROSS INDEX
F-16 A/B	General Dynamics	F33657-75-C-0310		Original	

1 NOMENCLATURE	CAL	3 CRITICAL
PROTRACTOR-THROTTLE SWITCH	2	ENG. ____ PROC. ____

4 ITEM NO.	5 SYSTEM AREA INDEX	6 WORD DESCRIPTION	7 AGE INDEX	8 NATIONAL STOCK NO. FSC	FIIN	9 FED. MFG.'S CODE PART OR DWG. NO.	10 MATCH CODE
23037	23IBG	Switch Assy. Throttle	AA-8.1	1730		81755 16A23037-1	

11 RESPONSIBLE AGENCY	12 PROPOSED SOURCE	13 EST. DATE 1ST. ARTICLE	14 EST. PROD. LEAD TIME	15 DATE OF APPROVAL	16 DATE REQ'D.	17 DEV. COST	18 END ITEM EFF.
	CFE	10 Mos.	6 Mos.			**	1 & On

REMARKS:

LOCATION	QTY
Edwards	1
Total	1

**1st Unit Cost:
***2 & On Unit Cost:

NTE PRICES WILL BE ADDED TO THE FIGURE 1b AFTER REVIEW MEETING AND FORWARDED IN 16PR011 SUBMITTAL.

Prime ________ SMR Code ________ Unit Price ________

Prod. Lead Time Plus Administration: ________

Item Manager ________ Symbol ________ Ext. ________

GD Engineer V. Patoski Ext. 2344

Operational Recommended Quantity Factor -1
*Number to be determined by Program Authority Document.

19 ORGANIZATIONAL REQUIREMENTS USE	Organ	Inter	PDM	TRC	ATC		20 FACILITY REQUIREMENTS	21 TOTAL REC. QTY.	22 UNIT COST	23 TOTAL ON ORDER	24 TOTAL COST
NO	0	*	*	0	0				***		
a/I											
TOTAL											

Figure 1b

Appendix B: The SERL

SE REQUIREMENT LIST

Contractor GENERAL DYNAMICS
Contract No. F33657-75-C-0310
End Article Ident F16A/B
Revision No. 1a Orig 1b Orig
Date 14 November 1977

P/N 16A23037-1 NSN 1730 GFE No Page No. 5

LCC COMPLETED, SUMMARY FORWARDED ______ MIL HDBK 300 SCREENING ACCOMPLISHED Yes

AF REQUIRED	GD RECOMMENDED	
		• CONFIGURATION MANAGEMENT
1.	1.	1. PRIME ITEM (Denotes CI Spec Requirement)
2.	2.	2. CRITICAL ITEM (Denotes CI Spec Requirement)
3.	3. X	3. NONCOMPLEX ITEM
4.	4.	4. STATUS ACCOUNTING REQUIRED
		• DESIGN
5.	5.	5. GENERAL DYNAMICS SPEC 16PS003
6.	6.	6. PER DEVIATION AS CITED IN SERD OR CI SPEC
		• TESTING
7.	7. X	7. SYSTEM COMPATIBILITY TESTING
8.	8.	8. FIRST ARTICLE TESTING AS CITED IN CI SPEC
9.	9.	9. FIRST ARTICLE TEST PLANS/PROCEDURES (Items 1 & 2 Above)
10.	10.	10. FIRST ARTICLE TEST REPORT (Items 1 & 2 Above)
11.	11.	11. COMPATIBILITY TEST PROCEDURES (Items 1 & 2 Above)
12.	12. X	12. COMPATIBILITY TEST REPORT
		• REVIEWS/INSPECTIONS
13.	13.	13. PRELIMINARY DESIGN REVIEW (PDR)
14.	14.	14. CRITICAL DESIGN REVIEW (CDR)
15.	15.	15. CONFIGURATION AUDITS
16.	16.	16. OTHER, SEE "REMARKS" BELOW
		• SE DATA
17.	17.	17. SE ILLUSTRATIONS
18.	18.	18. CALIBRATION REQUIREMENT SUMMARY
19.	19. *	19. ENGINEERING DATA (Reprocurement)
		• PROVISIONING DATA (Information Only)
20.	20.	20. CFAE/CFE NOTICES (Technical Orders) (For Tech Pubs)
21.	21.	21. RECOVERABLE ITEM BREAKDOWN (RIB) (For Spares Use)
		• OTHER
22.	22.	22. ATE SOFTWARE
23.	23. X	23. MULTINATIONAL REQUIREMENT

REMARKS

*Engineering data associated with this SERD will be prepared in accordance with 16PP140-IIA, Engineering Drawing Plan, dated 16 December 1974. Costs of the identification, reproduction and submittal of reprocurement data package is not included in this proposal. This additional task is subject to separate definition, pricing, and negotiation.

USAF DISPOSITION		NAME	DATE
☐ APPROVED	ENGINEERING-YPEC		
☐ COND APPROVED (See Remarks) ☐ DISAPPROVED (See Remarks)	LOGISTICS-YPL		

ITEM NO	ITEM NAME
23037	PROTRACTOR - THROTTLE SWITCH

Appendix C: Listing of Interviewees

Personal interviews were conducted with support equipment managers within AFSC at Aeronautical Systems Division, Wright-Patterson AFB Ohio. The interviews were conducted to gain a complete understanding of the support equipment acquisition process. The interviews were intended to supplement the examination of the Air Force regulations and the literature review. The interviewees are all middle level managers and project officers who are "insiders" in the support equipment acquisition process at ASD. The interviewees are listed below:

Mr. John D. Anderson
B-1B Avionics Support Requirements Manager
Directorate of Logistics
Deputy for B-1B
Wright-Patterson AFB, Ohio

Captain William Bridges, USAF
Support Equipment Manager
Common Support Equipment Division
Deputy for Aeronautical Equipment
Wright-Patterson AFB, Ohio

First Lieutenant Stephen Gray, USAF
F-15 Support Equipment Manager
Directorate of Logistics
Deputy for Tactical Systems
Wright-Patterson AFB, Ohio

Captain Richard Snyder, USAF
F-16 O & I Support Equipment Manager
Support Development Division
Directorate of Logistics
Deputy for F-16
Wright-Patterson AFB, Ohio

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VITA

Captain Mark R. L'Ecuyer received a Bachelor of Arts Degree in Economics from Assumption College, Worcester, Massachusetts in May 1980. Upon graduation, he received a commission in the United States Air Force through the Reserve Offices Training Corp (ROTC) at the College of the Holy Cross. His first assignment was to the Aeronautical Systems Division at Wright-Patterson AFB, Ohio in the F-16 System Program Office in the Directorate of Acquisition Logistics in October 1980. He was assigned as a Depot Mechanical Support Equipment Manager, responsible for the management of all F-16 mechanical depot support equipment for the U.S. and foreign Air Forces. Captain L'Ecuyer was selected for, and attended the Air Force Institute of Technology in May 1984.

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Thesis Chairman: Billy C. Cox, Captain, USAF
Instructor, LSP, School of Systems and Logistics

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The acquisition of support equipment consumes a large portion of the defense budget. In 1984, the Air Force Systems Command spent $1.8 billion on the procurement of support equipment. In the past, support equipment has not received proper management attention. However, people are beginning to realize that support equipment is one of the major factors affecting the maintainability and reliability of the fielded weapon system.

The purpose of this thesis is to examine the support equipment acquisition process within Air Force Systems Command and methods of improvement designed to reduce acquisition costs. The thesis considers support equipment from three perspectives; in terms of the Integrated Logistics Support concept, within the framework of the weapon systems acquisition process, and finally the "specifics" of the acquisition process. The thesis concludes with a thorough examination of three methods-multi-year contracting, breakout procurement, and local manufacture, presently being used within Air Force Systems Command to reduce support equipment acquisition costs. Presented are the benefits, disadvantages, and criteria for use of each method.

END

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