



Calhoun: The NPS Institutional Archive

Theses and Dissertations

Thesis Collection

1992-12

**Spare parts nonavailability: the identification of
impediments to spares acquisition**

Wynn, Milton E.

Monterey, California. Naval Postgraduate School

<http://hdl.handle.net/10945/24042>



Calhoun is a project of the Dudley Knox Library at NPS, furthering the precepts and goals of open government and government transparency. All information contained herein has been approved for release by the NPS Public Affairs Officer.

**Dudley Knox Library / Naval Postgraduate School
411 Dyer Road / 1 University Circle
Monterey, California USA 93943**

<http://www.nps.edu/library>



REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified		15. RESTRICTIVE MARKINGS Unclassified	
2a. SECURITY CLASSIFICATION AUTHORITY		3. DISTRIBUTION/ AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.	
2b. DCLASSIFICATION/DOWNGRADING SCHEDULE			
4. PERFORMING ORGANIZATION REPORT NUMBER(S)		5. MONITORING ORGANIZATION REPORT NUMBER(S)	
6a. NAME OF PERFORMING ORGANIZATION Naval Postgraduate School	6b. OFFICE SYMBOL (If Applicable) 36	7a. NAME OF MONITORING ORGANIZATION Naval Postgraduate School	
6c. ADDRESS (city, state, and ZIP code) Monterey, CA 93943-5000		7b. ADDRESS (city, state, and ZIP code) Monterey, CA 93943-5000	
8a. NAME OF FUNDING/SPONSORING ORGANIZATION	6b. OFFICE SYMBOL (If Applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER	
8c. ADDRESS (city, state, and ZIP code)		10. SOURCE OF FUNDING NUMBERS	
		PROGRAM ELEMENT NO.	PROJECT NO.
		TASK NO.	WORK UNIT ACCESSION NO.
11. TITLE (Include Security Classification) Spare Parts Nonavailability: The Identification of Impediments to Spares Availability. (U)			
12. PERSONAL AUTHOR(S) Wynn, Milton Eugene III			
13a. TYPE OF REPORT Master's Thesis	13b. TIME COVERED FROM TO	14. DATE OF REPORT (year, month, day) 1992 December 17	15. PAGE COUNT 138
16. SUPPLEMENTARY NOTATION The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.			
17. COSATI CODES		18. SUBJECT TERMS (continue on reverse if necessary and identify by block number)	
FIELD	GROUP	spares nonavailability, obsolescence, repair parts, provisioning	
	SUBGROUP		
19. ABSTRACT (Continue on reverse if necessary and identify by block number)			
The primary intent of this research effort is to provide an identification and analysis of impediments to the acquisition of spare parts. The focus of the research was in the area of Army rotary wing aviation spare parts. The research delved into both pre-nonavailability and post nonavailability issues and sought to establish responsibility for their resolution. It looked at such factors as those general factors shaping the procurement environment, and information gathered through archival research, interviews, questionnaires and selected component case analysis. It was apparent from the research that a myriad of causes of spares nonavailability exist. Some of these are controllable and some are outside the realm of reasonable control by those in the acquisition community. It also discussed the aggressive, iterative use of risk management to apply limited resources to those areas with demand the most attention due to their relative program impact should difficulties in sustainability be encountered.			
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS		21. ABSTRACT SECURITY CLASSIFICATION Unclassified	
22a. NAME OF RESPONSIBLE INDIVIDUAL Rebecca J. Adams		22b. TELEPHONE (Include Area Code) (408) 646-2052	22c. OFFICE SYMBOL Code AS/AD

T259317

Approved for public release; distribution is unlimited.

**Spare Parts Nonavailability:
The Identification of Impediments to Spares Acquisition**

by

Milton E. Wynn, III
Captain, United States Army
B.A., North Georgia College, 1982

Submitted in partial fulfillment of the requirements for
the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
December 1992

ABSTRACT

The primary intent of this research effort is to provide an identification and analysis of impediments to the acquisition of spare parts. The focus of the research was in the area of Army rotary wing aviation spare parts. The researcher delved into both pre-nonavailability and post nonavailability issues and sought to establish responsibility for their resolution. It looked at such factors as those general factors shaping the procurement environment, and information gathered through archival research, interviews, questionnaires and selected component case analysis. It was apparent from the research that a myriad of causes of spares nonavailability exist. Some of these are controllable and some are outside the realm of reasonable control by those in the acquisition community. It also discussed the aggressive, iterative use of risk management to apply limited resources to those areas with demand the most attention due to their relative program impact should difficulties in sustainability be encountered.

1 W0315
W965
C.1

TABLE OF CONTENTS

I.	INTRODUCTION	1
A.	FOCUS OF THE STUDY	1
B.	OBJECTIVES	1
C.	RESEARCH QUESTIONS	1
D.	RESEARCH METHODOLOGY	2
E.	SCOPE OF THE THESIS	3
F.	LIMITATIONS	4
G.	ASSUMPTIONS	4
H.	DEFINITIONS / ACRONYMS	5
I.	ORGANIZATION OF THE STUDY	5
II.	BACKGROUND	7
A.	INTRODUCTION	7
B.	SPARE PARTS PROCUREMENT PROCESS	8
C.	FACTORS SHAPING THE PROCUREMENT ENVIRONMENT	11
1.	Impact of the requirement for competition	11
2.	Impact of best value contracting	12
3.	Impact of modernization initiatives	14
4.	Impact of the declining defense base	16
5.	Impact of the military force drawdown	22
D.	SUMMARY	23

III. A PRESENTATION AND ANALYSIS OF RESEARCH FINDINGS	25
A. INTRODUCTION	25
B. RESEARCH METHODS	25
1. Archival research.	26
2. Interviews	29
3. Questionnaire	30
C. COMPONENT CASE ANALYSIS	31
1. Main Rotor Yoke.	33
2. Main Rotor Grip.	35
3. Tension Torsion Strap.	36
4. Universal Control Lever.	38
5. Straight Headless Pin.	40
D. CURRENT DOD SPARE PARTS PROCUREMENT PROGRAMS	41
1. Background.	42
2. Typical Life Cycle.	43
3. Procurement Methods.	44
a. Spares Acquisition Integrated with Production.	44
b. Rapid Acquisition of Manufactured Parts.	47
4. Assessment.	50
E. CHARACTERISTICS OF NONAVAILABLE COMPONENTS	50
1. Technical Complexity	51
2. Lack of design stability	52
3. Lack of interoperability and commonality	52

4. Long lead-times	53
5. Finite life criteria.....	54
6. Time in the inventory/level of technology	55
F. TOTAL RISK ASSESSMENT AND RISK MANAGEMENT.....	56
G. SUMMARY	58
IV. SPARES IMPEDIMENTS AND ALTERNATIVE ACTIONS	60
A. SPARES IMPEDIMENTS.....	60
1. Pre-nonavailability Impediments.....	60
2. Post Nonavailability Impediments.....	68
B. ALTERNATIVE ACTIONS	76
1. Pre-nonavailability actions.....	77
2. Post nonavailability actions.....	80
C. SUMMARY	82
V. CONCLUSIONS AND RECOMMENDATIONS	83
A. CONCLUSIONS	83
B. RECOMMENDATIONS	86
C. SUMMARY OF ANSWERS TO RESEARCH QUESTIONS	88
D. AREAS FOR FURTHER RESEARCH	91
APPENDIX A - QUESTIONNAIRE.....	93
APPENDIX B - ACRONYMS.....	100
APPENDIX C - SPRINT INITIATIVES.....	102
APPENDIX D - INTERVIEW RESPONSES	103
APPENDIX E - QUESTIONNAIRE RESPONSES	113
REFERENCE LIST.....	120

BIBLIOGRAPHY 123

INITIAL DISTRIBUTION LIST 127

LIST OF TABLES

TABLE 2.1	U.S. CONVENTIONAL FORCES	22
TABLE 3.1	HARD-TO-ACQUIRE COMPONENTS	32

LIST OF FIGURES

FIGURE 3.1 LIFE CYCLE OF A TECHNOLOGY	43
--	-----------

I. INTRODUCTION

A. FOCUS OF THE STUDY

The sustainability and maintainability of Department of Defense (DOD) procured items relies heavily upon the availability and uninterrupted flow of spare parts to meet the needs of the nation's military forces. Acceptable levels of mission readiness to meet the requirements of contingency operations is but one of a myriad of reasons that spare parts availability is of such critical importance. This research effort will focus on the identification of impediments to the availability of spare parts (spares) and the identification of alternative actions available to minimize and/or eliminate this occurrence. The research will look specifically at the Army aviation, rotary wing, spare parts commodity area.

B. OBJECTIVES

The primary intent of this research effort is to provide an identification and an analysis of impediments to the acquisition of spare parts. These impediments will be categorized into pre-nonavailability and post nonavailability issues and identified as either controllable by the Government or its contractors. In addition to the identification of impediments to spares acquisition, it will provide a selected case analysis of how several current nonavailability issues were addressed.

C. RESEARCH QUESTIONS

In support of the primary objective of this study the following research question is posed:

What are the primary impediments to the acquisition of Army rotary wing aircraft spare parts in the current DOD acquisition process?

In support of the primary research question, the following subsidiary questions are posed:

1. Which impediments are pre-nonavailability and which impediments are post nonavailability issues?
2. Which impediments are controllable by the Government and which are controllable by its contractors?
3. Are there types of components, within aviation commodity areas, which traditionally experience a higher degree of nonavailability than other components, and if so what are their characteristics?

D. RESEARCH METHODOLOGY

The research gathered for this study came from a variety of sources and utilized several collection techniques. Information was gathered using telephonic and personal interviews, archival research, a mailed questionnaire and a selected case analysis of a sampling of hard-to-acquire aviation components. Sources of interview information included the U.S. Army Aviation and Troop Command (ATCOM), the Defense Logistics Agency (DLA), and Bell Helicopter Textron, Inc. Principal parties interviewed within ATCOM included the contracting, material management, production management, breakout

engineering, Huey Product Management (PM) and Blackhawk Product Management offices. Principal parties interviewed within DLA included the technical section, aircraft structural components section and policy branch. The contract manager for military spares administration was interviewed at Bell Helicopter Textron, Inc.. Both structured and unstructured interviews were used during this portion of the data collection process.

Archival research included the use of the Naval Postgraduate Schools Dudley Knox Library, the Defense Logistics Studies Information Exchange (DLSIE), the Defense Technical Information Center (DTIC) and an Air Force Institute of Technology periodical listings search.

A questionnaire, enclosed as Appendix A, discussing spare parts obsolescence, one of the more difficult nonavailability issues to address, was sent out to ATCOM, DLA and Bell Helicopter Textron, Inc. It focused on a variety of generic obsolescence issues.

A series of case analyses were conducted on a list of five hard-to-acquire components. This listing was provided by the Huey Product Managers office as the PMs current top five spares nonavailability issues.

E. SCOPE OF THE THESIS

The scope of this study is limited to determining what are the current impediments to maintaining spare parts availability for Army rotor wing aircraft. The intent of this study is not to fix blame or to seek to justify nonavailability occurrences.

When utilized, case analysis was limited to components for the Army's UH-1, Huey helicopter. This airframe was selected for illustrative purposes because of

its status as a mature, fielded system and also because it is more than half way through its system life cycle.

Recommendations are provided as, and are limited to, alternatives for contracting personnel to pursue in precluding and/or resolving nonavailability issues. However, an all inclusive list of alternatives is not provided and is not within the scope of this study. Recommendations are focused on actions to be taken by the Government and/or its contractors. They are presented as overall concepts and are not exhaustively detailed (e.g., providing all necessary steps to reach their accomplishment).

Although this study is limited to nonavailability issues involving Army rotary wing aircraft, the findings, conclusions, and recommendations have applicability to virtually any commodity area. Commodity specific nonavailability factors are identified where applicable.

F. LIMITATIONS

No significant limitations were encountered during the conduct of this study. It is the researcher's contention that the availability of personnel and research material was such that the most critical, current impediments to the availability of spare parts were identified and adequately addressed.

G. ASSUMPTIONS

The research effort is based on three general assumptions. First, it is assumed that the reader has a familiarity with the DOD procurement system and standard military terminology.

Second, our current defense budget cuts and the associated military force drawdown is the environment that we will face in the future. Further, in the near

term, the annual defense budget will at best stabilize at its current reduced level, and at worst will continue to be reduced over time.

Third, the issue of spare parts nonavailability will be more importance, and a greater issue to the acquisition community in our current environment of force drawdowns and budget reductions. This is due to the constraining affects of these issues on our resource base.

H. DEFINITIONS / ACRONYMS

Definitions are defined in the body of the text. Standard military definitions were used throughout the text.

Acronyms are spelled out in their first appearance in the body of the text. As a quick reference, all acronyms which were not felt to be common to everyday use, or those that could be misinterpreted were incorporated into Appendix B, in alphabetical order.

I. ORGANIZATION OF THE STUDY

This thesis is divided into a series of five chapters. Each chapter builds on prior ones and is aimed at helping the reader logically progress through a thought process to arrive at a set of conclusions and recommendations, supported by a thorough analysis of the available data.

This chapter has introduced the reader to the focus, objectives, research questions, methodology, scope, limitations and assumptions of the thesis. It has developed the foundation for the research and established its purpose in a clear and concise manner.

Chapter II, background, sets the stage for the remainder of the research effort. After a brief introduction, it describes the U.S. Army and Defense Logistics Agency spare parts procurement processes to establish the parameters within

which their respective procurements occur. This is followed by a discussion of a series of major factors which help to shape our current procurement environment and a brief summary of the chapter's contents.

Chapter III, presentation and analysis of research findings, serves two functions. First it reports on the data collected during the research effort. Separate reports are provided on the results of archival research, personal and telephonic interviews, questionnaire responses, component case analysis, and interspersed general observations of the researcher.

Second, it analyzes the data captured using various collection techniques as described earlier in the chapter. It further discusses two current DOD spare parts procurement programs, identifies the characteristics of nonavailable components, discusses risk assessment and management, and closes with a summary statement.

Chapter IV, alternative actions, starts out by identifying impediments to spare parts availability discovered during the data collection and groups these impediments. It further discusses actions available to combat the occurrence of spare parts nonavailability and groups courses of action into two areas of focus: pre-nonavailability actions and post nonavailability actions. The chapter concludes with a chapter summary.

Chapter V, conclusions and recommendations, the study's closing chapter, covers exactly that. It brings out those conclusions and recommendations arrived at logically from the research effort as addressed in the study's preceding chapters. It further provides answers to the primary and subsidiary research questions and concludes by identifying areas for further research.

II. BACKGROUND

A. INTRODUCTION

Spare parts are one of the most critical elements required to sustain fielded systems. Not only systems, but virtually any item utilized by the Services, regardless of its purpose, requires the acquisition of spares to ensure its operational use. The timely acquisition of spares and the maintenance of adequate sources of supply further guarantees equipment mission readiness.

Problems involving nonavailability of spares are not new to the acquisition community. In the last decade, spare parts issues such as overpricing, lack of adequate competition and lack of availability of spares have placed the Services in the uncomfortable position of realizing their shortcomings in those areas. The environment in which we operate today will no longer tolerate the types of ill-fated procurements and blunders of the past.

One of the particularly interesting aspects of aviation spares, which this research focuses on, is that items which are not normally of a mission critical nature, such as nuts, bolts, and washers, can easily ground an entire fleet of aircraft. The possibility of severe repercussions from equipment nonavailability issues is greatly increased in this commodity area. The acquisition challenges of procuring aviation spares are boundless. Subsequent chapters will further expound on these issues.

The remainder of this chapter is devoted to two topics. First, an overview of the spares procurement process for the Army, specifically those of the Aviation and Troop Support Command (ATCOM), and the Department of Defense's

Defense Logistics Agency. This is intended to familiarize the reader with the similarities and differences existing between the two agencies. Second, an identification and description of five factors shaping our current procurement environment is provided to help establish a set of parameters within which the acquisition community operates. Some of these factors, which have been introduced into the environment within the last few years, offer unique challenges, requiring innovation and creative thinking. Both topics, the spares procurement process and factors shaping our procurement environment, will be explored in greater detail in subsequent chapters at which point their relationship to spares nonavailability will be discussed in depth.

B. SPARE PARTS PROCUREMENT PROCESS

This section will provide an overview of the spare parts procurement process for the Army and the Defense Logistics Agency(DLA). It will also describe the transition of spares responsibility from the Army to DLA.

It would probably be helpful, at this point, to provide a definition of aviation spare parts and further describe the two classes of spares. Spare parts are defined as:

Spares and repair parts, both repairable and consumable, acquired for use in the maintenance, overhaul, and repair of aircraft. It includes items, spares, repair parts, parts, subassemblies, components, and subsystems, but excludes end items. [Ref 1 : p. 5]

The two classes of spare parts, consumables and repairables, are defined as follows:

Consumable spare parts. Consumables are spare parts that are disposed of when they fail or are used up. In some cases they lose their identity through their use (e.g., lubricants). Consumables are normally less expensive than repairables. They include items such as bearings, nuts, bolts, and screws. Consumables comprise 75-80 percent of the spare part

inventory, yet they represent only 20-25 percent of DOD's monetary investment in spare parts [Ref 2 : p. 28].

Repairable spare parts. Repairables on the other hand are spare parts that are repaired when they fail, or on a pre-arranged rework cycle, and then returned to the inventory. The Army generally refers to these as spare parts. Repairables include such things as hydraulic pumps, generators, and valve assemblies. These parts are repaired by maintenance personnel at either the organizational, intermediate, or depot level using consumable spare parts. These comprise the remainder of the spares inventory. [Ref 23 : p. 29].

The Army has traditionally supported its own requirements for spares acquisitions, minus those items which were common to more than one Service's aircraft. These items were handled by DLA. Spares were acquired by the Army and stocked at National Inventory Control Points (NICP) for distribution as needed. In addition to NICPs, depots stocked items to facilitate the timely execution of depot repairs. Intermediate level and unit level maintenance facilities stocked mostly common items (bench stock) for routine scheduled and unscheduled maintenance requirements. As an item transitioned from the unit and intermediate levels to the depot level of repair, the complexity and number of stocked parts increased with the authorized level of work performed. [Ref 3]

Stockage levels were based on anticipated demand which was calculated from demand history, the introduction of new requirements, and projected nonrecurring needs (e.g., unusual, one time, depot overhaul requirements). Based on these projected demands, stocks were on-hand or on order to meet requirements as they materialized. [Ref 3]

The Defense Logistics Agency worked under a slightly different system. They have traditionally been responsible for spares for those end items common to more than one Service. A large portion of these items had short lead times and were not stocked. They were simply ordered when a requirement occurred.

Stockage and ordering decisions were based on weapons criticality or demand criteria per time period (e.g., number of requests or hits for the item per month). In a few instances the lack of the commercial availability of an end item would drive acquisition decisions. Short lead time, nonstocked items were ordered when requested by an end user, were shipped as direct vendor deliverables, and were lead time away from delivery. Identifying the need and ensuring the timely processing of the request prior to the anticipated need were two keys to successful sustainment under this system. [Ref 4]

As a result of the Defense Management Report (DMR) and its resultant decisions (DMRDs), this process has been somewhat altered with the purpose of establishing and benefiting from the centralized management of spares. Cognizance over spares, for the most part, has been shifted away from the Services and given to DLA. DLA now has responsibility for spares procurement for all the military Services and for the operation of wholesale depot operations [Ref 4]. The separate Services have retained cognizance over depot level repair facilities (e.g., Corpus Christi Army Depot (CCAD), for depot level aircraft maintenance), design unstable items, and safety of flight (SOF) items [Ref 5].

This shift in responsibility has resulted in a current transfer (October 1992) of 7000 consumables items per month from the Army [Ref 4], with about 1000 of these coming from the aviation community [Ref 6]. These transfers are staged and become effective on predetermined dates. On these dates, "paper transfers" of responsibility occur. Existing stocks of spares, at other than DLA locations, remain on site until stocks are exhausted at which time the positioning of future stocks shifts to DLA [Ref 6]. These transfers have resulted in a number of concerns voiced by both the Army and DLA. Most of these revolve around each

agency's interest in the other's ability to properly and effectively manage spares acquisition. Some of these concerns appear to be difficult to address while others will work themselves out over time as the slope of the learning curve shallows out. [Ref 6] [Ref 5]

C. FACTORS SHAPING THE PROCUREMENT ENVIRONMENT

Over the years there have been a myriad of factors which have helped shape the current procurement environment. Pressures exerted internally, from within the procurement community, and external pressures from Congress, special interest groups and the general public, have been driving forces for the procurement reforms of the past and recent DOD initiatives. Our current environment which has evolved from this ongoing evolutionary process is continuing to be shaped by the outcome of lessons learned. The researcher has identified five factors which currently appear to be having a broad impact and profound effect on the procurement process and therefore are likely to dictate how procurements, to include those of spares, will be handled in the future. These factors are the requirement for competition, best value contracting, modernization initiatives, the declining defense base, and the military force drawdown. The remainder of this chapter will be devoted to an overview of these factors. Chapter IV, data analysis, will expand on the discussion of these factors and delve into how they are actually affecting spares availability.

1. Impact of the requirement for competition

Few if any legislative actions have had the degree of impact on the acquisition community as the Competition in Contracting Act (CICA). "Passed by Congress in 1984, CICA amended the three principal statutes that prescribed

authorized methods of funding Government contracts” [Ref 7 : p. 688]. These statutes were:

1. The Armed Services Procurement Act of 1947.
2. The Federal Property and Administrative Services Act of 1949.
3. The Office of Federal Procurement Policy Act of 1974.

Under CICA, Government agencies were required to promote ‘full and open competition” in the procurement of property and services. “FAR part 6 defines full and open competition to mean that all responsible sources are permitted to compete for a contract action” [Ref 8 : p. 123]. To accomplish this task, legislation provided for the use of either sealed bidding or competitive proposals (negotiations) unless exemption criteria were met. CICA marked a fundamental shift away from the past practice of favoring noncompetitive negotiations. This shift was greatly influenced by the legislative pressure exerted by Congress in its efforts to monitor the expenditure of public funds. One of the negative effects of CICA, which was brought out during research, was the extensive amount of administrative time utilized in the pursuit of competition, sometimes at the expense of timely procurements [Ref 8 : p. 118-123]. The implementation of CICA, to some degree, has forced innovation to become a more commonly used tool to overcome such difficulties.

2. Impact of best value contracting

It is the researchers opinion that the emergence of best value contracting and its use by the Government has ushered in a fundamental shift in the way it selects with whom it will do business when utilizing competitively negotiated procurements. The old school professed the advantages of source selection based solely on the criteria of lowest bid, irrespective of other possible value

added factors. Fortunately, the procurement community has learned from such ill-fated procurements as the Army's SGT York and the Navy's A-12 Avenger that this style of contracting does not always yield the best results and/or meet the Government's need [Ref 9 : p. 1]. These unfortunate examples of procurement process failures have helped form the catalyst for change which has resulted in the realization that the Government needed to adopt, when possible, a more commercial style competitive environment. The essence of best value contracting is captured in the following definition. Best value contracting is best utilized:

... when the basis for contract award states that factors other than cost/price (such as technical merit, past performance, and management capabilities) will be considered in order to determine which proposal has the best promise of meeting the Government's need [Ref 9 : p. 3].

Selecting proposals which consider both price and non-price related factors provides a better opportunity for selecting the proposal which is most advantageous to the Government. Two goals of best value contracting are..." to increase the chance of a successful contract and decrease the chance of a successful protest" [Ref 10 : p. 33]. In order to make this selection, and accomplish these goals, the source selection authority (SSA) or his/her designated representative must make a value judgment. This value judgment requires support from a set of criteria equitably applied to all proposals in the competitive range. This latitude provided to the SSA greatly increases their responsibility and opens the door for formal protests if the source selection process is faulted in any manner.

What does the Federal Acquisition Regulation (FAR) say about best value contracting and the use of Contracting Officer (CO) value judgments? It explicitly encourages the use of best value but falls short of giving an explicit

definition or specific structure to the source selection methodology. FAR 15.605(c) states:

While the lowest price or lowest total cost to the Government is properly the deciding factor in many source selections, in certain acquisitions the Government may select the source whose proposal offers the greatest value to the Government in terms of performance and other factors. This may be the case, for example, in the acquisition of research and development or professional services, or when cost reimbursement contracting is anticipated.

The latitude afforded the contracting officer by the Federal Acquisition Regulation is far reaching. It relies on the CO's personal judgment and experience to implement best value effectively. The lack of specificity in the FAR is where the CO draws his/her judgment authority. Thus far, the judicial system has recognized and honored the flexibility afforded the CO by the FAR [Ref 26 : p. 11].

Judgment is not only critical in the final source selection but equally as important in the initial selection of criteria and their relative importance. These criteria (factors) are key to the source selection process. Each procurement's criteria must be tailored to meet the varying requirements of each type of acquisition. This is a requirement of the FAR, as well as, the requirement to utilize quality as a factor in each source selection [Ref 11 : p. 6]. Tailoring is an important feature since virtually no two procurements are identical in scope. Best value offers the CO an opportunity to best meet the sustainment needs of the end user. This is yet another example of innovation and good business judgment.

3. Impact of modernization initiatives

Modernization of the Army's equipment is of critical importance if the United States is to maintain its capability to project its combat power to

contingency areas and survive in a host of operating environments. Modernization is a continuous process. The aviation community has benefitted from this process, in the last decade, through the fielding of such aircraft platforms as the Blackhawk (UH-60L), the Chinook (CH-47D) and the Kiowa (OH-58D). Each of these modernized systems have significantly enhanced the force's previous capability.

"The modernization investment strategy is threat and resource driven" [Ref 12 : p. 46]. As such, the military encounters unique challenges in the face of a diminished threat and rapidly dwindling resources. It is clear that the acquisition environment is being realigned with regard to changes in threat, the reduction of risk, a new political environment, economic conditions, and declining resources. With these existing constraints in mind, the Army has developed near and long-term modernization objectives. Near term objectives include:

Pursuing material solutions for only the most critical battlefield deficiencies, and to focus the limited, available, long term modernization resources on leap-ahead technology - such as the next generation scout helicopter [Ref 13 : p. 62].

Modernization in the near term will be accomplished by upgrading our fielded equipment to insert modern technology that will provide us with the capability necessary to maintain a decisive combat edge. When upgrades are no longer effective, new systems will be developed, manufactured and fielded [Ref 12 : p. 46].

The Army's long term modernization objectives are focused on the maintenance of technical and tactical superiority. This will have to be achieved with a smaller, better trained, better equipped force.

The Army's long term objectives are designed to avoid technological surprise and maintain overmatch capabilities in lethality and survivability. Prior to investment in new solutions, a review of potential alternate solutions will be considered as possible cost-effective alternatives to a new start [Ref 12 : p. 46].

In order to achieve both its near term and long term modernization objectives, the Army has adopted a set of six guiding principles for this effort. These principles, outlined in the United States Army's FY 93 posture statement, capture the essence of modernization while operating with constrained resources. The principles are [Ref 12 : p. 42]:

1. Continuous modernization.
2. Priority to power projection/contingency capabilities.
3. Modernize by force packages (groupings of units with compatible equipment).
4. Provide maximum lethality and survivability of the force.
5. Optimize readiness and training.
6. Build and maintain balanced force capability.

Throughout the continuous process of force modernization, the acquisition community has the unique challenge of sustaining the existing fielded systems which may, in some cases, have a lower priority of logistical support. Meeting sustainment requirements with constrained resources will force the support priority to shift to modernization efforts. The likelihood of nonavailability of spares will increase as newer systems are fielded and as older technology becomes harder to support as industries focus shifts to current requirements. Diminishing sources of supply will occur as technologies and systems approach the end of their respective life cycles.

4. Impact of the declining defense base

The decline of the United States defense base is a critical issue in the sustainment of the nation's defenses. "American deterrent strategy depends on a healthy industrial base" [Ref 14 : p. 12]. This base is critical not only for the production of major weapon systems but has the potential to affect virtually any

end item utilized in the nation's defense. Based on this premise, military spares, which help ensure the mission readiness posture of fielded systems, appear to somewhat susceptibility to market trends and current economic forces.

With this in mind, an important question to ask is what comprises our defense base? The common misconception is that it comprises only those industries which directly support the production of items for the military Services to use in the defense of the nation. This is a rather simplistic view, and one with which the researcher initially started. Under closer examination, it became clear that this view was too narrow for the scope of the Services requirements.

The defense industrial base generally comprises the same manufacturers that produce goods for the commercial sector. Although a number of companies rely primarily on the Department of Defense as their principal market, few total industries do. The Defense Department buys manufactured goods from more than a quarter million firms, encompassing more than 215 industries. As a result, a legitimate interest in the defense industrial base is inseparable from an interest in the U.S. industrial base as a whole [Ref 14 : p. 13].

After the realization of the actual magnitude of the problem, the next logical question is what has been the catalyst of this decline? The answers to this question are varied and encompass areas which require both industry and Government responses. A comprehensive list of reasons is too lengthy and exhaustive for the discussion required here. The researcher has, however, selected several issues that were noted as recurring themes during the conduct of this research. These causes are: the emergence of peace and the vanishing threat [Ref 12 : p. 51-55], the accompanying reduction in the U.S. defense budget [Ref 15 : p. 18-19], the mounting deficit [Ref 16 : p. 1-12], an increasing dependence on foreign sources [Ref 17 : p. 22-24], adversarial relations between DOD and its vendors [Ref 18 : p. 45, 50-53], and the typical life cycle of military equipment [Ref 19 : p. 11-12].

The emergence of peace and the vanishing threat, whether seen as perceived or actual, is having an astounding impact on the Department of Defense. Its ripple effect can be seen in the questioning of existing military doctrine, the reshaping of the existing force structure, the overseas positioning and provisioning of forces. The emergence of peace, it is plain to see, is unlikely to bring prosperity to the military or the defense industry.

With the U.S. facing mounting debt and vanishing threats, the public and Congress are questioning - and, in some case, refusing - continued buildup of the nation's defense systems [Ref 20 : p. 54].

One of the most visible results of the emergence of peace in Eastern Europe and the end of the Cold War with the former Soviet Union is the declining defense budget.

The changes in the nature of the threat around the world, and the reality of the budget, mean that our defense budgets are going to be leaner in the years ahead [Ref 14 : p. 19].

This decline did not occur overnight, it has been a progressive, iterative process. The procurement portion of the defense budget ... " is half of what it was in 1985 in real dollar terms" [Ref 14 : p. 4].

As a result of this reduction of available funds, priorities for support will have to be revisited. This thesis proposes to the reader that it is logical to assume that priority shifts will result in support for newer systems at the expense of older systems which are at, or reaching, the end of their respective system life cycles. This will have a direct impact on the procurement of spares for these lower priority end items.

The mounting Federal deficit will no doubt be a beneficiary of part of any realignment of Government funding. Growing public sentiment and discontent over this issue will likely accelerate the decline of the defense budget. With the

popular belief in the outbreak of peace and the perception of a less well-defined threat, interest appears to be shifting from defense to the budget's other two discretionary accounts, international affairs and domestics. Additionally, these macrobudget discretionary categories have spending caps imposed on them by the Budget Enforcement Act (BEA) of 1990. These spending caps are strictly enforced through the use of mini-sequesters, which are in effect the reduction of the accounts by the amount it exceeds its cap. [Ref 16 : p. 5]

Confirmation of the shift in budget emphasis can be seen in the FY 92 appropriations for the budget's discretionary accounts.

Total discretionary spending increased about 2.3 percent between FY 91 - 92, with defense having minimal increases in budget authority, 0.9 percent, while the domestic account increased at a 4.7 percent rate [Ref 16 : p. 6].

What really impacts on the discretionary accounts is the requirement of the BEA to meet specified deficit targets for FY 91 - 95 [Ref 16 : p. 5-7]. During this period entitlement programs which are mandatorily funded, are expected to grow over time. These programs include such things as Medicare and unemployment compensation. As these programs expand, the only method of achieving mandatory deficit targets is to cut discretionary spending. The researcher proposes that the preferred method of reducing discretionary spending, given the current environment, is to reduce the defense account. This appears, for the near term, to be the "politically safe" track for politicians to follow in setting their budgetary priorities.

Increasing dependency on foreign sources is another critical concern [Ref 15 : p. 22]. This dependency is eroding the foundation of our industrial infrastructure and threatening our existence as a world industrial leader. The U.S. has already lost significant portions of the domestic market in areas such as

machining and electronics and it has been projected that, "...by the year 2000, the United States could be nearly totally dependent on Japanese supplies of key electronic components and equipment" [Ref 14 : p. 13]. This trend, if not put in check, could have a devastating impact on our ability to sustain ourselves during any future conflict. A scenario could evolve such that the support needed for a particular system could rest in the hands of our adversary.

Adversarial relationships between the Government and its contractors, and the complexity (lack of user friendliness) of the procurement process has increased the number of firms discontinuing or reducing their business association with the Government. Forging working relationships based on trust is imperative today more than ever before. As stated in the July 1988 report to the Secretary of Defense by the Undersecretary of Defense for Acquisition (USD(A)), titled Bolstering Defense Industrial Competitiveness ,

... there is a powerful need to build a cooperative relationship between the Department of Defense and industry that will lower barriers to improvements, enable more effective policy development and implementation, and contribute to the national goal of a strong industrial base [Ref 21 : p. 40].

A study by Dr. David V. Lamm, titled, "Why Firms Refuse DOD Business: An Analysis of Rationale", further validates the assertion that DOD desperately needs to seek methods of strengthening its relations with its industrial partners. Industry should be incentivized to conduct business with the Government. As Dr. Lamm points out in his introductory remarks,

Government red tape, extensive rules and regulations, bureaucratic inaction, and micromanagement of contractors' businesses are but a few of the criticisms leveled at the procurement process. There is a growing belief that as the Government continues to tighten its grip on both contractors and subcontractors through congressional legislation, firms will be squeezed out of the supplier base, unable and unwilling to compete for DOD business [Ref 18 : p. 45].

The message here is clear. The adversarial relations developed over the last few decades are no longer acceptable as a method of conducting business with civilian contractors. New relationships must be forged out of trust and mutual respect.

Lastly, the typical life cycles of military equipment further complicates the problem of the declining defense base. " The acquisition cycle for major weapon systems, as an example, runs anywhere from 8 - 12 years" [Ref 22 : p. 11]. Additionally, a major system can remain in the inventory for 20 to 30 years or longer as is the case with the Army's UH-1, Huey helicopter. It has been in the inventory since 1959 in one configuration or another. In total, the acquisition time and service life of equipment can add up to several decades making logistical support increasingly more difficult over time. As a result, the needs of the military habitually fall behind the technological advances of industry and commercial markets. Defense contractors who continue to support older systems and rely on these alone to sustain themselves are operating on borrowed time. Another key point is that many contractors tend to mix their business between commercial markets and the Government. Over time they find that continuing production of commercially obsolete components, solely to meet DOD requirements, is not advantageous from a business standpoint. The end result of all this is that businesses either exit a market segment, switch product lines within a market segment, diversify, or reduce production of defense products. Any of these choices results in the same outcome - a reduction in the defense base and the potential occurrence of nonavailability.

5. Impact of the military force drawdown

The impact of the drawdown of the U.S. military force structure is intertwined with the impact of modernization initiatives and the declining defense base. All three, in part, if not in total, are a result of our diminished threat. With this factor in mind, the United States Army Posture Statement for FY93 states the following.

The Army shapes its forces to fulfill the U.S. need for a worldwide, sustained land combat capability. Its structure is carefully tailored within manpower and fiscal constraints to optimize warfighting capabilities against the multiple and varied threats to U.S. interests abroad [Ref 12 : p. 39].

Two keys to determining force structure, as outlined above, are manpower and fiscal constraints. The President, in responding to these limitations, has proposed substantial reductions in U.S. conventional forces. Table 2.1 outlines the President's proposal for the Army's base force for FY95 and is contrasted with proposals from other politicians on Capitol Hill.

TABLE 2.1 U.S. CONVENTIONAL FORCES

Army Divisions	Fiscal Year 1990	President's FY95 Base Force	Aspin Alt. A	Aspin Alt. C	Korb
Active	18	12	8	9	9
Reserve	10	6	2	6	4
Cadre	0	2	0	0	0

Source: Program Manager, July-Aug 1992, page 45

If these proposals are realized, sustainability of such a reduced force will be even more crucial than before. However, any reduction in conventional forces will have an associated reduction in its support structure. This equates to a smaller civilian workforce which constitutes the largest portion of the acquisition community. With this smaller workforce, the acquisition professional will have to

be a better educated, more well-equipped individual, capable of responding to varied and unique situations (e.g., nonavailability issues). With the implementation of the Defense Acquisition Workforce Improvement Act (DAWIA), steps are being taken to ensure that this professionalization of the workforce takes place. It appears that the trend of "doing more with less" will be with us for the foreseeable future

D. SUMMARY

Providing the aviation community with its large number of mission critical spares requires thorough planning and execution. The differences between the Army's and DLA's procurement processes and the transition of spares responsibility between these agencies is but one of the many areas of concern in spares availability.

Along with shifting spares cognizance, factors shaping our procurement environment further delineate the boundaries within which acquisition professionals must function. Some of the factors which help to shape the procurement environment and impact on the acquisition and continuous availability of spares are: the Competition in Contracting Act, best value contracting, modernization initiatives, the declining defense base, and the military force drawdown. These factors play a key role in shaping acquisition policy and their significance must be thoroughly understood to function in an efficient and effective manner.

This chapter has, in essence, looked at spares nonavailability at a macro level. The following chapter, a presentation and analysis of research findings, will examine data gathered during the research effort and focus on a more micro level by discussing archival research, interviews, questionnaires, and component

case analysis. It will also describe two current DOD spare parts procurement programs, identify some of the key characteristics of nonavailable components, and will discuss risk assessment and management.

III. A PRESENTATION AND ANALYSIS OF RESEARCH FINDINGS

A. INTRODUCTION

This chapter will present and analyze the information and resources utilized to conduct research on spare parts nonavailability. Data were collected using archival research, personal and telephonic interviews (structured and unstructured), a questionnaire on component obsolescence, and selected component case analysis. Each of these collection methods revealed a variety of considerations and concerns regarding spares nonavailability. These will be discussed in greater detail in Sections B and C.

The remainder of the chapter is comprised of a presentation of two current DOD spare parts procurement programs aimed at resolving nonavailability issues at differing stages of the acquisition process, the identification of the salient characteristics of nonavailable components, a discussion of the assessment and management of risk and a chapter summary.

B. RESEARCH METHODS

This section comprises a summarized presentation of the research data gathered using the following methods of data collection: archival research, personal and telephonic interviews, and a mailed questionnaire. As an aside, an interesting , and in retrospect logical, pattern of data began to appear during this collection effort. Archival research seems to most often provide a macro, or larger issue, type of data while interviews and questionnaire responses focused more on the micro, or smaller organizational level. This recognition might

possible serve some use when attempting to focus or scope other research efforts when a desired level of response is sought. Another interesting point is that a lot of the issues looked at can be seen as timeless and/or cyclical. These issues resurface periodically, are dealt with, and recur at some later date.

1. Archival research

Sources utilized during this phase of research included, the Naval Postgraduate School's Dudley Knox Library, the Defense Logistics Studies Information Exchange (DLSIE), the Defense Technical Information Center (DTIC), an Air Force Institute of Technology periodical listings search, use of trade publications, professional journals, other theses and independent research efforts.

As stated in this chapter's opening comments, this research resulted in the uncovering of macro issues, those of a generalized nature, affecting the entire spectrum of DOD acquisitions. If one were to select a level of responsibility or influence for resolving these issues, they would more than likely rest at the separate Service or DOD level. Issues of this magnitude are not easily resolved, influenced, or impacted on by lesser levels of authority. While all professionals should play a role in resolving these issues, they typically call for "top down" initiatives.

Chapter II discussed, in detail, two areas developed from archival research. The first was the identification of the SAIP and RAMP programs. As spares management tools, these programs were found to be two of the best approaches to resolving nonavailability issues. Each addressed the issue from a different perspective, allowing application of the appropriate process at alternate phases of the acquisition process. The second area of interest that developed

was that of the factors shaping the procurement environment. The most pressing, frequently noted issues were: the impact of the requirement for competition, the impact of best value contracting, the impact of modernization initiatives, the impact of the declining defense base, and the impact of the military force drawdown.

The area of component obsolescence was researched and found to be an area with little available data. The only substantive work found on the issue was a graduate thesis by Lieutenant Commander Elizabeth Ann Tracy titled, "Component Obsolescence: Presentation of a Decision Process for Assessing and Selecting Alternative Solutions Applicable to Major Weapon Systems Production". The focus of the study (Ref 23) was on microelectronic circuit obsolescence, but the issues raised and the solutions proposed are viable alternatives to most commodity areas.

A research study (Ref 24) was examined which focused on reliability improvements in the Army's Light Helicopter program. An interesting twist to the nonavailability issue emerged to the researcher after reading this particular text. The author repeatedly pointed to an anticipated significant reduction in the demand for spares. This reduction was achieved, for the most part, by eliminating the vibrations normally associated with routine rotary wing flight. The key point here is that by engineering in reliability, the potential occurrence of nonavailability is lessened by a similar reduction in the demand for spares. This stresses the point that innovation provides alternative methods of dealing with issues and that the secondary affects of an action can be as beneficial as its original intent. By reducing the requirement for spares, the possibility of nonavailability was also reduced.

Another research effort (Ref 25) on aircraft sustainability was also studied. Its conclusion was that at some point in time, toward the end of a system's life cycle, the cost of supporting that system outweighs the benefit received from continuing to operate or support it. The primary reasons for this increasing cost were: spares obsolescence, spares nonavailability, increasing maintenance requirements, shifting priorities, age of the system, aging technology and the cost to upgrade. Long term support equated to high risk [Ref 25 : p. 1-6]. At some point, retirement from the inventory becomes the only cost effective alternative.

Several articles were found which addressed the situation where unforecast parts were required and only a short period of time was available to procure these parts. This was generally referred to in the literature as parts-on-demand (POD) [Ref 26 : p. 5]. The recurring chosen alternative, to meet this demand, was flexible manufacturing as used in the RAMP program. It was recognized that nonavailability issues occur regardless of the degree of planning and that short-lead time alternatives must be available to facilitate a timely resolution of the issue [Ref 26 : p. 17].

Other areas addressed in research involved the resolving of nonavailability issues through the cannibalization of components (Meyte), the assessment and streamlining of the DOD parts control program (Office of IG), the controlling of contractor delinquent deliveries (Air Force Audit Agency), and the need for interim contractor logistics support during the initial fielding of systems to support spares availability (USAMC).

The availability of material relating to the subject was such that limiting the quantity analyzed was required to keep the research from expanding outside

its original scope. The data evaluated during archival research, when melded together with interviews and questionnaire responses and component case analysis, provided an adequate basis from which to conduct research and draw logical conclusions and recommendations. The material contained in the previous section is representative of the material analyzed during archival research. Many sources were repetitive in nature, outdated due to advances in methods of acquisition or not germane to the central issue addressed by this thesis and as such were not included in the analysis.

2. Interviews

Both telephonic and personal interviews were conducted as part of the research effort. Whenever possible, respondents (subject area experts) were asked to participate in both interviews and as members of the questionnaire pool. In some instances both telephonic and personal interviews were conducted with the same people.

Participants in the interview pool provided, in some cases, rather frank and pointed answers to questions. In order to provide a degree of anonymity to respondents, references to such comments will not be identified in the normal manner. Where applicable, a statement such as, "an interviewed expert stated that ...", will be utilized to identify controversial issues and their associated responses.

A diversity of skills were selected to be in the interview pool. This was done to acquire a larger perspective on the issues addressed as opposed to simply interviewing a large number of like type skills and receiving answers of a lesser variety and from a narrower perspective. Interview sources included the U.S. Army Aviation and Troop Command (ATCOM), the Defense Logistics

Agency (DLA), and Bell Helicopter Textron, Inc. Principal parties interviewed within ATCOM included the contracting, material management, production management, breakout engineering, Huey Product Management and Blackhawk Product Management offices. Principal parties interviewed within DLA included the technical section, aircraft structural components section and policy branch. The contract manager for military spares administration was interviewed at Bell Helicopter Textron, Inc.

Due to the diversity of the respondents' job skills and therefore their differing responsibilities with respect to the issue of nonavailability, interviews were of an open ended nature. Not all respondents were asked the same questions nor were questions limited to those prepared prior to the interviews. This was done to facilitate the generation of answers that were unencumbered by questions which would lead in a particular direction of response. While specific questions were prepared ahead of time, they were asked when appropriate (timing) in the context of the particular discussion. Each interview generated its own unique questions based on the responses given in previous questions. This approach was found to be most advantageous in regard to allowing the respondents, when appropriate, to direct the interview. The researcher, however, reserved the option of redirecting the focus of the discussion when necessary.

Appendix D provides a compilation of the relevant questions and answers from each interview. Responses for the sake of brevity have been summarized, but their intent and content have not been altered.

3. Questionnaire

As part of the research effort, a questionnaire addressing spare parts obsolescence was sent out to various agencies within DOD and to civilian

industry. The questionnaire focused on what the researcher perceived was the most difficult type of nonavailability to resolve. The questionnaire responses validated the researcher's initial impressions regarding the sensitivity of this issue.

The researcher asked twenty-one, general in nature, questions regarding obsolescence which were structured to facilitate ease of answering. As part of the analysis, each question will be individually addressed, in the order they appeared to the respondents.

Unfortunately, due to the low response rate, approximately 6.7% (2 of 30), no accurate consensus of opinion, from a statistical standpoint, could be drawn from the responses. One respondent, after contacting the researcher, answered the questionnaire from the view of nonavailability versus obsolescence. The only respondent to answer the questionnaire in the context it was asked was Bell Helicopter Textron, Inc. The researcher can only gather from the lack of responsiveness to the questionnaire that either an atmosphere of apathy exists regarding spares obsolescence or that the subject itself has been placed in the "too hard" category.

Appendix E provides a compilation of answers to each question. Responses to questions are given in summary form.

C. COMPONENT CASE ANALYSIS

The aircraft platform utilized for the component case analysis was the Army's UH-1, Huey utility helicopter. It has been in the inventory for over three decades in one configuration or another. It offers unique challenges due to its age and the level of technology incorporated into its design.

Five hard-to-acquire components were identified and analyzed to ascertain what led them to become nonavailability issues. The Huey Product Manager (PM) identified these components as recent areas of concern while attempting to provide uninterrupted support for the Huey fleet. The nomenclature and national stock numbers (NSNs) of each of the five components analyzed are provided in Table 3.1

TABLE 3.1 HARD-TO-ACQUIRE COMPONENTS

#	Nomenclature	NSN
1	main rotor yoke	1615-00-757-2905
2	main rotor grip	1615-01-057-1827
3	tension torsion strap	1615-01-063-4016
4	universal control lever	1615-00-829-6855
5	straight headless pin	5315-00-834-1418

Source: ATCOM, UH-1 Program Manager

General information regarding the nonavailability of these components was provided through the Huey PM's office by one of their logistics management specialists. Specific detail was provided through the ATCOM, material management division, UH-1 coordinator, and through numerous telephonic interviews.

The following case analysis briefs will address the five selected components in the order they appear in Table 3.1. Each analysis will consist of identification of the problem, how and when the problem was identified, the root cause of the resulting nonavailability issue, solutions examined, and action(s) ultimately taken to resolve or avoid a break in sustainment.

1. Main Rotor Yoke.

The first evaluated component was the main rotor yoke, NSN 1615-00-757-2905. The difficulty with this component is the new requirement for fatigue testing of the item. ATCOM has been working on meeting this requirement, since it was placed on the item, approximately one and a half years ago.

The requirement for fatigue testing was placed on the component as the result of a safety of flight (SOF) issue. Depot overhaul facilities found excessive wear on the blade spindles of the main rotor hub. Subsequently engineers at ATCOM tightened the testing requirements for the yoke to help prevent the failure of the yoke and other associated rotor system components. This additional testing requirement has turned into a nonavailability issue due to the limited availability of qualified testing facilities. At this time, the Government still has no good solution to the problem and no approved source. Another problem is that there are no fatigue tested, baseline yokes, available to use as a gage to test others against. A procurement has been placed with Bell Textron Helicopter, Inc., but deliverables will not be received until sometime in calendar year 1993. Once these items are received, the issue is not completely resolved. Tightened tolerances will require the adjusting of depot level overhaul rates, which will increase as a result of these new requirements. The depot overhaul rate, known as the depot overhaul factor (DOF), is a means of forecasting component requirements. A DOF is expressed by a quantity per end item and a percentage of how many are required per a given number of end items overhauled. For example, there is one yoke for each main rotor hub (end item) and if historical data support the need to replace 48 out of 100 overhauled hubs, then the DOF

for yokes is 0.48. That is, the number of end items overhauled \times DOF = the number of repair parts required per year.

Most components of this type have a multi-year lead time which must be factored into forecasts. In addition to routine requirements, safety stock and mobilization requirements must be brought back up to requirement levels as well. As a result, any change in forecasts can significantly impact the capability to adequately supply the needed component. It can take years to fully recover from the effects of such a change given the quantity of items needed and the capacity available to meet that need.

Careful coordination between the parties involved in the management of spares (e.g., material management, contracting, quality assurance, engineers, etc.) is paramount so that the best management decisions are made when issues such as the main rotor yoke requirement occur. It is simply not good enough for a decision to be made without input from all knowledgeable sources. Decisions of this magnitude could potentially ground an entire aircraft fleet, for an indefinite period of time. Such a grounding could severely impact unit mission readiness. The following types of questions need to be asked prior to making decisions with potentially adverse impacts.

1. Is this a valid requirement and why was it not required earlier?
2. Was the incident prompting this change an isolated incident?
3. What is the impact of this decision on current procurements?
4. Are there other alternatives available?
5. How will mission readiness be affected by this decision?
6. Has input from all affected parties been received and evaluated?

2. Main Rotor Grip.

The second evaluated component was the main rotor grip, NSN 1615-01-057-1827. As the nomenclature indicates, this is the attachment point of the main rotor blade to the main rotor hub. In this case, the component itself was not the direct source of the issue. The problem evolved out of a depot overhaul requirement to remove excess corrosion from aircraft main rotor grips taken off aircraft undergoing airframe overhaul. During the overhaul process, engineers at Corpus Christi Army Depot (CCAD) had observed the occurrence of frequent excessive corrosion on main rotor grips. In order to remove this corrosion and return the component to stockage, the process of shot-peening was chosen as the best solution. In non-engineering terms, this process is similar in concept to sandblasting. The consequence of not completing this, or a like process, could render the blade grip unserviceable if it failed to be within inspection parameters thus causing disposal action. While this process was not required for all overhauled grips, its occurrence was frequent enough that it was felt that total requirements for the process could potentially disrupt the overhaul of aircraft and result in a significant work backlog.

Additionally, the shot-peening process did not guarantee the grip would be made serviceable. A small quantity of grips required a level of processing which rendered the blade grip walls too thin to remain in a serviceable status. As a result, even after processing, disposal of a small portion of overhauled grips was necessary.

Unfortunately the ability to perform shot-peening in-house was not possible. CCAD had to find an outside source to perform the work. The administrative leadtime to find a source was longer than anticipated. It took

roughly one year to find a source (out of Houston, Texas) and contract for the service and an additional 19 months to begin delivery of processed grips. During this time the parts system ran out of issuable stock. At this point, aircraft that did not require the process were overhauled and returned to the fleet. Others, requiring shot-peening, were put back into service as serviceable grips became available.

In this case, as with case five, a series of unrelated events culminated to produce a nonavailability situation. The events that contributed to this situation were, the occurrence of an unplanned requirement to remove corrosion from main rotor grips, the lack of in-house shop capability to perform the required task, and the lower level of priority placed on the Huey versus other higher priority aircraft such as the UH-60 (Blackhawk) and the AH-64 (Apache).

3. Tension Torsion Strap.

The third evaluated component was the tension torsion strap, NSN 1615-01-063-4016. This item is a component of the main rotor system which dampens main rotor blade oscillations. This item is a field replacement item and as such requirements from both the unit and intermediate levels as well as depot level facilities must be met. The item has a finite life and must be periodically replaced. The difficulty with this component was the potential lack of a qualified source of supply as a result of the prime contractor serving notice to the Government of their intent to discontinue the components manufacture. The Government has relied on this single source of supply for quite a few years and had made no provisions, at the time of notice, to identify another component source. Another interesting twist was that this original equipment manufacturer (OEM) had qualified himself as a source of supply at his own expense.

What caused this notice of intent to be served? The company had recently come under new management and had made a fundamental business decision to discontinue the manufacturer of the tension torsion strap and to refocus its work effort. At the time the notice was served, there appeared to be an adequate number of items on-hand, stocked at various locations at depots and in the field, to meet near term requirements. As of 23 October 1992, there were 3000 components on-hand. Since the notice, no additional orders for tension torsion straps have been placed. Although quantities on-hand were adequate to provide for short term needs, the potential existed for the exhausting of stocked supplies in the out years resulting in a nonavailability issue. As with most other rotor system components, lack of a qualified source of supply would lead to the grounding of aircraft as the requirement to replace these items occurred. Unlike other components evaluated, this situation had little or no immediate effect on the aircraft fleet and provided an opportunity to aggressively pursue corrective actions.

The only option available to correct this deficiency was to find and qualify another source of supply, a process that is not as simple as it sounds. After a considerable period of time, the Government was able to accomplish this task. Much to the dismay of the Government, about this same time, the OEM expressed a desire to reenter the market and again supply the component, a complete reversal in the stance expressed in its earlier notice of intent. This resulted in the need to compete the requirement, further adding to the time necessary to resolve the nonavailability issue. Administrative and manufacturing lead times were now a critical part of the acquisition.

As of the time of this research, ATCOM was still in the process of resolving the issue. One of the key points to be taken away from this scenario is that there are positive aspects of having more than one identified and qualified source of supply for components. Relying on a single source, regardless of the economies of scale realized through economical order quantities, can prove to be a serious planning shortfall when a prime contractor makes a business decision which impacts on component availability. The benefits of single sourcing from the OEM or breaking out the requirement to more than one source must be closely examined during acquisition planning and sourcing decisions.

As a result of nonavailability issues, the Army, as part of their Spare Parts Reform Program, came out with the Spare Parts Review Initiatives (SPRINT). These initiatives sought to streamline the acquisition process, focus more attention and planning on spare parts procurement, and help ensure the availability of spares (Appendix C). SPRINT initiative 3: Implement Defense Acquisition Supplement No. 6 "Breakout", and initiative No. 4: Eliminate disincentives on industry to breakout, specifically address the nonavailability issue raised by the inadequate number of sources of supply for the Huey's tension torsion strap.

4. Universal Control Lever.

The fourth evaluated component was the universal control lever, NSN 1615-00-829-6855. This item is a component of the main rotor control system. After looking at four hard-to-acquire components, all of which are from or associated with the main rotor system, a trend seems to appear.

The problem with this component arose out of the small business (SB) portion of the contract. In order to comply with small business and small

disadvantaged business (SDB) goals, certain portions of work on noncompetitive procurements were set-aside for these businesses. In compliance with these goals, half of this contract was awarded to a small business.

What eventually led to a nonavailability issue was poor quality control on the part of the small business. As part of the manufacturing process, the universal control levers have to be baked (heat treated) at a predetermined temperature and for a predetermined time. This procedure, if done properly, eliminates the possibility of hydrogen impregnation of the metal, otherwise known as hydrogen imbrittlement. If the procedure is not performed properly, the metal becomes impregnated with hydrogen, becomes brittle and is easily fatigued under rotor system operating conditions. At some point, which can not be determined, the component would fail.

The second problem with hydrogen imbrittlement is that it is not detectable until it occurs or is found during inspection (most likely during daily, preflight or post flight inspections). In this situation, the imbrittlement was not discovered until the items were received and shipped out worldwide. It was ultimately discovered by personnel in the field after several component failures. After investigating these failures, it was determined that only one or two lots were found to be defective, all from the same vendor.

How did this lack of quality control occur? The vendor in question had historically provided quality products to the Government. With this fact in mind, no preaward survey had been conducted to confirm the vendor's capability to perform the work. After the situation developed, the Government provided the contractor an opportunity to correct it's deficiencies but they were unable to do so

to the Government's satisfaction. Subsequently, another vendor was located and awarded the contract.

From the time the hydrogen embrittlement was discovered up through the time another vendor was located and awarded the contract, backlogs totaling 5000 + components piled up. The universal control lever is a heavy use component, with requirements totaling 55 - 60 per month. At an average high of 60 per month this could have worked out to a backlog of approximately 83.3 months if the contract had not been split. Situations such as this lend strong support to the idea of the multiple sourcing of requirements. Because of the use of two vendors, the backlog, although still large, was made more manageable.

5. Straight Headless Pin.

The fifth, and last, evaluated component was the straight headless pin - main rotor system, NSN 5315-00-834-1418. These pins hold the tension torsion straps in place on the main rotor hub. There are four on each hub, with two going to each tension torsion strap.

As will be seen, this scenario, like the previously discussed main rotor grip, developed as a result of the cumulative affect of unrelated events that all occurred in close proximity to each other. There were three separate events that led to the resulting issue. First, the contractor manufacturing the component went out of business. This forced the Government to acquire another source of supply to meet requirements for the item. Second, the item was declared a finite life item, drastically changing the quantity requirements for the component. Up to that point, they had been replaced if and when it was declared out of tolerance during the overhaul of the aircraft. With the new requirement, they were changed regardless of condition at a predetermined, tracked time interval. The

third, less serious factor, the requirement to place serial numbers on the pin, necessary for tracking of finite items, also caused some delay. This delay, however, ran more or less concurrently with the first two factors.

The straight headless pin was a field replacement item with requirements coming from all maintenance levels. During the resolution process, backorders totaling into the thousands were accumulated. Total monthly requirements for the pin averaged 150 - 160 items. After a new contractor was located, qualified and awarded new replacement items began to enter the system and began working off the backlog.

The finite item requirement was addressed as follows. Non-serial numbered items that were already stocked but not installed (condition code A) on aircraft were etched, with an allocated serial number, at the level they were stocked at and were tracked from that point as new stock. Items installed on aircraft were given an arbitrary remaining life figure and tracked from that point. The arbitrary time applied to all pins within category regardless of the actual time of use. New components coming out of production were stamped, on the pin head, by the manufacturer.

D. CURRENT DOD SPARE PARTS PROCUREMENT PROGRAMS

The purpose of this section is to provide an overview of two innovative procurement methods, whose purpose is to provide for the continuous sustainment of spare parts (spares) throughout a system's life cycle. The two methods identified, focus on different phases of the procurement process to achieve their intended result. They also both offer practical solutions to the problem of spares nonavailability.

The remainder of this section will consist of: the development of background information relevant to the subject (showing the critical role spares play in the overall acquisition process), the discussion of a typical life cycle scenario, the discussion of the Spares Acquisition Integrated with Production (SAIP) and the Rapid Acquisition of Manufactured Parts (RAMP) procurement methods (listing their advantages and disadvantages), and lastly an assessment of the best use of these methods and a determination of their effectiveness.

1. Background.

Spares traditionally comprise the largest portion of overall fiscal year procurement expenditures. A recent General Accounting Office (GAO) report on Air Force spare parts showed that 62 percent of Fiscal Year 1988 procurement expenditures were utilized to procure spare parts [Ref 27 : p. 11]. Once systems go into full scale production and are deployed to units in the field, the criticality of spares availability increases. Availability is also critical prior to fielding, because a viable logistics support base must be in place to sustain the system once it is initially put into service.

Life cycles of technology, and subsequently the systems we procure, are other key elements to consider when looking at questions such as when and how to procure spares. The life cycles of technology and military equipment contributes additional complexity to the diminishing military spares (DMS) problem. The acquisition process alone runs from 8-12 years for many weapon systems. However, technology is improving so rapidly that the typical advanced component stays out front for less than five years, creating a likelihood that there may be a nonavailability problem by the end of the acquisition cycle [Ref 19 : p. 11].

2. Typical Life Cycle.

As the life cycles of technology and systems peak and begin their decline, the issue of spares availability is virtually guaranteed to become a more pressing consideration in the sustainment process. Figure 3.1, below, illustrates the typical life cycle of a new technology and the associated disparity between the requirements of the civilian and Government sectors [Ref 19 : p. 12].

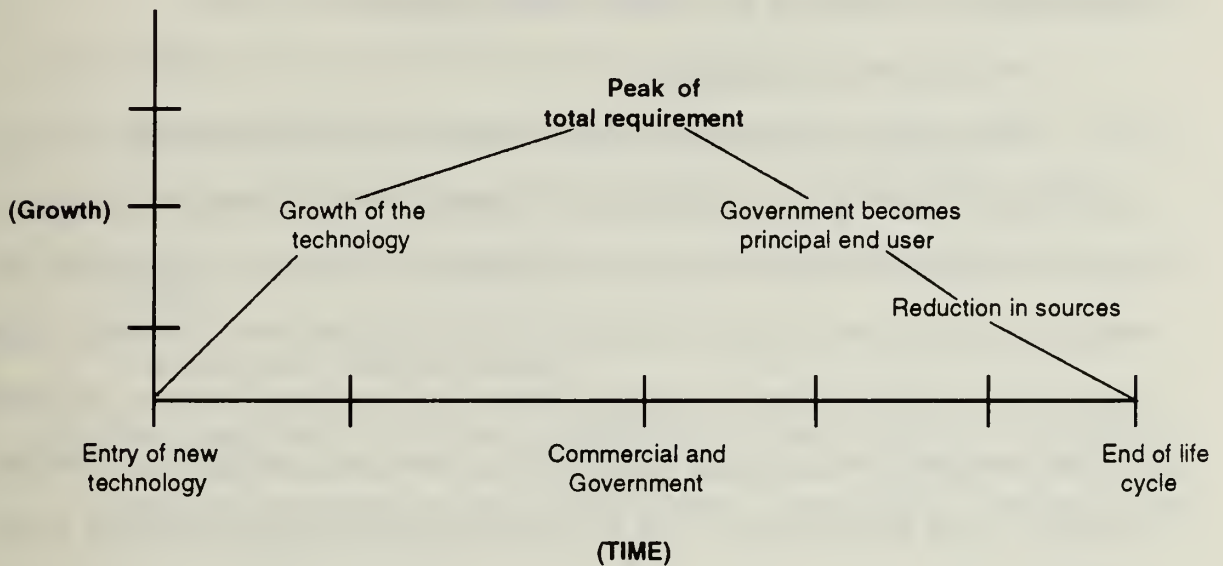


Figure 3.1 Life Cycle of a Technology

As Figure 3.1 indicates, as technological changes occur, the total requirement for old technology and systems is greatly diminished. In several cases the Government is the only customer for such items, due to the length of time the equipment is retained in inventory (e.g. the Army UH-1 helicopter has been in the inventory since 1959, in one model or another). From an economic standpoint, it is hard to persuade industry to maintain sources of supply for critically needed spares when two of their primary motives for being in a

particular industry, profit and return on investment, are seriously impacted due to industry-wide trends. The competitive nature of the market place demands that a company's resources be directed towards more lucrative, newer technologies. With the declining defense budget, a large number of prime contractors and even a larger share of subcontractors are concentrating on the commercial market to maintain an overall increased market share. It is apparent that this trend is making it increasingly more difficult for the Government to influence or direct technology, as it has done in the past to some degree.

3. Procurement Methods.

This section will address two innovative procurement methods which can be utilized to help ensure the availability of spares during a weapon system's life cycle. The two methods addressed are Spares Acquisition Integrated with Production (SAIP) and Rapid Acquisition of Manufactured Parts (RAMP). These methods are utilized during separate phases of the acquisition process and each requires adequate and accurate prior planning to ensure its effective and efficient utilization. The SAIP program will be addressed first, followed by the RAMP program.

a. Spares Acquisition Integrated with Production.

Spares Acquisition Integrated with Production was first developed by McDonnell Douglas Corporation [Ref 28 : p. 3]. It came about as an attempt to realize the monetary benefits of manufacturing parts utilizing economies of scale. The Air Force subsequently began utilizing the procedure, though not as effectively, in its procurements of the F-15 and F-16 fighter aircraft. Its later procurement of the A-10 proved to be more satisfactory than its previous applications, due to more adequate planning and a more thorough understanding

of the underlying SAIP principles [Ref 28 : p. 2-4]. The SAIP program is a concept designed for acquiring initial and follow-on (replenishment) spare parts to support DOD weapon systems at the least cost to the Government. It is a pre-availability tool. Conceptually, SAIP holds down the cost of spares by avoiding the expense associated with separate material orders. Spares costs can be reduced if separate set up and acceptance/test procedures can be avoided by the contractor [Ref 29 : p. 4].

There are five principles which are essential to the successful implementation of the program. These principles are:

1. The concurrent ordering and release of initial spares with installed orders.
2. The use of firm fixed-price contracts or Not To Exceed (NTE) pricing.
3. The initial spares must meet current configuration requirements of the aircraft.
4. The use of firm order quantities.
5. The application of the procedure to new production programs estimated to cost \$300 million or more and any new modification program estimated to cost \$100 million or more which requires initial spares support [Ref 28 : p. 1-2].

In applying the SAIP program one of the biggest concerns is the possibility of component obsolescence. In order to preclude procuring a large number of such items, the single most important factor is the "Stability of design" of the required item. With the primary objective of the SAIP program being cost reduction, such risk analysis and management is critical so as not to nullify the possible benefits derived from the program. An option to minimize the possible cost of obsolescence is the inclusion of a contractual clause, such as the one utilized by the Air Force in the procurement of its A-7 spares. This clause required that approved Engineering Change Proposals (ECPs) be incorporated

into both production and initial provisioning spares; if not the spares would be declared defective [Ref 29 : p. 9]. A clause of this type could be used when a component's design stability was in question and the use of the SAIP program was highly favored. Prior to including such a clause, one must carefully consider the possible negative effects such a course of action might have on a contractor's willingness to come forward with contractor proposed ECPs [Ref 30].

According to the Air Force, when properly applied, the SAIP program offers advantages to both the contractor and the Government. These advantages are as follows:

Contractor advantages: [Ref 28 : p. 5]

1. Reduced cost through the use of economies of scale with its subcontractors.
2. Reduced number of production starts and retooling/setup requirements and their associated costs.
3. Consolidation of orders to allow for more efficient production planning.

Government advantages:[Ref 29 : p. 10] , [Ref 28 : p. 5]*

1. Reduced acquisition cost.*
2. Timely delivery of properly configured spares.*
3. Reduction of Not Mission Capable Supply (NMCS) rates and increased unit readiness rates.*
4. Reduced requirement for contractual monitoring, measurement, and negotiation.*
5. Benefits of centralized procurement.*
6. Reduction of risk through the use of firm fixed-price contracts.

It is easy to see that, when properly utilized, the SAIP program is highly advantageous to all parties involved. However, its use requires the cooperative efforts of industry and the Government. Buying spares in advance of need and in larger quantities than demand indicates, requires a carefully calculated requirements determination. The Government makes this call based on contractor input, in-house assessments, and historical data on like or like-type components.

Finally, consideration must also be given to the number of components to fall into this category of procurement.

Ideally, the SAIP items selected should comprise only from 10 - 15 percent of the total initial spares, but should represent a large share of the initial spares investment (from 65 - 75 percent). This provides intensive management of the most significant cost-driving spares [Ref 29 : p. 12].

b. Rapid Acquisition of Manufactured Parts.

The second program to be examined is the Rapid Acquisition of Manufactured Parts (RAMP) program. It is a maturing Navy-funded Research and Development (R&D) program whose primary objectives are the reduction in cost and shortening of lead times for selected hard-to-acquire parts and assemblies. The Navy's RAMP Strategic Implementation Plan gives a further explanation of the program.

In the narrowest sense, it is a self-contained machine shop enterprise, run by software, which can produce on demand from prepositioned raw materials and digital parts data. In the broadest sense, RAMP is a group of concepts: flexible manufacturing; globally linked and integrated data bases; paperless logistics channels; and alliances of manufacturers and customers [Ref 31 : p. 8].

The RAMP program implementation has been organized into three phases. Phase one (1986-1993) consists of proving that RAMP related

technology can be used to manufacture hard-to-acquire parts. Phase two (1992-1995) consists of a technology transfer within the Navy and DOD. Phase three (1993-2010) consists of a technology transfer to industry. Movement from one phase to the next is predicated upon a positive cost/benefit analysis of the previous phase.

Unlike SAIP, which is a pre-nonavailability management tool, RAMP focuses on post nonavailability issues. It comes into play once a requirement is identified that demands a reduced lead time.

RAMP uses part specifications in computer readable format in a computer integrated manufacturing (CIM) and a flexible manufacturing system (FMS) environment to produce a wide variety of high-quality, low-cost parts with lead times which are about one tenth as long as current procurement channels [Ref 32 : p. 3].

In addition to the reduced cost and shortened lead times, RAMP is anticipated to also improve unit readiness, integrate advanced computer technology into the Navy, establish procedures and capabilities to communicate requirements and specifications to automated manufacturing facilities, lead to the installation of FMS cells in the Navy industrial activities and to reduce the Navy's wholesale spare parts inventory level.

In order for RAMP to achieve these goals, several critical elements must exist. First, part specifications in computer readable format must be available, able to be updated and transferable.

Most existing parts technical and engineering data is in two dimensional (2-D) paper drawing format. For RAMP to function properly, three dimensional digital product model data must be provided to the Navy by its contractors [Ref 27 : p. 15].

Second, adequate economic incentives must be available for industry to gain their support. Incentives such as commercial applicability (spin-off) of

developing FMS facilities, the value of Government technology transfer and sustained use of established FMS facilities. Last, CIM/FMS facilities must be available to perform the required manufacturing tasks.[Ref 33]

FMS, while a departure from the normal manufacturing process, is the wave of the future for batch manufacturing. It is particularly well-suited to medium and small batch manufacturing, the production of lot sizes usually associated with defense industries [Ref 33 : p. 20].

In the current environment of reduced budgets and force drawdowns, the need for ensuring the availability of spares to maintain force readiness will become more and more critical. Continued modernization efforts will shift the focus (e.g. budget) from older systems and further complicate their sustainment. Innovative procurement techniques which provide an economic advantage while maintaining product quality will be of particular interest.

The Spares Acquisition Integrated with Production (SAIP) program, as a pre-nonavailability management tool, offers distinct advantages in weapon system sustainment. This program has been found to be extremely effective in meeting its goals of cost reduction, timely delivery, and configuration control. The key to successful use of the SAIP program is design stability. When a design stable procurement is made using SAIP there has been, according to research, no increased incidence of obsolescence as originally feared by its opponents [Ref 29 : p. 29-30]. By all accounts, SAIP has proven itself to be a viable tool in spares availability management.

The Rapid Acquisition of Manufactured Parts (RAMP) program, as a post nonavailability management tool, also offers unique advantages in weapon systems sustainment. Its ability to rapidly produce small batch, hard-to-acquire parts at a reduced cost makes it a prime candidate for acquiring short lead time

requirements. Indicators from initial test sites at Naval Aviation Depot (NADEP) Cherry Point, Naval Administrative Center (NAC) Indianapolis and Naval Shipyard (NSY) Charleston show that the program is meeting its milestone requirements as indicated in the RAMP Strategic Implementation Plan [Ref 27 : p. 33].

4. Assessment.

It is the researcher's conclusion, that when properly utilized, both the SAIP and RAMP programs offer DOD the types of spares management tools which will help ensure the timely and cost efficient acquisition of spares, which in turn will help to maintain and/or increase unit mission readiness. Procurement innovations such as these will become increasingly more critical in our current operating environment and in the future.

E. CHARACTERISTICS OF NONAVAILABLE COMPONENTS

It is an assertion of the researcher that the ability to proactively preclude the occurrence of spare parts nonavailability is the best defense against such issues. In order to facilitate this proactive approach to spares management, the identification of the salient features (characteristics) of nonavailable components is necessary. While not all inclusive, the following list provides an identification, and subsequent discussion, of those features which appear to correspond with the occurrence of spares nonavailability. This list of characteristics is the result of an analysis of the researcher's gathered data and personal experience as an Army aviator and reflect his original thought. Any similarity in thought, to other researcher efforts on the subject, is purely coincidental and should serve to validate prior conclusions drawn by other researchers.

The proposed salient features of nonavailable components, identified through an analysis of gathered research data are:

1. Technical complexity.
2. Lack of design stability.
3. Lack of interoperability and commonality.
4. Long lead-times.
5. Finite life criteria.
6. Time in the inventory/level of technology.

While these salient characteristics do not apply to every nonavailability occurrence, their frequent appearance seems to indicate a pattern which could be used to identify and target possible future areas of concern in spares availability.

1. Technical Complexity

Unfortunately for the material manager, contracting personnel, and others charged with maintaining spares availability, most aviation components, by nature, are more technically complex than other systems (e.g., ground vehicles) [Ref 3]. Examples of this complexity are: the tightened tolerances placed on bearings in the main rotor system due to vibration and balance requirements and the increased tensile strength requirements for bolts in the main rotor head assemblies due to the forces/stresses placed on the main rotor system during normal operating conditions. The point to be made here is that technical complexity equates to time. Long periods of time are generally required to resolve nonavailability issues for technically complex items. The more technically complex an item is, the harder it is to manufacture and the harder it is to procure. As a simplistic example: it would be considerably easier to acquire a washer for a starter bolt of a jeep than it would be to acquire a washer for virtually any component of a helicopter's main rotor system. The engineering

requirements placed on these two components are simply not the same and are based on different operating conditions and configurations. Technical complexity not only addresses the issue of time but also that of cost. Entering an era of declining budgets is sure to pose challenges in sustainment, particularly in the area of unforecasted spares requirements resulting from such things as aircraft modernization and safety of flight issues. Simply stated, technically complex components require more thorough planning to ensure continuous availability.

2. Lack of design stability

Components that are not design stable or are pushing the state of the art tend to generate more changes than do design stable components [Ref 30]. Changes, if not planned for, can easily result in component nonavailability. Lack of design stability introduces an element of risk into the procurement of any system or its components. The probability of change, and increased risk, is greatly enhanced as the design is refined. Conversely, as the design is refined, design stability is built into the component. In some respects design refinement is a double edged sword. While generating initial changes, it most often results in stability over time. Almost any aircraft platform that has been in the inventory for any number of years has gone through several model changes. These upgrades are generally a result of technical advances allowing the design to be refined to better meet evolving mission requirements. [Ref 30]

3. Lack of interoperability and commonality

The researcher sees lack of interoperability and commonality as major shortfalls in our past integrated logistics support (ILS) planning. While overall aircraft design differences are a fundamental function of differing mission needs, interoperability and commonality of components appears to have only been given

a cursory look. An example where commonality was incorporated into aircraft design was the hydraulic pump system for the UH-60 Blackhawk, utility helicopter. On this aircraft, its three hydraulic pumps, the number 1, 2, and backup hydraulic pumps, are all interchangeable. This flexibility was designed into the system allowing the positioning of the pump in any one of three separate locations. The lack of such commonality in design would require the procurement and implied availability of three separate hydraulic pumps to replace what one could do through innovative design.

Interoperability and commonality not only enhance the chances of component availability, due to fewer required separate components, it also allows the ordering of components in more economical order quantities, reducing the overall life cycle cost of an end item. [Ref 30]

4. Long lead-times

As was illustrated by the component case analysis of the Huey utility helicopter, every component, regardless of the circumstances originally leading to nonavailability, ended in a long lead-time situation. This has two root causes. The first is the cumbersome procurement process and the failure to prequalify alternate sources of supply. If a single source of supply is used to provide an item and that source, for whatever reason, is unable or unwilling to continue to do so, the burden of acquiring another source of supply falls to the Government. If no other sources are known, the process of soliciting, locating and qualifying a source(s) of supply begins. As a general rule of thumb, from historical experience, this takes approximately 18 months [Ref 34]. During this time, if sufficient stocks of supply are not already on-hand, serious shortfalls in

availability can occur. This has a severe impact on unit mission readiness for the affected system.

The second cause is the time required after contract award to attain a sustained operating rate at full production. The ability to attain this level of work is directly related to the manufacturer's past experience in the field. If he/she has manufactured like items, the time required to achieve full production is greatly reduced, as the learning curve rapidly shallows out in slope. The less experienced manufacturer will require additional time to meet production goals.

Once production begins, the task of working off the backlog of orders for parts begins. The nonavailability issue is not resolved until all backorders are filled, adequate replenishment stocks are on-hand to meet estimated demand and a source of supply is available and contracted with to continue the production of spares.

5. Finite life criteria

An item has a finite life when it must be replaced at a predetermined time regardless of its materiel condition at that time. In the case of aviation components, finite life is measured in hours logged on a particular component from the time of its installation on the airframe.

Finite life component criteria is not a serious problem, if it is planned for. The problem arises when a component that has traditionally not been a finite life item, has that criterion placed on it as a result of changing replacement requirements. An example of this situation was the straight headless pin - main rotor system component case discussed earlier in this chapter. Declaring a component a finite life item drastically increased the replacement requirements for the component. As an illustration, an item that might have lasted 500 hours

before its replacement was required might now be mandatorily switched out at 250 hours.

The first two questions to ask in this situation are: does the manufacturer have the plant capacity to increase production to meet the new demand? and does the manufacturer desire to increase its level of work? If the answer to either of these questions is no, the Government is again facing an eventual nonavailability issue. The Government will either have to incentivize the manufacturer to invest in plant and equipment to meet the increased demand or will have to acquire another source of supply.

6. Time in the inventory/level of technology

As a generalization, the longer a system is in the inventory, the more likely it or its components will face nonavailability. This issue, basically that of a system life cycle, was previously discussed in Section D of this chapter. The point was made that as military equipment, of a given technical level, is retained in the inventory, the use of that technology in the commercial market will probably decline because new technology is being introduced. The commercial market traditionally cycles through technology quicker than the military. As a result, the military ultimately becomes the principal user of that technology. Unless a manufacturer is primarily a producer of military equipment, or is incentivized to continue production, the likelihood of diminishing sources of supply for technologically obsolete equipment is greatly enhanced. This is a stage of the system's life cycle when component obsolescence can become an overwhelming burden.

At the risk of sounding repetitive, the current environment we operate in and the forces shaping that environment, will have an impact on manufacturers'

decisions to stay in or divest themselves of interest in the defense industrial base. Also, as the defense budget continues to get “nickel and dimed” to meet domestic and entitlement programs, the incentives for manufacturers to remain business partners with the Government will likewise diminish.

Another point is that as systems remain in the inventory, the focus of resources shifts to newer systems, either modernized systems (e.g., OH-58D observation helicopter) or new entries (e.g., AH-64A attack helicopter). This shift in resource allocation impacts areas such as authorized funding, personnel, and priority of work effort. Admittedly, this shift in focus is logical and is to be expected considering our current level of resourcing. Available resources, through careful planning, must be put to their best use in order to provide the necessary level of support required until such time as the system is eliminated or retired from the inventory.

F. TOTAL RISK ASSESSMENT AND RISK MANAGEMENT

Total risk assessment and management is a critical element of any acquisition and should be incorporated into all phases of planning [Ref 30]. The value and necessity of initiating these actions early in the acquisition planning can not be overemphasized. The assessment and management of risk is an evolutionary process that changes focus as the procurement environment also undergoes change. It is not simply an initial assessment that, once acted on, remains unchanged throughout the life of the acquisition.

Risk management includes an analysis of tradeoffs between cost and benefit, particularly during periods of constrained resources. The optimization of resources is a key issue in program support (e.g., sustainability). For example, if the last 5% of something were to account for 90% of the cost of an item, that last

5% would more than likely be judged as not being cost effective or worth the cost risk involved, unless it was critical to achieving the stated requirement. This is the same type of thought process involved with spares management. Trade-offs must be made to provide the necessary type and level of support required (e.g., does the additional surety of maintaining spares availability by having two sources of supply for a critical component outweigh the cost increase in not being able to order in more economical order quantities from one vendor?).

As stated earlier, risk is assessed at various stages of the acquisition process and by various means. As a part of risk management, in the area of major weapon systems acquisition, the Integrated Program Summary is prepared by the Program Executive Officer (PEO) to facilitate acquisition milestone decisions [Ref 35 : p. 4-1]. A portion of this summary is devoted to an affordability assessment of the support requirements of the acquisition, to include the procurement of spares [Ref 30]. Affordability is assessed at each Milestone Decision Point (MSDP) beginning with Milestone I [Ref 36 : p. 4-D-1].

Risk is also addressed throughout the Integrated Logistics Support (ILS) planning process. The policies and procedures outlining ILS ensure:

1. Support considerations are effectively integrated into the system design; and
2. Required support structure elements are acquired concurrently with the system so that the system will be both supportable and supported when fielded [Ref 36 : p. 7-A-1].

As part of ILS planning, the use of the SAIP program is integrated into the procurement when determined to be cost-effective. SAIP, addressed earlier in the chapter, is one of the Government's pre-nonavailability management tools. Support risk, when properly assessed and managed, can be minimized to avoid or offset the effects of spares nonavailability (e.g., the use of SAIP). The

cooperative efforts of the Government and its contractors are required to achieve these ends.

G. SUMMARY

This chapter has provided the reader with a presentation and analysis of research findings. This was achieved by presenting the reader with the data gathered during archival research, personal and telephonic interviews, a mailed questionnaire, and selected component case analyses. During research, two current DOD spare parts procurement programs were found to be applicable to this study and were also presented in the discussion.

As the chapter transitioned from the presentation of findings to an analysis of findings, several areas of interest were developed. As research was conducted, a list of the salient characteristics of nonavailable components was developed. It was shown that an understanding of these characteristics could serve as a useful tool in the proactive prevention of spares nonavailability. If not prevented, this method of analysis could lessen the severity of nonavailability issues by allowing a reasonable projection of their occurrence.

The last area discussed in the chapter was total risk assessment and management. As a part of total program performance, the importance of risk management can not be overstated. Thorough risk management can prevent crisis management. However, all too often, nonavailability issues fall into the latter category. It was also pointed out that risk management is an evolutionary process in that it is reevaluated and changed, when necessary, throughout the course of the procurement.

The following chapter, alternative actions, will discuss those actions which procurement personnel can take, at various stages of the acquisition process, to

help preclude or respond to the occurrence of spare parts nonavailability. These stages are broken down into pre-nonavailability actions, post nonavailability actions, and generalized actions.

IV. SPARES IMPEDIMENTS AND ALTERNATIVE ACTIONS

A. SPARES IMPEDIMENTS

After a thorough examination of the research data, it was evident that a myriad of impediments to spares availability existed. Some of these impediments were found to be controllable while others were found to be outside direct control. The latter were generally circumstances driven by prevailing global economic and political factors.

Impediments were categorized, by the researcher, as either pre-nonavailability or post nonavailability issues. Resolution of these issues was further categorized as the responsibility of the Government, its contractors or outside either parties' control.

The sheer volume of possible factors contributing to spare parts nonavailability is enormous. The procurement environment is so complex and dynamic that preparing for all possible eventualities is an ominous task. The following lists of pre- and post nonavailability impediments, identified as a result of interview and questionnaire responses, are representative of the challenges facing the acquisition community.

1. Pre-nonavailability Impediments

The researcher has defined pre-nonavailability impediments as those which can be either partially or completely controlled during the acquisition process up to the point of contract award. Those impediments identified as pre-nonavailability issues are listed below and are accompanied with an analysis of their relationship to the issue, which shows how they tie into the research effort.

While these impediments were identified during research on aviation spares nonavailability, they are not commodity specific and have applicability in many commodity areas.

1. Poorly structured contract elements.
2. Poor Integrated Logistics Support (ILS) planning.
3. Faulty source selection process.
4. Quality of the workforce.
5. Faulty specifications.
6. Lack of coordination among interagency departments.
7. Disconnect between funding and what demand history supports.
8. Maintaining tooling for older systems.
9. Obtaining current Technical Data Packages (TDPs) for breakout.
10. Factors shaping the procurement environment.
11. Politics.
12. The cumbersome procurement process.
13. Requirement for competition.

The thirteen pre-nonavailability impediments, listed above, are all controllable by the Government with the possible exception of number ten. This impediment is outside the area of reasonable control of those individuals normally responsible for ensuring the effective and efficient operation of the procurement system. It is also outside the reasonable control of industry.

a. Poorly structured contract elements

This issue was raised by both questionnaire and interview respondents. It was also emphasized on several occasions during archival

research. The vast majority of respondents expressed a concern over the need for current, accurate, and complete TDPs, This area was not addressed during component case analysis.

Poorly structured contracts (e.g., lack of appropriate clauses) can be a significant contributor to nonavailability. As an example, the use of clauses in contracts are a way for the Government to mitigate risk. Clauses such as options to extend production, options for additional spares, rights to technical data packages (TDPs) and liquidated damages all assist the Government in managing this risk and help to ensure spares availability. The cost of acquiring these options and rights can be significantly increased, if not made impractical, after the fact. Responsibility for ensuring the proper structuring of contracts rests with the contracting officer after coordination with all contributing/affected agencies.

b. Poor Integrated Logistics Support (ILS) planning

This issue was raised during component case analysis, specifically on the UH-1 main rotor yoke. It was also emphasized during several telephone interviews. ILS planning is the cornerstone of spares availability. Failure to properly plan here can have serious repercussions after contract award. Thorough ILS planning takes into account all aspects of support required for a fielded system, to include initial and provisioning spares. ILS planning is a team effort and as such requires input from all agencies involved in the acquisition of a given system (TQM approach). One individual can not be expected to perform this planning in a vacuum; making needs known during planning is paramount.

c. Faulted source selection process

This impediment was addressed in the context of best value contracting. Respondents argued that their primary difficulty was in the

evaluation of potential sources of supply. Sources would be identified , qualified, awarded a contract and then fail their First Article Test (FAT), causing significant delays in delivery. The problem rests with a lack of resources to adequately oversee and evaluate a vendor's technical capability. Since technical ability can be a major consideration in best value analysis, an error here could easily lead to the selection of a source incapable of completing its contractual obligations.

d. Quality of the workforce

This was alluded to on several occasions by respondents during telephone and personal interviews. Those interviewed were reluctant, due to a fear of reprisal, to specifically address this issue, but the subject of the quality of the workforce surfaced in several interviews. Worker apathy towards duty performance was seen, by the Government, as a result of this impediment. This was also noted as a contributing factor to nonavailability in the universal control lever component case analysis. It also appeared to the researcher that members of the workforce have a fundamental lack of understanding as to what their role(s) are, could be, and should be in the acquisition process. This process is a team effort. When one member of the team fails to participate in the process, critical elements of planning can be left to chance. A quote from a contracting official stating that, "... we are the tail on the dog, doing what we are told", is a prime illustration of non -participation in the process. Challenging the system to ensure adequate performance is much more acceptable.

e. Faulty specifications

This issue was addressed on several occasions during archival research. Faulty specifications result in an item that is either too difficult to produce efficiently (over specification) or an item that is not fit for use (under

specification). Over specification seemed to be the primary concern of those interviewed. The use of military and design specifications were given as examples of over specification. Over specification usually resulted in a situation where the earned value of the degree of over specification does not equal the cost incurred to meet that specification. Again, not getting the product that is desired can result in schedule slippage, increased cost, rework, and degraded readiness.

f. Lack of coordination among interagency departments

This was one of the most commonly addressed impediments during interviews and with questionnaire respondents. This can result in an incomplete definition of need or initiation of actions which result in breaks in sustainment. This could occur, as illustrated by the main rotor yoke component case analysis, when engineering, without discussing a proposed inspection tolerance change with material management, arbitrarily initiates the action. Material management has not programmed in an anticipated increase in the requirement for spares for the component in question. As a result, safety stocks may not absorb the increased demand, resulting in spares nonavailability. This scenario is not an uncommon occurrence. The researcher believes there is a correlation between this impediment and the quality of the workforce, discussed above.

g. Disconnect between funding and what demand history supports

This was addressed during two telephone interviews. Respondents related that this issue had steadily escalated over the last few years as their respective budgets had systematically been scaled down. This is currently a serious area of concern for many agencies. With the decreasing defense budget, funding shortfalls are more likely to occur. Funding will have to be prioritized and

allocated to those systems most critical to force readiness (risk management). This is not a situation that anyone can correct, it is a situation that must be managed aggressively. Relief will not be realized until this latest dip in the budget runs its course.

h. Maintaining tooling for older systems

This was addressed during interviews with personnel at the Aviation and Troop Command (ATCOM) and the Defense Logistics Agency (DLA). This was also addressed in the tension torsion strap component case analysis. The storage, maintenance and acquisition of tooling for older systems was a recurring concern. For example, when a sole source subcontractor goes out of business or discontinues the production of an item, these issues surface. The two areas of real concern were the cost of replicating unavailable tooling and the time involved in identifying, qualifying, and receiving components from a new source of supply.

i. Obtaining current TDPs for breakout

This area was addressed by both questionnaire and interview respondents. Industry expressed a particular concern with this issue. Both Government and industry recognized that the lack of rights to technical data is a serious shortcoming as it significantly increases administrative acquisition times.

This is both a pre- and post nonavailability issue. Future demands may dictate the breakout of components to additional manufacturers. This either can not be accomplished due to the proprietary nature of the required data or the cost of acquiring these data after contract award. Industry, in questionnaire responses, stressed the importance of procuring sustaining effort for the Provisioning Master Record (PMR) which would accommodate such future

needs. They also pointed out that the Government generally elects not to procure this effort.

j. Factors shaping the procurement environment

This area was addressed most frequently in archival research. Several respondents did, however, address the issues of the declining defense base and the military force drawdown.

This is both a pre- and post nonavailability issue. These are factors which are influenced by the overall economic and political environment. Their impact on the economy, in general, and their impact on the defense industrial base and all its participants, specifically, is significant. These factors include: the requirement for competition, the use of best value contracting, the implementation of modernization initiatives, the declining defense base, and the military force drawdown. These factors are more easily addressed and managed at the Federal Government level. All of these factors affect DOD's ability to ensure spares availability and can affect out-year sustainment over a prolonged period.

k. Politics

This was addressed by two respondents as a frequent distracter in the completion of their assigned duties. This is both a pre- and post nonavailability issue.

Political gamesmanship is recognizable at all levels of virtually any organization. It impedes the procurement process when what is required to be done by regulation is subordinated to what will ensure the status quo (e.g., job security, paying back obligations). An ingrained atmosphere is pervasive and

directly impacts the efficient functioning of the procurement process. This was a sensitive issue for those interviewed.

l. The cumbersome procurement process

This area was addressed during several telephone and personal interviews. Its impact was felt the most in trying to resolve short-fused unforecasted requirements. This was also addressed in every component case analysis, and in archival research.

The point most often alluded to here was the time requirements dictated by the Federal Acquisition Regulation (FAR) make the timely execution of acquisitions virtually impossible. For example, the administrative lead time required to identify, qualify, and contract with a new source of supply could take 18-24 months to accomplish. The fact is painfully obvious that this is not satisfactory in regard to short-fused support requirements. The procurement system is so convoluted and difficult to navigate, that efficiency is seriously hampered from the offset. Many Small Business (SB) and Small Disadvantaged Business (SDB) concerns can not operate in this environment.

m. Requirement for competition

This was addressed during personal interviews. The respondents' concern was that the procurement environment had changed enough over the last few years that the Competition in Contracting Act (CICA) required updating to be more responsive to these new circumstances.

When originally enacted in 1984, CICA, was needed to enhance the procurement process. There are serious differences between 1984 and 1992. The world order has changed, the threat has changed, the defense base is going through a fundamental change and budgets are in decline and the difficulty of

maintaining a competitive environment grows. The question becomes, can we (the Government) continue to promote and support effective competition in the current environment? Data indicate that some modification to the requirement might be necessary to maintain its integrity and usefulness.

2. Post Nonavailability Impediments

Post nonavailability impediments are defined as those which occur after contract award , during the actual administration of the contract, through contract termination and close-out. Those impediments identified as post nonavailability issues are listed below and are accompanied by a brief analysis of their relationship to the issue.

1. Inaccurate demand history.
2. OEM out of business or production.
3. Delinquent deliveries.
4. Obsolescence.
5. Unforecasted requirements.
6. Contract changes.
7. Foreign Military Sales (FMS) and other agency requirements.
8. Defense Logistics Agency (DLA) Consumable Item Transfer (CIT).
9. Quality assurance at the vendor level.
10. Sole source procurements.
11. Vendors going into bankruptcy.
12. Mixed Service requirements.
13. SB/SDB inability to perform.
14. Economic infeasibility of sustainment.

The following analysis will include a brief discussion of each impediment, state whether it is controllable or uncontrollable and by whom and address how it ties into the research effort (e.g., how it relates to reviewed literature, interviews, and component case analysis). Unlike pre-nonavailability issues which can usually be controlled by the Government, some post nonavailability can be influenced by the Government, its contractors or in some instances both parties.

a. Inaccurate demand history

This issue was raised by a questionnaire respondent. The respondent's impression was that, in most cases, demand history is distorted out of an ignorance of the impact of such actions on the requisitioning process. End users simply do not understand how the system works. This impediment is controllable, to a large degree, by the end user level.

Demand history can be distorted by ordering in bulk, hoarding stocks at unit level and other means of circumventing the system which cause stocks of supply to be inadequate to meet true demand. Also, failure to consolidate requirements among Services and agencies denies economical ordering and also distorts the true cyclical nature of many requirements. During ILS planning, the use of inaccurate demand history from a like system, to use as a basis for provisioning, can cause problems to migrate to that system causing additional nonavailability issues.

b. OEM out of business or production

This was discussed by virtually every respondent as a significant cause of spares nonavailability. It is controllable, to a large extent, by all parties

participating in the acquisition process, through the proactive management of programs.

Situations in which this occurs are not all that uncommon for older fielded systems. The lack of availability of components due to this circumstance are some of the most problematic and time consuming to resolve, according to those interviewed. In a lot of cases the lack of availability is not realized until a requirement hits the system, effectively stifling the proactive management of such a shortfall.

c. Delinquent deliveries

As with item b above, this was another common issue raised by respondents. It was noted that industry did not discuss this issue, nor was it found in literature (e.g., trade journals and industry magazines). This issue was also discussed in the universal control lever component case analysis.

Delinquent deliveries have their own myriad of reasons for occurrence. The consistent result of delinquency is program schedule slippage and possible degraded unit mission readiness. This impediment is controllable at the vendor level.

d. Obsolescence

This was addressed by respondents from DLA. They felt that this was by far the hardest type of nonavailability to resolve. ATCOM respondents stated their position was that they did not deal in obsolete items. Unfortunately this is a largely uncontrollable situation. As technology advances, older systems become obsolete.

This generally involves the development of a new source as most OEMs are not in the business of producing obsolete components or systems.

Availability of current technical data, a qualified source with available capacity and necessary tooling are but a few of the considerations necessary to acquire these components. According to the respondents, these are, with rare exception, extremely long lead time items.

e. Unforecasted requirements

This was a hot issue with the ATCOM, material management division. From what the researcher observed, reacting to unforeseen events (crisis management) was a major element of the work they performed. Its affects were also seen in every component case analysis.

Examples of causes of increased unforecasted requirements include inaccurate usage, inaccurate forecasts, safety of flight messages, finite life designations, and changed (tightened) inspection criteria. Any or all of these can combine to invalidate prior forecasts. As with most other nonavailability issues, time is a factor. One of two things must occur to meet this increased demand. Either the capacity to meet this new requirement must be obtained, or the usage of the component must be reduced to coincide with availability. The latter is usually not the case, as established or required Operational Tempo's (OPTEMPOs) are not easily altered as they affect a host of other Service's agencies. This can be controlled, to some extent, by all parties involved in the procurement process through proactive program management and the coordination of efforts.

f. Contract changes

This was addressed in archival research and during a graduate course on contracting for major systems. It is controllable by the Government and those it contracts with.

Changes in a system or its components can occur as a result of the Government requiring the change or as a result of the vendor submitting an unsolicited Engineering Change Proposal (ECP). Change, for the purpose of this research, is the material modification or modernization of an item. Any such change(s) must be carefully evaluated to assess its full impact on availability and sustainment, prior to its implementation. As a general rule, change rarely results in the immediate removal of older systems from the inventory. It usually results in the supplementation of the existing inventory which can lead to the occurrence of nonavailability for both the old and new systems due to a resulting competition for scarce resources. Modernization initiatives are usually top priority and usually force a switch in focus from older systems.

g. Foreign Military Sales (FMS) and other agency requirements

This was addressed by two respondents, one from ATCOM and one from DLA. While recognized by both parties as a necessary requirement, it was observed by the researcher as an extreme strain on a system with diminishing resources. This is an impediment that can not be resolved as long as the requirement to support FMS exists.

This area poses a unique challenge. Due to resource constraints, FMS customers usually operate older systems. These may or may not still be in our active inventory. The logistics of supporting older systems or in some cases obsolete systems has been adequately described previously. It should be clear, at this point, that two recurring themes are seen in most nonavailability scenarios, those of cost and time. FMS sales are no different. If anything they require a larger allocation of both. In our current environment of dwindling resources, FMS support may become too burdensome to effectively manage.

h. Defense Logistics Agency (DLA) Consumable Item Transfer (CIT)

This issue was raised by both the DLA and the Army. Both parties were concerned about the smooth transition of spares management from the separate services to DLA and the potential problems which might arise. The researcher believes that transition difficulties can be resolved by DLA and the separate Services through a carefully coordinated effort.

This is an area of concern for both the Defense Logistics Agency (DLA) and the separate Services. The DLA fears that the Services will not requisition the number and types of items that they request be stocked, while the Services appear to be fearful that DLA does not have the experience in the Services' individual (historical) management areas to meet their requirements for spares. Each Service has an established body of knowledge that has effectively been lost in this transfer of material responsibility. Another concern, expressed by both parties, is the apparent lack of control each agency has over the other. If they exist, the tools to administer this new relationship are not well known. One source characterized the situation as a serious "policy deficiency".

i. Quality assurance at the vendor level

This impediment was illustrated by the universal control lever component case analysis. This was a prime example of a lack of quality assurance oversight. According to those interviewed, this impediment is the direct responsibility of the vendor.

The lack of quality assurance at the vendor level, equates to delivery of unusable items at the user level. This in turn evolves into a failure to have necessary stocks of supplies on-hand as originally planned. Poor quality is particularly detrimental to vendors today. With reduced resources the order of the

day and an increased use of best value analysis/contracting, poor performance is not a method to guarantee success. Poor quality assurance almost always guarantees that two prime objectives, delivery on time and at or below cost, are not realized.

j. Sole source procurements

This was a recurring concern in interviews, questionnaires, and literature. It is the researcher's assertion that this almost ensures disaster and that the Government has the responsibility for dual sourcing, where applicable, to avoid this impediment. All through this research, case after case, was seen where sole source procurements led to the eventual loss of a source of supply at some stage of a system's life cycle. It is to the Government's advantage to have at least identified, and maybe even qualified, another source of supply for critical components. The cost, and more importantly, the time delays involved in completing these actions after the fact are too great. Sole source procurements, by not ensuring an uninterrupted source of supply, do not facilitate or support sound supply discipline.

k. Vendors going into bankruptcy

This was addressed in a personal interview, with a member of a Project Manager's office, as an area of significant current concern. When combined with the case of sole sourcing, the impact of this event can be devastating to a program. If such a vendor holds multiple contracts, the case becomes even more problematic. Does the Government continue to pump funding to the vendor to shore him/her up or does the Government terminate for default/convenience? Neither scenario offers the Government much hope of achieving its original program objectives. With the economy in its current

downturn, this scenario may become more frequent. This also speaks to the Government's responsibility of ensuring a thorough preaward survey is conducted and that a company's financial status is monitored throughout the life of a contract.

l. Mixed Service requirements

This was addressed by two respondents, one from ATCOM and one from DLA. It is the responsibility of the Government to manage systems to maximize commonality and interchangeability and to minimize mixed requirements. Close coordination among using Services can facilitate the minimization of such requirements.

This situation is characterized by one segment of a fleet of aircraft (e.g., the Army) using one type of component on its aircraft, while the rest of the Services use another type of component on its identical aircraft. The components serve the same purpose, in a lot of cases, but are different in their configuration and makeup. This divergence from interoperability and commonality drives up support costs as two components must now be stocked. Economical order quantities for both may not be realized, and different repair kits/tools may be required. This also has the affect of doubling the acquisition requirements and doubling the possibility of nonavailability.

m. SB/SDB inability to perform

This issue was raised by several respondents from ATCOM, each from different areas of spares responsibility. The inability of these vendors to perform has the same material affect as with other types of vendors. The difference is the degree of difficulty required to get these businesses up to an acceptable level of performance. SB/SDBs operate at a lower capital level than

larger vendors and normally do not have the assets availability to implement the necessary changes. The added effort in helping these businesses drains the already limited Government resources. Failed businesses also impact on the Government's ability to meet SB/SDB goals, as each loss takes away from an already small pool of qualified vendors. While ensuring an ability to perform is primarily a vendor responsibility, the Government can assist through the use of such programs as the Mentor-Protégé program.

n. Economic infeasibility of sustainment

This was addressed by a logistics manager interviewed at ATCOM. The basic economic feasibility of supporting a system has to be questioned as a given system reaches the end of its life cycle. At some point in time, a cost/benefit analysis will show the prudent decision to be one of system retirement. All systems in the inventory will approach this decision point based on such things as, cost of sustainment, changes in doctrine, and changes in the threat. This assessment is not something that can be overlooked. All systems ultimately have a finite life. It is the Government's responsibility to ensure these assessments occur proactively.

B. ALTERNATIVE ACTIONS

There are a myriad of actions both the Government and its contractors can take to ensure spare parts availability. While it is not practical, from an economics standpoint, or probable, from a realism standpoint, to completely eliminate nonavailability as an issue, there are certain steps that can be taken to minimize its occurrence and limit its impact.

Controllability is another part of the puzzle to consider. There are, by their nature, certain things that can and can not be controlled. The ability to control

nonavailability is based to a large extent on the degree and quality of the effort focused on the issue, and the quantity and variety of resources available to allocate to the task. Some impediments, such as the declining defense base and the decreasing defense budget, were triggered by events unforeseen by most and controllable by only a few. Events of this nature and magnitude are outside the scope of reasonable control for the purpose of this research.

As impediments are grouped into pre-nonavailability and post nonavailability issues, so are the actions available to facilitate their resolution. In most cases, pre-nonavailability actions can be thought of as proactive in nature, requiring insightful planning. Post nonavailability actions are usually reactive in nature and focus on the minimization of the impact resulting from spares nonavailability.

1. Pre-nonavailability actions.

The first and foremost action that can be taken is to ensure a thorough, calculated, and coordinated planning effort. Thorough initial ILS planning will reap its benefits throughout the life of the program. The researcher would categorize this as the cornerstone of systems sustainment and spares availability. The benefit received from such an effort will far outweigh the potential costs of an ill-fated effort. With most major systems remaining in the inventory several decades, the long term impact of poor planning can be drawn out over a sustained period.

It is the researcher's opinion that such a planning effort should involve actions such as; structuring contracts correctly to reflect the clauses required to ensure compliance with the provisions of the contract, questioning statements of need and specifications which are vague and ambiguous, ensuring the integrity of the source selection process, training a quality workforce, demanding

cooperation and taking the lead in fostering such relationships with all parties involved in the acquisition process, and minimizing the effects of political gamesmanship by stressing conformance to regulations and issued guidance.

In addition to those described above, the following actions could also be taken to facilitate a more innovative approach to spares management. Presentation of these actions are a result of the researcher's analysis of the pre-availability impediments discussed in Section A of this chapter.

a. The use of the Spares Acquisition Integrated with Production (SAIP) program

The use of the SAIP program could be used for design stable, high cost components as a method of reducing/controlling cost and ensuring configuration control (accelerates the provisioning process).

b. Incorporate the use of standard parts

The incorporation of the use of standard parts in systems, where applicable would facilitate commonality and interoperability among systems.

c. Use of key characteristics

Matching the key characteristics of spare parts to the manufacturing process which is best suited to its production would allow for the use of the most efficient process available to meet the required demand (e.g., the use of flexible manufacturing for certain components).

d. Spares breakout

The breakout of spares to provide two sources of supply for critical, hard-to-manufacture components would help preclude a nonavailability situation from occurring when a sole source of supply can not meet demand. Component breakout is not necessary, advisable and/or cost effective for all components.

e. The use of best value contracting

The use of best value contracting helps ensure that the Government gets the best possible product after considering all relevant factors. Devising a method of splitting requirements between a proven producer and a qualified best value candidate further mitigates spares nonavailability.

f. The minimization of program change

The following actions help to minimize change to a design or modification of a fielded system and provide for a more stable requirements base. This stabilization can be partially implemented by incentivizing contractors to minimize change (e.g., program slippage) through the use of such vehicles as a liquidated damages clause (proactive management), and through coordination among Services and agencies when change is imminent to minimize its impacts (e.g., between engineering and material management). The ability to determine the impact of a change prior to its implementation may help to favorably affect its outcome.

g. Emphasize the use of cost-reimbursement contracts

Push for the use of cost-reimbursement contracts, in areas which have traditionally using fixed-price arrangements to provide a profit motive for contractors to remain a part of the defense industrial base.

h. Use the Navy "Price Fighters"

The use of such organizations as the Navy's "Price Fighters" to investigate suspect areas where resources may be misutilized due to overcharging is a valuable resource management tool. In its simplest terms, cheaper parts equals more parts. These cheaper components can also mean a redirection of funds to areas that have funding shortfalls.

Some pre-nonavailability issues require a different approach. The factors shaping the procurement environment, described in Chapter II, are examples of such issues. Factors like the impact of modernization, the declining defense base and the military force drawdown are driven by factors largely external to the acquisition community. In many cases, measures taken are limited to gaining the best outcome from an uncontrollable series of events. Acquisition professionals can contribute to this effort through the innovative use of available resources.

2. Post nonavailability actions.

As stated previously, these are the actions taken, after the fact, to minimize the effects of the occurrence of spares nonavailability. It is the researcher's opinion, that when proactive management fails, these are the types of steps necessary to reestablish sustained program support. These proposed actions, as with the pre-nonavailability actions, are a result of the researcher's analysis of the post nonavailability impediments discussed in Section A of this chapter.

a. The use of prequalified alternative sources of supply

Alternate sources of supply could be identified prior to their actual need, as a proactive measure, to offset the effects of nonavailability when it occurs. These sources should be identified for high cost, high technology components as a risk management tool.

b. The use of the Rapid Acquisition of Manufactured Parts (RAMP) program

The use of the RAMP program would facilitate the timely resolution of nonavailability issues through the use of Flexible Manufacturing Systems (FMS).

These facilities specialize in the rapid turnaround of critical components (e.g., parts-on-demand (POD)).

c. The use of life of type buys

Life of type buys can be used when components are identified as those nearing an obsolescence status. These buys can be used when a system is going to be in the inventory for a specified period after the manufacture of some of their components has been or will be terminated.

d. The use of risk management

As stated previously, such spares management is an iterative process. It is not conducted initially and then forgotten. After a spares nonavailability occurrence, continued risk management of that component is necessary to minimize a recurrence.

e. Make or buy analysis

In an obsolete technology or one with limited continued commercial use, the in-house production of the item may be the only economically feasible alternative. This alternative should be assessed prior to selecting another outside source to complete the required work.

f. The use of Electronic Data Interchange

Electronic Data Interchange (EDI) can be used to accelerate the reacquisition process. The chief complaint in regard to nonavailability is the administrative time required to resolve the issue. EDI can reduce the time required to achieve procurement by several orders of magnitude.

When taken at their aggregated level, it is clear that most of the actions required to either proactively manage sustainment or react to its occurrence can be initiated by virtually any level of the acquisition community. Responsive

management allows these measures to be addressed at their lowest levels and takes the necessary actions to implement change, regardless of its origin in the organization. -

C. SUMMARY

In summary, it is evident to the researcher, after an analysis of available data, that the responsibility for identifying and reacting to nonavailability issues rests with the parties involved in the spares procurement process. It is the researchers contention that, each party must play an active role in spares management. While pre-nonavailability issues are largely a Government responsibility, post nonavailability issues offer an opportunity for all parties to participate in the process. Without proactive participation, the only recourse is time consuming and costly reactive management. The latter alternative offers few long term benefits for either the Government or its industrial partners.

V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

As a result of the research of spare parts nonavailability, the following conclusions have been drawn. Their sequence does not signify any order of preference or priority.

1. Nonavailability will increase if not proactively and aggressively pursued. In our current environment of budget reductions, force drawdowns, and diminishing sources of supply, the potential for the increased occurrence of spares nonavailability is a likely scenario. Reactive measures are not what is required. Proactive measures are necessary to preclude the further decline of the defense industrial base.

Industry and Government fail to achieve the prevention of production deficiencies (leading to nonavailability) due to our insistence on mere problem detection. While more industries are adopting the philosophy of "continuous improvement" it has not permeated industry and Government to the point where availability can be significantly assured. Enough examples of the inability to produce a satisfactory product were noted in research to conclude that this is a valid point. Instances of poor quality at the end of production indicate a lack of prevention during the process.

2. The principles of Total Quality Management (TQM) can not be applied to the procurement process as a complete package in our current operating environment. For example, our environment allows the shifting of inspection focus from error detection to error prevention, but does not allow the

establishment of habitual working relationships with selectively chosen vendors. Competition, as currently practiced, denies the potential benefits derived from such relationships. Also the benefits of continuous improvement can only partially realized due to our requirement to continuously compete new contracts when a proven producer is available and has the production capacity to produce under the new contract. Resetting the learning curve with each new contract does not facilitate continuous process improvement.

3. The causes of spare parts nonavailability are not totally controllable. Nonavailability is inherent in the procurement process, and can not be completely eliminated. As alluded to earlier, the procurement process, due to its complexity and shear volume, lends itself to a certain degree of inefficiency. As a result, the total elimination of impediments to spares availability is not a likely prospect. This is, however, not a rationalization of error acceptance, but rather an acknowledgment of the degree and scope of the problem.

4. Long lead times are inherent due to the technologically complex nature of most aviation spare parts. As was pointed out in virtually every example of spare parts nonavailability addressed in this research, long lead times are a consistent characteristic of technologically complex components. The process of identifying, qualifying, selecting, and awarding a contract to a vendor for such a product is a time intensive administrative task. At present, no relief to this process complexity is in sight.

The Competition in Contracting Act (CICA) is too restrictive and does not provide for the adequate protection of critical industries and producers of critical components. CICA, as it now stands, does not allow the latitude in judgment required by the contracting officer (CO) to foster long term (habitual) relationships

with industry. Such latitude would allow the CO to better ensure the continued supportability of spares by developing contractual vehicles unrestrained by the current provisions of CICA. Competition still has its place and still needs to be the norm in areas of less critical concern where sustainability is not an issue.

5. The increased cooperation of the parties participating in the acquisition of spares is required. Adversarial relationships between the Government and its vendors persist, as do poor working relationships and ill feelings between the separate Services, the Services and DLA, and even between competing layers of most organizations. A renewed, and in some cases an introduction of, cooperative effort among all these agencies is required. In our environment of diminishing resources it is to the advantage of all to forge relationships based on trust and the achievement of common goals.

6. The procurement environment offers many unique challenges in the acquisition of spare parts. Having an understanding of the procurement process and an understanding of the environmental limits within which the process must function are fundamental requirements for maintaining spares availability. The process, over time, has become so cumbersome and dynamic that only the proactive acquisition professional can maintain currency in all relevant issues.

7. Resources drive the train. If nothing else is apparent from this research, this fact most certainly is. Regardless of need, current policy or influence, spares nonavailability is largely governed by the resources allocated for the procurement. Congress' power to manipulate the appropriation of funds is a powerful political tool, often used in direct opposition to the stated military need (e.g., V-22 program).

8. The only thing certain is uncertainty. This statement is very appropriate for the area of spares procurement and sustainment. Regardless of the degree and quality of planning, it is impractical, if not impossible, to plan for all the possible contingencies or eventualities. The prudent thing to strive for, in a resource constrained environment, is the aversion of crisis management through proactive risk management. Risk management can take a variety of forms such as the selection of contract type, use of component breakout, and thorough Integrated Logistics Support (ILS) planning. Risk management is an iterative process.

B. RECOMMENDATIONS

1. Implement the pre-nonavailability and post nonavailability actions described in Chapter IV, Sections B and C. These actions were developed to facilitate the resolution of the impediments to spares availability identified during research. While not all inclusive, they serve as a guide to the selection of courses of action available to combat the occurrence of spares nonavailability. Actions necessary will vary with the circumstances surrounding individual nonavailability issues. Potential pre-nonavailability and post nonavailability actions identified in Chapter IV are summarized, in list form, below.

1. Pre-nonavailability actions.
 - a. Proper Integrated Logistics Support (ILS) planning.
 - b. The use of the Spare Acquisition Integrated with Production program.
 - c. The use of standard parts.
 - d. The use of Flexible Manufacturing Systems (FMS).
 - e. The breakout of spares.

- f. The use of best value contracting.
- g. The minimization of contractual changes.
- h. The use of cost-reimbursement type contracts to incentivize contractors to produce a product that matches requirements.
- i. The use of organizations such as the Navy Price Fighters to investigate areas of suspect pricing.

2. Post Nonavailability actions.

- a. The use of prequalified sources of supply.
- b. The use of the Rapid Acquisition of Manufactured Parts (RAMP) program.
- c. The use of life-of-type- buys.
- d. The use of continuous risk management throughout a programs life cycle.
- e. Make or buy analysis.
- f. The use of Electronic Data Interchange (EDI) to accelerate the reacquisition process.

2. The relaxation or modification of the Competition in Contracting Act (CICA). Some relaxation or modification of CICA is required to allow the protection of critical industries and producers of critical components. This would help develop a viable defense industrial base at a time when it is in serious jeopardy. This would also allow the more complete realization of the benefits of continuous process/product improvement derived from habitual working relationships.

3. Adopt Total Quality Management (TQM) principles. The Government and its industrial partners should adopt those principles of TQM which can be applied to the procurement of spares. Those which fit within the

scope of current governing regulations should be incrementally applied to achieve continuous process improvement. Examples of proactive measures include the shoring up of critical technologies by developing long term relationships with critical industries, investments in Flexible Manufacturing Systems (FMS), implementation of TQM to the procurement process (e.g., process control) and similar initiatives.

C. SUMMARY OF ANSWERS TO RESEARCH QUESTIONS

Answers to both primary and subsidiary research questions are provided as follows:

Primary Research Question. **What are the primary impediments to the acquisition of Army rotary wing aircraft spare parts in the current DOD acquisition process?**

1. Pre-nonavailability impediments.
 - a. Poorly structured contracts (e.g., lack of appropriate clauses).
 - b. Inadequate Integrated Logistics Support (ILS) planning.
 - c. Faulted source selection process.
 - d. Faulty specifications.
 - e. Inadequate training of the acquisition workforce.
 - f. Lack of coordination within the DOD and the Services.
 - g. Funding shortfalls.
 - h. Improper disposition of tooling.
 - i. Lack of Technical Data Packages (TDPs) and or inadequate updating.
 - j. General factors shaping the acquisition environment.
 - k. Politics.

- l. An acquisition process that is cumbersome/not user friendly.
2. Post nonavailability impediments.
 - a. Inaccurate demand histories.
 - b. Out-of-production Original Equipment Manufacturers (OEMs).
 - c. Delinquent deliveries.
 - d. Obsolescence.
 - e. Unforecasted requirements.
 - f. Contract changes.
 - g. Foreign Military Sales (FMS) support.
 - h. DLA consumable item transfer.
 - i. Lack of quality assurance at the vendor level.
 - j. Sole sourcing.
 - k. Vendors going into bankruptcy.
 - l. Mixed Service spares requirements.
 - m. Small business (SB) and Small Disadvantaged Business (SDB) performance.
 - n. Economic infeasibility of supporting older systems.

This list is not all inclusive and only addresses those significant impediments identified during the research.

Due to the complexity of the acquisition process, the opportunity for difficulty in maintaining spares availability presents itself frequently, as illustrated by the above lists. Chapters II and III explored this process and presented/analyzed impediments to the acquisition of spares. This was accomplished by discussing the factors currently shaping the procurement environment, discussing

information obtained using a variety of research methods, and analyzing five separate component cases.

Subsidiary-Research Question #1. Which impediments are pre-nonavailability and which impediments are post nonavailability issues?

These were identified, by category, in response to the primary research question. These were also discussed in detail in Chapter IV, Section A.

Subsidiary Research Question #2. Which impediments are controllable by the Government and which are controllable by its contractors?

The pre-nonavailability factors identified in the primary research question are all controllable by the Government. Pre-nonavailability was defined, for the purpose of this research, to be the time period up to, but not including, contract award. As defined, the Government has the responsibility of adequately addressing these issues. Proper ILS planning will ensure that the vast majority of these pre-nonavailability impediments are never given the opportunity to occur.

Post nonavailability impediments can be controllable by the Government, its contractors, or both. Post nonavailability was defined, for the purposes of this research, to be the time period after contract award. Post nonavailability impediments A, F, H, and I, identified in the primary research question, are controllable by the Government. Impediments B, C, G, and J, are controllable by the Government's contractors and impediments D, E, and K, are controllable by both. While specific responsibility for the resolution of these issues has been placed, it is not unusual for all participants in the acquisition process to have an influence over the impact of these impediments. Carefully orchestrated cooperation among participants will preclude the occurrence of most impediments.

Subsidiary Research Question #3. **Are there types of components, within aviation commodity areas, which traditionally experience a higher degree of nonavailability than other components, and if so what are their characteristics?**

The research did not result in the identification of homogenous groups of components as originally intended. Experts questioned were unable to accurately identify component groupings but did provide information that allowed the researcher to identify the salient features (characteristics) of nonavailable aviation components. These recurring characteristics are:

1. Technical complexity.
2. Lack of design stability.
3. Lack on interoperability and commonality.
4. Long lead times.
5. Finite life criteria.
6. Time in the inventory/level of technology.

It is not necessary for nonavailable components to possess all of these characteristics but most of those identified during the research usually possessed two or three of those described above.

D. AREAS FOR FURTHER RESEARCH

As a result of the level of research conducted on the identification of impediments to the availability of spares, three areas warrant further research.

These subject areas are:

1. The further identification and definition of the salient characteristics of nonavailable components to provide a proactive tool with which to manage spares sustainability.

2. The exploration of supportability requirements for major systems to determine the point at which a system is upgraded and/or retired due to the economic infeasibility of further support. The focus could be to the development of a model assessing critical system criteria (e.g., cost drivers).
3. To explore the possibility of relaxing or modifying the current CICA requirements for competition to allow habitual buyer-seller relationships for identified critical systems/components. This would be done in support of strengthening the defense industrial base in the area of critical technologies.

APPENDIX A

Spare Parts Obsolescence - Questionnaire

Instructions: Please answer all questions, 1 through 21, to the best of your ability. If you are unable to answer a question please indicate why (e.g. this question does not relate to my current position). If necessary, feel free to use the back of the questionnaire or additional paper to answer the questions if the space provided is not adequate.

Definition: Spare Parts Obsolescence - Component obsolescence is a problem which affects the continuity of readiness of an item or system. This lack of continuity can occur due to such things as contract closeouts, manufacturers going out of business or the introduction of new technology. Obsolescence occurs when the item is no longer available or is no longer suited to its original use.

Optional: Please provide this information if at all possible.

Name: _____
Title/position: _____
Phone (comm): _____
Phone (DSN): _____
Phone (FAX): _____
Address: _____

1. Are obsolete spare parts a problem for your activity and if so, how frequently do they occur?

yes ____ no ____ .

weekly ____ monthly ____ quarterly ____ annually ____ other ____ (specify).

2. Can obsolete parts be identified prior to their need and if so, how? yes ____ no ____ .

a.

b.

c.

3. Do you proactively try to identify obsolete spare parts? yes ____ no ____ .

If not, why (e.g. current work load)?

a.

b.

c.

4. Is it economically feasible to proactively search for obsolete spare parts?

yes ____ no ____ . Briefly explain your response.

5. What are the reasons obsolete spare parts can not be identified prior to their need?

a.

b.

c.

6. What are the reasons spare parts requisitions can not be filled?
- a.
 - b.
 - c.
7. What type(s) of spare parts usually turn out to be obsolete?
- a.
 - b.
 - c.
8. What are the regulations and/or policies which hamper the filling of obsolete spare parts requirements?
- a.
 - b.
 - c.
9. What is a typical scenario under which spares procurement problems surface? Briefly explain.

10. Why do you think spare parts become obsolete (e.g. lack of demand history)?

a.

b.

c.

11. Have obsolete spare parts groupings been identified? yes ____ no ____ .

If so, what are they?

a.

b.

c.

Are they homogeneous or unrelated? _____ .

12. Do you have set procedures, in place, for acquiring obsolete spare parts once they have been identified? yes ____ no ____ .

If so, what are they?

a.

b.

c.

13. Are you aware of other methods of filling obsolete spare parts requisitions used by other agencies / Services? yes _____ no _____ .

If so, what are they?

a.

b.

c.

14. How do obsolete spare parts affect your ability to conduct and complete your duties in your current position? Briefly explain.

15. From your experience, how long does it take to find or develop a source for obsolete parts, or if not applicable to your position, how long does it normally take for the obsolescence issue to be resolved by other agencies, to your satisfaction?

1 week or less _____

4 - 6 months _____

other _____ (specify)

1 - 4 week _____

7-11 months _____

1 - 3 months _____

1 - 2 years _____

16. Who do you think should fix the problem of spare parts obsolescence? Briefly explain.

17. In your opinion, what could be done to prevent spare parts from becoming obsolete?

a.

b.

c.

18. With the current environment (political, economic/budget, defined threat) do you see service life extensions being a possibility for the existing aircraft fleet?

yes ____ no ____ . Briefly explain your response.

19. What contracting methods do you see as useful for obtaining obsolete spare parts (e.g. commercial equivalent, contract spares options, foreign sourcing)?

a.

b.

c.

20. With the current environment (political, economic/budget, defined threat) do you see the problem of spare parts obsolescence increasing?

yes ____ no ____ . Briefly explain your response.

21. Are there any additional questions which you can think of which might prove useful to this research? If so, what are they ?

a. -

b.

c.

APPENDIX B

Acronyms

ATCOM.....	AVIATION AND TROOP COMMAND
BEA.....	BUDGET ENFORCEMENT ACT
CASL.....	COMPETITION ADVOCATES SHOPPING LIST
CCAD.....	CORPUS CHRISTI ARMY DEPOT
CICA.....	COMPETITION IN CONTRACTING ACT
CIM.....	COMPUTER INTEGRATED MANUFACTURING
CIT.....	CONSUMABLE ITEM TRANSFER
CO.....	CONTRACTING OFFICER
DOD.....	DEPARTMENT OF DEFENSE
DOF.....	DEPOT OVERHAUL FACTOR
DLA.....	DEFENSE LOGISTICS AGENCY
DLSIE.....	DEFENSE LOGISTICS STUDIES INFORMATION EXCHANGE
DMR.....	DEFENSE MANAGEMENT REVIEW
DMRD.....	DEFENSE MANAGEMENT REVIEW DECISION
DTIC.....	DEFENSE TECHNICAL INFORMATION CENTER
ECP.....	ENGINEERING CHANGE PROPOSAL
EDI.....	ELECTRONIC DATA INTERCHANGE
EOQ.....	ECONOMICAL ORDER QUANTITY
FAR.....	FEDERAL ACQUISITION REGULATION
FAT.....	FIRST ARTICLE TEST
FMS.....	FLEXIBLE MANUFACTURING SYSTEM
.....	FOREIGN MILITARY SALES
GAO.....	GENERAL ACCOUNTING OFFICE
ILS.....	INTEGRATED LOGISTICS SUPPORT
JIT.....	JUST IN TIME
MSDP.....	MILESTONE DECISION POINT
NAC.....	NAVAL ADMINISTRATIVE CENTER

NADEP..... NAVAL AVIATION DEPOT
NICP NATIONAL INVENTORY CONTROL POINT
NMCS NOT MISSION CAPABLE SUPPLY
NSN..... NATIONAL STOCK NUMBER
NSY NAVAL SHIPYARD
NTE..... NOT TO EXCEED
OEM..... ORIGINAL EQUIPMENT MANUFACTURER
OPTEMPO OPERATIONAL TEMPO
PALT..... PROCUREMENT ADMINISTRATIVE LEAD TIME
PEO PROGRAM EXECUTIVE OFFICER
PM..... PRODUCT MANAGER
..... PROJECT MANAGER
PMR..... PROVISIONING MASTER RECORD
POD PARTS ON DEMAND
RAMP RAPID ACQUISITION OF MANUFACTURED PARTS
R&D RESEARCH AND DEVELOPMENT
RD&A..... RESEARCH, DEVELOPMENT AND ACQUISITION
SAIP SPARES ACQUISITION INTEGRATED WITH PRODUCTION
SB SMALL BUSINESS
SDB..... SMALL DISADVANTAGED BUSINESS
SOF SAFETY OF FLIGHT
SPR SPECIAL PROGRAM REQUIREMENTS
SPRINT SPARE PARTS REVIEW INITIATIVES
SSA..... SOURCE SELECTION AUTHORITY
TDP..... TECHNICAL DATA PACKAGE
TQM..... TOTAL QUALITY MANAGEMENT

APPENDIX C

The Army's reform program began in April 1983, in conjunction with their planning for the implementation of the Breakout Program (Defense Acquisition Regulation No. 6). As a result, the Army issued initiatives for the refocusing of acquisition processes in respect to spare parts. These were known as the Spare Parts Review Initiatives (SPRINT) and are listed below.

1. SPRINT 1: Give spare parts necessary attention.
2. SPRINT 2: Ensure that prices paid are fair and reasonable.
3. SPRINT 3: Implement DAR Supplement No. 6 "Breakout".¹
4. SPRINT 4: Eliminate disincentives on industry to breakout.
5. SPRINT 5: Optimize use of standard military parts.
6. SPRINT 6: Use value engineering to investigate prices.
7. SPRINT 7: Acquire reprocurement (Data) restriction free.
8. SPRINT 8: Automate data repositories.

¹ Refer to Appendix E , DFARS for current guidance regarding this topic.

APPENDIX D

Interview Responses

Telephonic interviews: (alphabetical order).

1. Mr. Bill Ebeler, Defense Logistics Representative(DLA) at Aviation and Troop Command (ATCOM).

Question: What has caused the shift in consumables responsibility from the separate Services to DLA?

Answer: Procurement costs were thought to be too high with several activities purchasing like items. Maintaining consumables at one location would reduce cost and improve oversight (more like a business system).

Question: How will DLA handle special requirements for the Services?

Answer: Through the use of Special Program Requirements (SPRs). This is for abnormal parts usage. It identifies what is needed and when, in the context of special requirements (e.g., low demand, cyclical usage). The SPR program is characterized as: buying in anticipation, out on a limb stocking. If the Services do not request an item once it is stocked, DLA is left "holding the bag". This is a significant problem area for DLA. Neither agency is responsible to the other (no adverse actions for not supporting the program from either side, no or few mechanisms to "punish" for abuses to the system).

2. Mr. Ray Heim, DLA, Aviation Technician.

Question: What are some major issues which result in spares nonavailability and/or obsolescence?

Answer(s): Tooling is a major issue. For older systems like the F-4, the storage and disposal of tooling by contractors and the Government poses problems. Maintaining tooling becomes increasingly difficult as the system ages. Replacing damaged, destroyed or misplaced tooling is difficult at best.

Foreign Military Sales (FMS) is very problematic. Examples are the F-86 (sabre jet) and the TA-4 which are both 1950s technology. FMS countries frequently switch out original components (e.g., engines) making it all the more difficult to support. Ordering in uneconomical order quantities is another major problem. Finding sources of supply at a reasonable cost is next to impossible.

Technical Data Packages (TDPs). Prime contractors are reluctant to release data to the Government without some type of consideration (cost). Older contracts do not necessarily have provisions for the acquisition of such data. Primes use programs like "rights guard" to sell usage to the Government for a number of years. Also when a prime goes out of business or discontinues production (e.g., Fairchild, producer of the A-10 Thunderbolt) and another company buys the rights to the airframe, problems generally arise in regard to the future release and updating of technical data.

To be completely fair, the Services also do many smart things. An example is the Air Forces' C-5. In this situation, the Service contracted for a 10 year supply of high use items (e.g., belly landing crash kits). This kit is a complete component replacement kit for the repair of an airframe damaged after a no gear down landing. The kit is preconfigured and purchased at a reduced, package price.

3. Mr. Jerry Johnson, ATCOM, Engineer.

Question: What is your opinion on the usefulness of best value and how do you feel it can best be applied?

Answer: Best value is a proven method of acquiring components. From an engineering standpoint it makes a lot of sense. Best value can be very beneficial. The problem, however, can arise when 100% of a requirement is placed with a selected best value contractor and he/she fails First Article Test (FAT). An application of best value could be arranged in which the procurement could be broken out to a proven producer and an identified best value contractor (50-50%).

This would minimize the chances of shortfalls in sustainment. Where best value failures hurt the most is in the long lead time items like forgings which can take 18-24 months to acquire. Failure at FAT is devastating to sustainability.

4. Mr. Cal Kalkins, ATCOM, Aircraft Systems Division, Administrative Section.

Question: What forced the Services and DLA to start transferring consumable item responsibility?

Answer: Defense Management Review Decision (DMRD) 926 relates to Consumable Item Transfer (CIT). Transfers are occurring at a rate of 1000 items a month (ATCOM), until complete. Items are selected for transfer on a specific date. On that date a paper transfer occurs, reestablishing responsibility from ATCOM to DLA. All consumables are transferred except non depot repairable, design unstable and Safety of Flight (SOF) items.

5. Mr. Don Love, DLA, Policy Branch.

Question: How does DLA determine its stockage requirements?

Answer: It does so by criticality or demand criteria per time period. Some stockage is based on commercial availability but very little falls into this category. A lot of items are direct vendor deliverable, lead time away. A large number of stocked items have short lead times.

Question: Does DLA stock prior to demand?

Answer: Prior to DMRD 926, approximately one-half of managed items were stocked. Now, afterwards, about ninety-eight percent of low demand consumables are stocked. This stockage increase is hard to sustain with current hiring freezes, personnel drawdowns and funding reductions. Funding drives the train when it comes to stocking consumables. Funding levels do not always support what demand history dictates. Reduced budgets and increased requirements do not equate to full support.

6. Mr. George Maisenhelder, ATCOM, Material Management, UH-1 Coordinator.

Question: Can you describe several reasons for spares nonavailability?

Answer(s): There are a number of reasons for its occurrence. Budgets focusing on newer procurements, politics in the workplace (not always in sync with regulations and policies), lack of quality assurance at the vendor level (poor oversight of processes leading to unacceptable products) and use of sole source procurements (effects of a sole source going out of business must be considered).

Question: What is the impact of nonavailability?

Answer: The greatest impact is seen in unit mission readiness. It all boils down to supporting the units out in the field.

Question: What is your opinion regarding DLA taking over responsibility for consumables?

Answer: The concern is that DLA will not be able to support the fleet. A large shift in responsibility has occurred but the body of developed knowledge on the Huey has not shifted. There appears to be a tremendous learning curve involved with this realigned responsibility.

Question: How frequently does nonavailability occur?

Answer: This is a constant crisis management challenge. Unforeseen circumstances cause the majority of difficulties. It is rarely a question of can it be fixed. The question is how long will it take to fix. A lot of unforeseen requirements work into long lead time fixes.

7. LTC Lee McMillen, Procurement Staff Officer, OASA (RD&A), U.S. Army Contracting Support Agency.

Question: What are some of the causes of spares nonavailability?

Answer(s): Clear specifications and access to current, accurate, and complete Technical Data Packages (TDPs). If either of these two areas is not managed

properly, significant problems arise as a result. An example is the area of tooling for out-of-production items.

Personnel cuts impact on the ability of all responsible agencies to effectively and efficiently conduct business.

DLA responsibility for consumables items management is another concern. Some factors causing reductions in stockage levels are reductions in funding levels and a push towards the Just in Time (JIT) inventory system. The JIT system has lots of bugs to work out before its benefits can be fully realized. GAO audits also sight procurements of items which were not done using economical order quantities, however, funding in some cases does not allow this to occur, or agencies do not cooperate in accurately determining their needs.

Difficulty with the breakout of spares is another cause. Prime contractors claim technical data are proprietary and frequently want to provide all the spares required if capacity/facilities allow them to do so. They are frequently reluctant to lose any competitive edge in this area.

Lack of updated technical drawings. This is frequently a failure to procure them and/or the rights to any future updates, or if procured, then a failure to follow through on receipt.

Procurement Administrative Lead Time (PALT) on long lead time components is a serious concern. The acquisition process is cumbersome and not always responsive (e.g., expeditious).

Subcontractors who want to produce spares are not allowed to do so due to the proprietary nature of the work. This generates adversarial relations between competitive parties.

8. Mrs. Carol Morris, DLA, Deputy for Consumable Item Transfer.

Question: ATCOM has addressed a concern that DLA may have difficulty providing adequate consumable item support for its programs. Do you think this is a viable concern?

Answer: While concerns do exist, with all parties involved, we (DLA) are not concerned to the extent that the Services are. We understand their concern and are taking steps to ensure adequate support. DLA has a vast amount of experience in consumable item support. The mission has not changed, to any great extent, but the level of support has.

9. Unnamed source, ATCOM, name(s) withheld due to the nature of the responses given.

Question: How do you, in contracting, respond to spares obsolescence issues?

Answer: We do nothing. We are the "tail on the dog". We do what we are told to do. We (ATCOM) are not in the business of dealing in obsolete items. One respondent stated that "if we have to have it, we go to the OEM, or whoever, and pay whatever it costs to get it".

Personal interviews: (grouped by office). The following interviews were all conducted at the U.S. Army Aviation and Troop Command (ATCOM), St Louis, Missouri. These interviews, five in all, were found to be the most beneficial interviews accomplished. They addressed a variety of issues pertinent to spares availability.

1. COL Green, ATCOM, Blackhawk Project Manager and Mr. Chris Redd, ATCOM, Blackhawk Project Managers Office, Logistics Manager.

Question: What are the top two issues facing your office today that materially affect your ability to maintain spare parts availability?

Answer(s): The two top issues are DLA procurement policy and the economic feasibility of sustainment. First, the DLA issue arose from the recommendations from the Defense Management Review (DMR). As such, DLA has assumed responsibility for spare parts sustainment. The concern here rests with differing requisition and stockage policies. The differences that currently exist are such that sustainment of the fleet may become an issue. There is little doubt that DLA is a competent agency, but the magnitude of this shift in responsibility is enormous. Without careful

coordination and collaboration on this issue, sustainability will be affected. Second, the issue of the economic feasibility of sustainment is an issue for all fielded systems. The Huey is reaching a point in its life cycle where cost effective sustainment could become an issue. -At some point in time the cost of sustainment is such that further operational use of the system is questioned. Support cost is generally driven up by the nonavailability of spares, the sheer cost of maintenance per flight hour and other considerations involving the support of obsolete or near obsolete technology. Supporting systems which have been fielded for several decades can be a very difficult task. The trick is to recognize this time will come for any system and to manage the program so that these effects are minimized.

Modernization of platforms and reengineering can reduce the long term costs of sustainment by introducing newer technology into an older system. However, at some point in time, these possible solutions also become economically not feasible to pursue. It is a fair assessment to equate length of time in the inventory with increased support costs. For example, the cost of supporting one blade hour for a Huey is rapidly approaching and will pass the cost of supporting one blade hour for a Blackhawk. When this occurs, and is sustained over time, an assessment will be required to analyze options to either reduce support costs or retire the less cost effective system.¹

2. LTC Terrance Reininger, ATCOM, UH-1 Product Manager.

Question: In addition to the five component cases you provided for analysis, what other significant issues pose sustainment problems for the Huey?

Answer: The greatest problem involves the issue of the qualification and maintenance of a viable vendor base for the procurement of spares outside the OEM. The concern is that the process of qualifying vendors, particularly under the concept of best value, does not have adequate oversight. Too many vendors who are qualified as sources and awarded contracts, fail First Article Test (FAT). The affect of such failures equates to possible breaks in sustainability if current on-hand stocks are not sufficient to support the fleet through issue resolution. This has been a recurring problem with many Project/Product Offices.

3. Mr. Steve Monaco, ATCOM, UH-1 Product Managers Office, Aero Engineer.

¹ Various estimates were given for the completion of the Huey phase out. Most experts questioned gave general estimates around the year 2005-2010.

Question: Same as 2 above.

Answer(s): Best value is not attaining its goals. Breakout engineers determine who is qualified, from a technical standpoint, to produce a give component. Each component is coded and a Technical Data Package is developed. The problem arises when a component is difficult to manufacture (highly technical, state of the art) and is a critical component. This combination offers the opportunity for great difficulty in sustainment. The manufacture of critical components is restricted to approved sources. These approved sources, prior to becoming such, are screened for access on a bidders list, Once on this list, they have access to the Competition Advocates Shopping List (CASL), a list of components which are purchased for a system.

The problem with source qualification is that the resources are not available to adequately oversee and evaluate a vendor's technical capability. Due to this lack of oversight, the following areas can remain in question: manufacturing capability, facility availability, existence and implementation of quality programs, the detailed process of production and First Article Test (e.g., ability to pass).

As noted previously by LTC Reininger, the failure to pass FAT is the wrong time to discover that a manufacturer can not perform. Past experience has shown that efforts to fix FAT shortfalls are usually long lead time fixes. The effects of which are, slipped delivery schedules, increased cost (depending on contract type), grounded aircraft, delayed maintenance, and degraded unit mission readiness.

Other problem areas involve vendors, who for a myriad of reasons, go into bankruptcy. At the time of this research, a major source of supply for Huey components, handling 15-20 separate contracts, filed for chapter 11 protection. This places the fulfillment of these contracts in serious jeopardy and in most cases freezes them for a time until the issue can be properly addressed. If the vendor closes his doors and the contracts as terminated for convenience or default, the process of identifying, qualifying, and awarding a contract to an alternate source of supply begins. Keep in mind that this is an administratively long process.

Lastly, the requirement for fatigue testing is a hot issue. Applicable law requires that all fatigue testing must be conducted using the same processes as the OEM. The problem here is cost and finding a facility that has the ability to duplicate the OEM's processes. This was specifically addressed in chapter III, section C, component case analysis, page 34.

4. Mr. George Maisenhelder, ATCOM, Material Management, UH-1 coordinator.

Question: What is the status of the phase out of the Huey?

Answer: There are approximately 3000 aircraft in the inventory today (1992). We are in the process of phasing out the older aircraft first, at a rate of roughly 200-300 per year. By the year 2000, approximately 1200 (+/-) aircraft will remain. These phase outs, to a large extent, go to other agencies. ATCOM and DLA still support these systems, which equates to little actual reduction in support, just a change in who the customer is.

Question: Is spares nonavailability a current issue?

Answer: Yes, there are always issues which develop that lead to breaks in availability or increased demand. Sometimes the supply system can support these shifts in requirements and sometimes it can not.

Question: What are some of these causes of nonavailability?

Answer(s): Changing climatic conditions or a need to operate in an unfamiliar environment (e.g., Desert Shield/Storm).

Obsolete parts. The provisioning process replaces old with new as quickly as possible. Sometimes there is an easily identified replacement item but more frequently the solution is not that simplistic.

Modifications such as the change of the Huey's lubrication system from oil to grease. The oil lubrication system is now obsolete, yet not all DOD agencies and/or FMS customers changed to the new system. Items that are coded obsolete (PZ) are dropped out of the material management system. The problem arises when an agency still using an older system has a requirement for a component to support the use of that system. This is not a rare occurrence.

Mixed requirements are another issue. The lubrication system, illustrated above is also an example of a mixed requirement as well as a modification. Another example is the Army's use of a hub spring for the Huey's main rotor head. The other Services have elected not to use it but it must be stocked for the Army (increasing support requirement).

Redefining an item's inspection criteria to include a finite life status, when it originally did not. This can drastically increase the demand for an item and easily overwhelm the supply system until demand can be matched through procurement.

Supporting systems no longer actively stocked in the inventory (e.g., UH-iM, operated by El Salvador (20 each) and by Redstone Arsenal as drones). ATCOM and DLA will support these until current stock is exhausted, at which point the user assumes responsibility for the systems support. ATCOM normally gives 2 to 3 years notice to users of obsolete or no longer stocked items.

Manufacturers (sole source) that serve notice to the Government of their intent to discontinue the manufacture, or that obsolete an item. Breakout engineers must qualify another source to meet any further requirement that must be met. Make or buy decisions are also analyzed at this point.

The quality of Small Business (SB) and Small Disadvantaged Business (SDB) products are a recurring concern. Experience has shown this to be a problem area, particularly when the vendor is sole source. This area of concern was specifically addressed in chapter III, section C, component case analysis, page 39.

Unforeseen demand which exceeds the safety stock level. This can happen as a result of a number of circumstances. The safety level can easily be exceeded, as some items have a level set at zero. Long lead time, as a general rule, is required to resolve these issues, and as such can result in a break in sustainment.

APPENDIX E

Questionnaire Responses

1. Are obsolete spare parts a problem for your activity and if so, how frequently do they occur?
 - a. Both agreed that it was a problem.
 - b. Frequency of occurrence ranged from weekly to monthly.

2. Can obsolete parts be identified prior to their need and if so, how?
 - a. Yes they can be identified prior to their need (occurrence).
 - b. By procuring sustaining effort for the Provisioning Master Record (PMR). This amounts to the updating of data and notification of obsolete parts and their replacements from the OEM.
 - c. Tracking demand history.
 - d. Trend analysis.
 - e. Surveys of end users and other agencies.
 - f. Proactive management from the owning service.

3. Do you proactively try to identify obsolete spare parts?
 - a. Both respondents answered this questions yes.

4. Is it economically feasible to proactively search for obsolete spare parts?
 - a. One respondent misread the question and answered no. The other respondent answered yes.
 - b. The rationale behind the yes response was that cost is not the driver behind this effort. The actual driver is readiness. If cost is found to be unreasonable, then the actual need for the system needs to be questioned and its use reevaluated.

5. What are the reasons obsolete spare parts can not be identified prior to their need?
 - a. Low or no demand for the item in question. When the need does arise, in a lot of cases, the fact that the item is now obsolete has not been disseminated to those who have a need to know.
 - b. Lack of data. Data on such issues as usage, stockage, engineering are not available or not provided to those who need the data.
 - c. Resource constraints (e.g., personnel, funding, and apathy).

6. What are the reasons spare parts requisitions can not be filled?
 - a. National Inventory Control Points (NICP) do not have the stocks on-hand to issue.
 - b. Out of production (OEM or its subcontractors) - no steady demand to make it profitable or practical to maintain production capability.
 - c. Do not order in economical order quantities (EOQ).
 - d. Serious conflicts between sound supply management and sound business / contracting practices. (e.g., GAO writes adverse reports about depot excess and in response the budgeteers cut funding, resulting in an inability to procure 100% of what demand history supports).

7. What type(s) of spare parts usually turn out to be obsolete?
- Out of production weapon systems.
 - Weapon systems with long service lives.
 - Weapon systems which are constantly upgraded or modernized.
 - Items or spares which are technologically inferior.
 - Unforecast safety issues.
 - Item is no longer suited for its original use. This may be a result of better manufacturing processes, better technology or the fact that quality, safety or useful life of the part was not as good as planned.
8. What are the regulations and/or policies which hamper the filling of obsolete spare parts requirements?
- From industry - none, to the OEM.
 - Same as 6c and 6d, above.
9. What is a typical scenario under which spares procurement problems surface? Briefly explain.
- From industry - anytime the Government orders an obsolete spare part, the Procurement Administrative Lead Time (PALT) causes serious problems. The acquisition time for these parts is historically longer than desired.
 - When a major system goes out of production, the number of suppliers (prime and its subcontractors) slowly decreases, over time, until few if any remain to fill requirements.
10. Why do you think spare parts become obsolete (e.g. lack of demand history)?

- a. lack of demand history.
- b. low or no demand history.
- c. Poor management, personnel cuts, little or no automation, limited automation interface with other activities, data exchange difficulties between users - item managers, engineers, etc.
- d. Same as 7f, above.

11. Have obsolete spare parts groupings been identified? Are they homogeneous or unrelated?

- a. One respondent said no.
- b. The other respondent said it was "real tough" to handle due to the number of fielded systems and possible multiple uses of NSNs. An effort is made to track items which are being phased out, to minimize unforecast problems with the remaining fleet. Homogenous groupings have not been identified.

12. Do you have set procedures, in place, for acquiring obsolete spare parts once they have been identified?

- a. Both respondents said yes.
- b. From industry - Advise the Government that the required part is obsolete. If they still require the part and fit and function remain, the part will be provided, lead time away.
- c. Potential sources lists by commodity (e.g., Lockheed).
- d. Attempts to procure one time buys of the production spares being disposed of by the OEM.
- e. If no commercial source exists, check DOD maintenance depots.

f. Long term response - send a request to "special" factories set up to do spares. The sheer volume of spares makes deciding what they will be set up to produce a difficult question. They can be a big help for select areas but are not the panacea to fix the big spares production problems.

13. Are you aware of other methods of filling obsolete spare parts requisitions used by other agencies / Services?

- a. Industry responded with no.
- b. Restriction on the procurement of spares to the OEM.
- c. Restriction of procurement to limited sources.
- d. Service depot fabrication.

14. How do obsolete spare parts affect your ability to conduct and complete your duties in your current position? Briefly explain.

- a. PALT grows and requisitions are not filled. There is not single solution as each problem requires its own unique solution. PR's back up and management issues grow.
- b. Industry - It is necessary to make some parts obsolete as we continuously strive to furnish a better quality part that performs better to reduce operator cost. This in turn causes various problems with contracts.

15. From your experience, how long does it take to find or develop a source for obsolete parts, or if not applicable to your position, how long does it normally take for the obsolescence issue to be resolved by other agencies, to your satisfaction?

- a. 6 months to a year.
- b. 7 to 11 months on average, some take years.

16. Who do you think should fix the problem of spare parts obsolescence? Briefly explain.

- a. Government response - All of us. Don't hide from the problem or pass the buck.
- b. Get control of the data and make it accessible.
- c. Recognize that spares equate to readiness.
- d. Government, through the acquisition of data for the Provisioning Master Record (PMR). The government generally does not elect to do this.

17. In your opinion, what could be done to prevent spare parts from becoming obsolete?

- a. Only incorporate technological advances when they are necessary. Change will always obsolete some parts.
- b. Accurate and timely receipt, filing/storage, and dissemination of technical data (e.g., drawings, revisions, instructions).
- c. Accurate data base of technical data, requirements data and stockage.
- d. A comprehensive and automated system to share knowledge between all parties (e.g., Army, Navy, DLA). Information exchange is a real bottleneck. As an example: ATCOM is the system owner, DLA is the NICP and procuring agency, the Navy in Philadelphia has the technical repository and the OEM has multiple plants and produces or did produce multiple systems, most of which are out of production (e.g., UH-1H, OH-58A, AH-1).

18. With the current environment (political, economic/budget, defined threat) do you see service life extensions being a possibility for the existing aircraft fleet?

- a. Industry - No, environmental conditions should never be reasons to increase risk or reduce safety to the operator.

b. One respondent answered yes. This has a good and a bad side. Good - reliable systems are retained. Bad - spares become more difficult to acquire. Old technology keeps getting older.

19. What contracting methods do you see as useful for obtaining obsolete spare parts (e.g. commercial equivalent, contract spares options, foreign sourcing)?

a. The above options are good, but not if demand is low. Manufacturers don't like to make commitments and then not have the Government follow through (e.g., not order the number of parts forecast, termination for convenience).

b. Presolicitation notices, preapproved producer.

c. Industry - always deal with the OEM.

20. With the current environment (political, economic/budget, defined threat) do you see the problem of spare parts obsolescence increasing?

a. Industry - no. The Government is buying and stocking lower quantities of parts and intends to eventually force this (lower demand) on to the OEM.

b. One respondent answered yes. GAO and Congressional pressure to reduce Depot stocks, reduce buys (e.g., buys at 70% of demand), increased pressure regarding unreasonable prices will increase the occurrence of obsolescence.

21. Are there any additional questions which you can think of which might prove useful to this research? If so, what are they ?

a. Tooling is another thorn, maybe worthy of another paper.

b. Question of breakout policies that allow the Government to purchase obsolete parts.

REFERENCE LIST

1. Office of Federal Procurement Policy, "Review of the Spare Parts Procurement Practices of the Department of Defense" , Report to Congress , June 1984 , 172 pages.
2. Graham, R., "Life Cycle Costing in Spare Parts Procurement: A Decision Model" , Graduate Thesis , June 1988, pages 28-29.
3. Logistics Officer Course (S-4), Ft. Lee, Va., Summer 1987.
4. Love, D., Defense Logistics Agency, Policy Branch, Richmond, Va., Telephone interview, 14 September 1992.
5. Maisenhelder, G., U.S. Army Aviation and Troop Command, Material Management Division, St. Louis, Mo., Telephone interviews, 10 July - 21 November 1992.
6. Kalkins, C., U.S. Aviation and Troop Command, Aircraft Systems Division, Administrative Section, St. Louis, Mo., Telephone interview, 23 October 1992.
7. Dobler, D.W., Burt, D.N., Lee, L. Jr., Purchasing and Materials Management , McGraw-Hill Publishing Company, New York, 1990.
8. Sherman, S.N., Government Procurement Management , Woodcrafters Publications , Germantown Maryland , 1991, pages 118-123.
9. Vollmecke, K.F., "Understanding Best-Value Contracting" , Research Paper , 1992 , 15 pages.
10. Roman, C.S., "Best-Value Acquisitions: Zeroing in on Optimal Offer" , Federal Computer Week , July 1992, 2 pages.
11. Hernandez, R.J., "Best Value Contracting", NCMA: Topical Issues in Procurement Series, Volume 3, Number 5, May 1992, 16 pages.
12. The United States Army Posture Statement FY93 , Department of the Army, US Army Publications and Printing Command, 1992.
13. Army Focus - June 1991 , Department of the Army, US Army Publications and Printing Command, 1991.
14. Atwood, D.J., "Industrial Base: Vital to Defense" ' Defense 90 , Jan/Feb 1990, pages 13-16.
15. Scott, R., "Contract Management in the Era of the Peace Dividend" , National Defense , September 1990, pages 18-19.
16. Doyle, R., McCaffery J., "The Budget Enforcement Act of 1990" , Information Paper , 1991, 12 pages.
17. Miskell, J.F., "Domestic Industrial Base Vulnerability" , National Defense, October 1990, pages 22-24.

18. Lamm, D.V., Tracy, E.A., "Loss of Manufacturing Sources: An Analysis of Alternative Solutions", NCMA Journal, summer 1987, pages 35-44.
19. Brigham, E.F., Gapenski, L.C., Financial Management Theory and Practice, The Dryden Press, 1991.
20. Gehly D.T., "Defense Contractors Adjust to Survive the 1990's", Journal of Electronic Defense, July 1990, 54-58.
21. Under Secretary of Defense (Acquisition), "Bolstering Defense Industrial Competitiveness", Report to the Secretary of Defense, July 1988.
22. Brooks, M.E., "An Investigation of the Time Series Growth Curves as a Predictor of Diminishing Manufacturing Sources of Electronic Components", Graduate Thesis, 1981, 134 pages.
23. Tracy, E.A., "Component Obsolescence: Presentation of a Decision Process for Assessing and Selecting Alternative Solutions Applicable to Major Weapons Systems Production", Graduate Thesis, December 1985, 102 pages.
24. Knese, P.B., "Fewer Spares: A Challenge Met by the Light Helicopter", Technical Report, July 1990, 42 pages.
25. Redd, C., U.S. Army Aviation and Troop Command, Blackhawk Project Managers Office, Logistics Manager, St. Louis, Mo., Personal Interview, 27 October 1992.
26. Nevins, J.L., Whitney, D.E., Frasier, C.W., Deutsch, S.E., "Parts on Demand: Manufacturing Technology and Technology Transfer Assessment", Technical Report, December 1983, 44 pages.
27. Rapid Acquisition of Manufactured Parts (RAMP) Strategic Implementation Plan, Department of the Navy, Naval Supply Systems Command, May 1989.
28. Aven, W.M., Root, D.R., "A Study of the Computation Requirements for Spares in the USAF A-10 SAIP Program", Graduate Thesis, 1980, 63 pages.
29. Arthur, R. J., Fisher, O.L., "Spares Acquisition Integrated with Production and it's Influence on the Obsolescence of Spares", Graduate Thesis, 1980, 58 pages.
30. Contracting for Major System: MN4301, graduate course, 7 July - 24 September 1992.
31. Ballwally, N.M., "Forecasting Digital Microcircuit Obsolescence", Technical Report, March 1991, 16 pages.
32. Martin, M.P., "Performance Measurement in the RAMP SMF Facility", Graduate Thesis, 1989, 119 pages.
33. Crawford, G.B., "Variability in Demands for Aircraft Spare Parts: It's Magnitude and Implications", Technical Report, 1988, 103 pages.
34. Maisenhelder, G., U.S. Army Aviation and Troop Command, Material Management Division, St. Louis, Mo., Personal interview, 27 August 1992.

35. Department of Defense Instructions 5000.2M , UnderSecretary of Defense (Acquisition), U.S. Government Printing Office, February 1991.
36. Department of Defense Instructions 5000.2 , UnderSecretary of Defense (Acquisition), U.S. Government Printing Office, February 1991.

BIBLIOGRAPHY

Armed Services Pricing Manual, Department of Defense, U.S. Government Printing Office, 1986.

Army Focus - June 1991 , Department of the Army, US Army Publications and Printing Command, 1991.

Arthur, R. J. , and Fisher, O.L. , "Spares Acquisition Integrated with Production and its Influence on the Obsolescence of Spares" , Graduate Thesis , 1980, 58 pages.

Atwood, D.J., "Industrial Base: Vital to Defense" *Defense* 90 , Jan/Feb 1990, pages 13-16.

Aven, W.M. , and Root, D.R. , "A Study of the Computation Requirements for Spares in the USAF A-10 SAIP Program", Graduate Thesis , 1980, 63 pages.

Ballwally, N.M., "Forecasting Digital Microcircuit Obsolescence", Technical Report, March 1991, 16 pages.

Biggins, J.A., Zeger, H.D., "Obsolescence Loss Rates", Technical Report, 1972, 41 pages.

Brigham, E.F., Gapenski, L.C., Financial Management Theory and Practice, The Dryden Press, 1991.

Brooks, M.E., "An Investigation of the Time Series Growth Curves as a Predictor of Diminishing Manufacturing Sources of Electronic Components", Graduate Thesis , 1981, 134 pages.

Brown, D.W. , "Dynamic Order Quantity - An Alternative to Economic Order Quantity" , Technical Report , 1988 , 89 pages.

Christian, R.D., "The Impact of Agency Audits on the Buy Our Spares Smart (BOSS) Program", Graduate Thesis , June 1988, 116 pages.

Contracting for Major System: MN4301, graduate course, 7 July - 24 September 1992.

Crawford, G.B. , "Variability in Demands for Aircraft Spare Parts: Its Magnitude and Implications" , Technical Report , 1988, 103 pages.

Darby, M.M., " Rapid Acquisition of Manufactured Parts: Methods of Contracting and Incentives for Industry" , Graduate Thesis , 1985 , 84 pages.

Department of Defense Instructions 5000.2 , UnderSecretary of Defense (Acquisition), U.S. Government Printing Office, February 1991.

Department of Defense Instructions 5000.2M , UnderSecretary of Defense (Acquisition), U.S. Government Printing Office, February 1991.

Dobler, D.W., Burt, D.N., and Lee, L. Jr., Purchasing and Materials Management , McGraw-Hill Publishing Company, New York, 1990.

Defense Systems Management College, "Defense Procurement Industrial Base Study: Why Firms are Leaving the Defense Market", Research Study , December 1990

Doyle, R., and McCaffery J., "The Budget Enforcement Act of 1990" , Information Paper , 1991, 12 pages.

Ebeler, B., Defense Logistics Agency Representative, Aviation and Troop Command, St. Louis, Mo., Telephone interview, 23 October 1992.

Federal Acquisition Regulation , General Administrative Services, U.S. Government Printing Office, 1 February 1987.

General Accounting Office, "Spare Parts: Air Force Reports Progress and Problems in Obtaining Competition", GAO Report , February 1990.

Graham, R., "Life Cycle Costing in Spare Parts Procurement: A Decision Model" , Graduate Thesis , June 1988, pages 28-29.

Green, G.C., U.S. Army Aviation and Troop Command, UH-60 Project Manager, St. Louis, Mo., Personal interview, 27 August 1992.

Heim, R., Defense Logistics Agency Technician, Richmond , Va., Telephone interview, 23 July 1992

Hernandez, R.J., "Best Value Contracting", NCMA: Topical Issues in Procurement Series, Volume 3, Number 5, May 1992, 16 pages.

Johnson, J., Breakout Engineer, Aviation and Troop Command, St. Louis, Mo., Personal interview, 29 August 1992.

Gehly D.T., "Defense Contractors Adjust to Survive the 1990's" , Journal of Electronic Defense , July 1990, 54-58.

Kalkins, C., U.S. Aviation and Troop Command, Aircraft Systems Division, Administrative Section, St. Louis, Mo., Telephone interview, 23 October 1992.

Knese, P.B., "Fewer Spares: A Challenge Met by the Light Helicopter", Technical Report , July 1990, 42 pages.

Lamm, D.V., and Tracy, E.A., "Loss of Manufacturing Sources: An Analysis of Alternative Solutions", NCMA Journal, summer 1987, pages 35-44.

Logistics Officer Course (S-4), Ft. Lee, Va., Summer 1987.

Love, D., Defense Logistics Agency, Policy Branch, Richmond, Va., Telephone interview, 14 September 1992.

Martin, M.P., "Performance Measurement in the RAMP SMF Facility " , Graduate Thesis , 1989, 119 pages.

Maisenhelder, G., U.S. Army Aviation and Troop Command, Material Management Division, St. Louis, Mo., Personal interview, 27 August 1992.

Maisenhelder, G., U.S. Army Aviation and Troop Command, Material Management Division, St. Louis, Mo., Telephone interviews, 10 July - 21 November 1992.

McMillen, L., U.S. Army Contracting Support Agency, Procurement Staff Officer, Falls Church, Va., Telephone interviews, 13 July and 25 August 1992.

Miskell, J.F., "Domestic Industrial Base Vulnerability" , National Defense, October 1990, pages 22-24.

Monaco, S., U.S. Army Aviation and Troop Command, UH-1 Product Managers Office, Aero Engineer, St. Louis, Mo., Personal interview, 28 August 1992.

Morris, C., Defense Logistics Agency, Deputy, Consumable Item Transfer, Richmond, Va., 23 October 1992.

Nevins, J.L., Whitney, D.E., Frasier, C.W., Deutsch, S.E., "Parts on Demand: Manufacturing Technology and Technology Transfer Assessment" , Technical Report, December 1983, 44 pages.

Office of the Inspector General , "The DoD Spare Parts Control Program" , DoD Audit Report , 1988.

Office of Federal Procurement Policy, "Review of the Spare Parts Procurement Practices of the Department of Defense" , Report to Congress , June 1984 , 172 pages.

Rapid Acquisition of Manufactured Parts (RAMP) Strategic Implementation Plan , Department of the Navy, Naval Supply Systems Command, May 1989.

Redd, C., U.S. Army Aviation and Troop Command, Blackhawk Project Managers Office, Logistics Manager, St. Louis, Mo., Personal Interview, 27 October 1992.

Reininger, T.L., U.S. Army Aviation and Troop Command, UH-1 Product Manager, St. Louis, Mo., Personal interview, 27 October 1992.

Roman, C.S., "Best-Value Acquisitions: Zeroing in on Optimal Offer" , Federal Computer Week , July 1992, 2 pages.

Rose, K.H., "TQM: Beyond the Buzzword", Army RD&A Bulletin , Jan-Feb 1992, pages 1-4.

Sellers, B., "Second Sourcing, a way to Enhance Production Competition", Program Manager , May-June 1983, page 16.

Scott, R., "Contract Management in the Era of the Peace Dividend" , National Defense , September 1990, pages 18-19.

Sherman, S.N., Government Procurement Management , Woodcrafters Publications , Germantown Maryland , 1991, pages 118-123.

The United States Army Posture Statement FY93 , Department of the Army, US Army Publications and Printing Command, 1992.

Thomas, B.M., "The Acquisition Challenge", Army RD&A Bulletin , Jan-Feb 1992, pages 5-7.

Tracy, E.A., "Component Obsolescence: Presentation of a Decision Process for Assessing and Selecting Alternative Solutions Applicable to Major Weapons Systems Production", Graduate Thesis , December 1985, 102 pages.

Under Secretary of Defense (Acquisition), "Bolstering Defense Industrial Competitiveness", Report to the Secretary of Defense, July 1988.

United States General Accounting Office, "Spare Parts - Air Force Reports Progress and Problems in Obtaining Competition" , GAO Report , Feb 1990.

Vollmecke, K.F., "Understanding Best-Value Contracting" , Research Paper , 1992 , 15 pages.

INITIAL DISTRIBUTION LIST

	No. Copies
1. Defense Technical Information Center Cameron Station Alexandria, Virginia 22304-6145	2
2. Defense Logistics Studies Information Exchange U.S. Army Logistic Management Center Fort Lee, Virginia 23801-6043	2
3. Library, Code 52 Naval Postgraduate School Monterey, California 93943-5100	2
4. Dr. David V. Lamm, Code AS/Lt Naval Postgraduate School Monterey, California 93943-5100	3
5. CDR Rebecca J. Adams, Code AS/Ad Naval Postgraduate School Monterey, California 93943-5100	1
6. CPT Milton E. Wynn, III, USA 884 Harris Street Madison, Georgia 30650	3

229.546

Thesis
W965 Wynn
c.1 Spare parts nonavail-
ability.



DUDLEY KNOX LIBRARY



3 2768 00033191 2