AU/ACSC/02-103/2002-04

AIR COMMAND AND STAFF COLLEGE

AIR UNIVERSITY

COST-BENEFIT ANALYSIS TOOLS FOR AVIONICS PARTS OBSOLESCENCE

by

Luvenia L.M. Shuman, GS-13, USAF

A Research Report Submitted to the Faculty

In Partial Fulfillment of the Graduation Requirements

Advisor: Major Bridget K. Carr

Maxwell Air Force Base, Alabama

April 2002

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Report Documentation Page

Form Approved
OMB No. 0704-0188

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1. REPORT DATE **00 APR 2002**	2. REPORT TYPE **N/A**	3. DATES COVERED **-**

4. TITLE AND SUBTITLE **Cost-Benefit Analysis Tools For Avionics Parts Obsolescence**	5a. CONTRACT NUMBER
	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Air University Maxwell Air Force Base, Alabama**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**UU**	**33**	

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Abstract

Obsolescence management, an ever-increasing topic in the Department of Defense, is not new. Since the service life of military systems is much longer than commercial systems, maintaining military systems when parts and components go out of production remains a sustainment challenge. Typically, resolving obsolete parts problems are incorrectly identified as reliability and maintainability issues that provide no improved capability or reduced cost; the primary benefit is continued sustainability of the existing system. Since loss of a capability is not an option, maintaining the capability without a part redesign does require increased cost for the commercial market to support a military-unique application. In addition, constrained defense funding will necessitate prudent use of limited funding to balance current systems maintenance and new systems acquisition.

The specific objective of this project is to show the need for automated cost-benefit analysis tools to assist program/item managers in identifying the cost savings associated with resolving obsolete parts problems. The project provides an analysis of the cost-benefit relationship of the resolution options available to the program/item manager. Additionally, the project identifies and analyzes cost-benefit analysis tools for making decisions associated with sustaining the obsolete item versus acquiring a supportable replacement.

Chapter 1

Introduction

Background and General Issue

Obsolescence management, an ever-increasing topic in the Department of Defense, is not new. Concerns and studies of how to address obsolete technology can be traced back to the 1960s; however, the growing technology refresh rate in the commercial market has exacerbated the issues surrounding management of obsolescence. Since the service life of military systems is much longer than commercial systems, maintaining military systems when parts and components go out of production remains a sustainment challenge. Further, constrained defense funding will necessitate prudent use of limited funding to balance current systems maintenance and new systems acquisition.

Definitions

Part obsolescence does not mean that the part is no longer required but refers to a component or part that the commercial market considers no longer economically feasible to manufacture. Diminishing manufacturing sources and material shortages (DMSMS) is a larger category of supply concern that includes discontinued production resulting from obsolescence as well as other reasons such as rapid change in technology, foreign source competition, and federal environmental or safety requirements.[1] The terms part obsolescence and DMSMS are used interchangeably. Weapon system as used in this document includes major weapon systems such as aircraft, missiles, or tanks as well as their internal or external subsystems such as radar warning receivers, jamming systems, precision munitions, or chaff dispensers.

Statement of the Research Question

Typically, resolving obsolete parts problems are incorrectly identified as reliability and maintainability issues that provide no improved capability or reduced cost. The primary benefit, continued sustainability of the existing system, normally does not receive high funding priorities due to the absence of a known cost savings associated with the solution until an immediate impact exists. Since loss of a capability is not an option, maintaining the capability without a part redesign does require increased cost for the commercial market to support a military-unique application. "It has been estimated that the obsolescence problem has cost the military services $27 billion over the 10-year period beginning in 1982."[2]

The specific objective of this project is to show the need for automated cost-benefit analysis tools to assist program/item managers in identifying the cost savings associated with resolving obsolete parts problems. Many experts point out that the question is not how to solve obsolescence but how to manage the problems economically in the best interest of the program. "Obsolescence is the most frequent cause for unplanned redesign of military hardware. The redesign is rarely due to obsolescence of the entire system – it is simply due to one of its subcomponents no longer being available."[3] The project will provide an analysis of the cost-benefit relationship of the resolution options available to the program/item manager. Additionally, the project will identify and analyze cost-benefit analysis tools for making decisions associated with sustaining the obsolete item versus acquiring a supportable replacement.

Summary of Approach

To accomplish the objective, the first step in this analysis is to search existing literature for the definitions of obsolescence, industry reported trends related to obsolescence, guidelines and directives governing obsolescence management, automated cost-benefit analysis tools for making obsolescence decisions, and accepted solutions for managing obsolescence. Chapter 2 presents a historical perspective of obsolescence management with recent trends in the Department of Defense and financial tools identified that are available to assist program/item managers in making decisions to resolve obsolete part issues.

The second step is an analysis of the cost-benefit relationship of the resolution options available to the program/item manager. Chapter 3 provides a description of the key steps in resolving an obsolete part problem, the obsolescence resolution options available to the program/item manager, and the cost-benefit relationships of the resolution options are discussed.

The final step is to analyze automated cost-benefit analysis tools or models that are available to assist program/item managers in making decisions to resolve problems associated with the obsolete parts. Chapter 4 includes a description of the cost-benefit analysis model identified, the criteria used for analysis of the model, and the results of the model analysis. If adequate cost-benefit analysis tools for comparing the resolution options exist, they could be instrumental for program/item managers to assist in timely solution decisions.

Limitations and Assumptions

Most research studies are constrained by time limitations imposed by the requirement source and this study was no different. Three other limiting issues in the scope of this study require mentioning.

First, the author and reviewers of the study are not experts in the areas of obsolescence management or program management. While this limitation had an obvious disadvantage (a subject familiarization period), its advantage is somewhat less obvious. It provides the author an opportunity to comment on the ease of availability of obsolescence management information and tools. Program management personnel are faced with numerous daily management decisions, each requiring a significant amount of time; therefore, easy access to relevant information and tools is very important.

Second, the research scope is confined to automated cost-benefit analysis tools and similar models to analyze the total ownership cost of sustaining or redesigning a system with obsolescence management issues that was identified by literature search. Although the literature review did not identify any existing automated cost-benefit analysis tools, two models/tools along with ongoing efforts to develop automated tools were identified that are available to assist program/item managers in making decisions to resolve obsolete parts problems.

Finally, the information presented in this project is based on a review of current literature and discussions with individuals who are knowledgeable about current obsolescence issues and efforts.[4] The limited number of tools that were mentioned in scientific literature limits the confidence that this effort identified all of the cost-benefit analysis tools currently in use. Additional cost-benefit analysis tools may exist that were not identified using this method of identification.

Notes

[1] Department of Defense (DoD) Regulation 4140.1-R, *DoD Materiel Management Regulation*, May 1998, C1.4.1.1.

[2] Virginia Day and Zachary F. Lansdowne, "Impact of Electronics Obsolescence on the Life Cycle Costs of Military Systems," *Air Force Journal of Logistics*, 17, no. 3 (Summer 1993): 29.

[3] Steven R. Osburn, "Custom Engineered Solutions: The Answer to Being Held Hostage by Obsolescence," Proceedings of the DMSMS Conference (2000), Online, Internet, 27 November 2001, Available from http://smaplab.ri. uah.edu/dmsms2k/ proceed.htm.

[4] Personnel from the Aging Aircraft Program Office, B-2 System Program Office, and Defense Microelectronics Activity were contacted to specifically identify automated cost-benefit analysis tools for making obsolescence resolution decisions.

Chapter 2

Literature Review

Historical Perspectives

Obsolescence management has become an increasingly important issue to the Department of Defense. Concerns and studies of how to address obsolete technology can be traced back to the 1960s as technology transitioned from vacuum tubes to solid-state transistors and then to digital electronics.[1] These earlier obsolescence concerns were normally managed under broader support concepts such as maintainability or sustainability. Today, several factors have increased the historical problems creating the need for a separate obsolescence management field. These include an increase in electronic combat technologies, the extension of weapon system service life, rapid technology advancements, and the shrinking military market.

Obsolete Parts = Electronics

As the Department of Defense continues to emphasize technology through national military operational concepts such as precision engagement and dominant maneuver, the use of electronics in military systems will continue to grow. To achieve these objectives, the United States Air Force uses electronic combat technologies.

> Electronic combat involves actions to neutralize or destroy an enemy's electromagnetic capability and to protect friendly electromagnetic

> capabilities. It includes electronic warfare as well as elements of command, control, and communications; countermeasures; and suppression of enemy air defenses.[2]

While extensive research has not been performed on the narrower category of obsolescence in electronic combat systems, electronic combat technology is a subset of avionics or aviation electronics, which has been studied extensively.

Two separate studies have concluded that obsolescence is a major problem for electronic parts while obsolescence problems relating to mechanical parts are only minor.[3] In one of the studies, the author concluded, “Without exception, every DoD agency and contractor visited stated that electronic components were the greatest problem in both cost and quantity of discontinuances.”[4]

The costs of these problems are revealed in the Air Force capability and budget. A national committee on aging avionics attributed a decline in the 1990s of the mission capability of Air Force aircraft from 83 percent to 73 percent to the aging aircraft fleet, particularly the aging avionics systems.[5] Also, in 1999, one-third of the Air Force’s expenditures for depot-level repairs of its aircraft went to the support and maintenance of avionics systems, which totaled approximately $1 billion.[6]

Weapon System Service Life

While military weapon systems by design experience long service lives to recoup the cost of the investment, limited defense funding has extended service lives even longer and delayed needed weapon system modernization. “The operational lifetimes of legacy aircraft are being extended well beyond their original design lifetimes resulting in an average age of U.S. military aircraft of 20 years.”[7] “Platforms such as the B-52 bomber, the KC-135 tanker aircraft, and the C-130 cargo plane, which were conceived in the

1940s and 1950s, for example, are expected to remain operational into the next century--giving them a service life of more than 80 years."[8]

These long service lives result in the loss of supply sources for electronic components. While the military still requires availability of electronic devices and components (some military unique) for these older weapon systems, commercial sources move on to more profitable markets with higher volumes. "From 1986 to 1996, for example, the percentage of discontinued military/aerospace electronic devices nearly doubled—from 7.5 to 13.5 percent."[9]

Rapid Technology Advances

The obsolescence problems faced in today's military environment do not stem only from aging systems but also from rapid changes in commercial technology. The current market demands for the latest and fastest technology result in new technology updates every 18 months to 3 years.[10] The typical life cycle of an electronic part lasts from 4 to 7 years while development of a military weapon system can take up to 5 years with production spread over several more years.[11] As a result, new military systems such as the F-22 fighter and the B-2 bomber are also experiencing ever increasing electronics obsolescence problems.[12] For example, "the F-22 program now budgets $50 million a year to replace 'old' avionics with new hardware and software and will have undergone four technology refresh cycles by the time the first production F-22 rolls off the line."[13] According to the F-22 program manager, "no two of the 339 aircraft that I build will be the same."[14]

Military Market Trends

The military services no longer control the major portion of the electronics industry and thus, have little influence over electronics manufacturers and technology refresh cycles. In the 1970s and early 1980s, military requirements were the principle influence over the market's technology.[15] Now, military requirements in the thousands for a microelectronic device cannot compete against commercial markets such as cell phones and personal computers that have requirements in the millions. According to the Director of the Defense Microelectronics Activity, "The entire Defense industry share of the global microelectronics market is now only about 0.3 percent so our [the military's] influence on the component manufacturers is minimal."[16]

Obsolescence Handbooks and Tools

With the growing number of obsolete parts, program/item managers are in need of tools to assist them in making timely decisions to resolve the obsolescence problem. Several automated tools designed to predict future obsolete parts early in the system's life cycle are available. While these predictive tools provide an invaluable capability to the program/item manager by identifying potential obsolescence problems early in the life cycle increasing the time and options available for resolution, these tools do not include cost-benefit analysis of the obsolescence resolution options which is the focus of this project. During the literature review, two models/guides relating to costs were identified that are available to assist program/item managers in making decisions to resolve obsolete parts problems and ongoing efforts to develop automated cost-benefit analysis tools.

Model/Guide

In addition to DoD and individual service directives and instructions, the Air Force, Army, and Navy have each produced a DMSMS case resolution guide to assist program/item managers in lessening or eliminating the risks caused by parts non-availability before the weapon system is adversely affected. The Air Force guide, *Air Force Materiel Command Case Resolution Guide,* includes worksheets to compute rough-order-magnitude estimates to assist in the cost-benefit analysis.[17] This cost-benefit analysis tool will be further discussed and analyzed in Chapter 4. Additionally, the Defense Microelectronics Activity (DMEA) as the DoD Executive Agent for DMSMS developed cost factors for various DMSMS resolutions so that DoD programs can uniformly report cost avoidance and determine the cost impact of implementing a DMSMS program.[18]

Tool Development Efforts

Although existing automated cost-benefit analysis tools to assist program/item managers in selecting obsolescence resolution options were not identified by review of current literature, an initiative was identified with the goal of developing automated support tools for this decision. The Air Force Research Laboratory has projects under contract to develop decision tools to assist managers in identifying the most cost-effective resolution option given the stage of a particular system/subsystem life-cycle and other factors unique to the organization's decision making process. This objective is only part of the 5-year, $32 million ($11 million in contractor cost share) initiative to improve the management of obsolescence.[19]

With limited defense funding, the cost-benefit analysis of obsolescence resolution options is critical to selecting a lasting solution at the most economical cost. It is essential that program/item managers have the required tools to compare the monetary benefits and costs of the many options available for resolving an obsolete part. These options exist not only at the integrated circuit/part level but also at the next higher assembly levels—such as the circuit card assembly, box, or system level, thus, making the decision even more complex. Automated cost-benefit analysis tools with "what if" scenarios for comparing the obsolescence resolution options would be instrumental in assisting program/item managers with timely solution decisions.

Notes

[1] Colonel Donald L. Nangle, USAF, *Obsolescence in Weapons Systems*, A Military Essay Submitted to the Faculty of Air War College, May 1971, 1-2.

[2] Joseph J. Landino, Jr., "Staging Options for the Air Force's Electronic Combat Test Capability: A Cost Analysis," Essay Submitted to the Faculty of the Air Force Institute of Technology, September 1990. 1.

[3] Stottler Henke Associates, Inc., "Artificial Intelligence Techniques for Parts Obsolescence Prediction. Phase 1," Contract Report presented to the Naval Regional Contracting Center, 14 March 1995, 9.; and Transition Analysis Component Technology, Inc. (TACTech), "Computer Aided Prediction Tool for Parts Obsolescence Management," Contract Report presented to the Naval Regional Contracting Center, 11 January 1995, 7-8.

[4] Transition Analysis Component Technology, Inc. (TACTech). "Computer Aided Prediction Tool for Parts Obsolescence Management." Contract Report presented to the Naval Regional Contracting Center. Washington, D.C., 11 January 1995, 7.

[5] Air Force Science and Technology Board, National Research Council, Committee on Aging Avionics in Military Aircraft. *Aging Avionics in Military Aircraft.* National Academy Press, Washington, D. C., 2001, 1.

[6] Roxana Tiron, "Aging Avionics Spell Doom for Air Force, Study Warns," *National Defense*, August 2001, 3.

[7] Air Force Science and Technology Board, 1.

[8] Sandra I. Meadows, "Electronic Commerce Technology Spawns Virtual Supplier Base for Obsolete Parts," *National Defense,* December 1997, 2.

[9] Air Force Science and Technology Board, 1.

[10] Tiron, 2.

Notes

[11] Virginia Day and Zachary F. Lansdowne, "Impact of Electronics Obsolescence on the Life Cycle Costs of Military Systems," *Air Force Journal of Logistics*, 17, no. 3 (Summer 1993): 29.

[12] Anthony Bumbalough, "USAF Manufacturing Technology's Initiative on Electronics Parts Obsolescence Management," 44th International SAMPE Symposium and Exhibition, May 23-27, 1999, 2045.

[13] Air Force Science and Technology Board, 2.

[14] Bill Sweetman and Nick Cook, "Military Avionics: Engine of change or obsolete relic?" *Interavia*, January 1999, 2.

[15] Philip Hamilton and Gorky Chin, "Aging Military Electronics: What Can the Pentagon Do?" *National Defense*, March 2001, 1.

[16] NATO Research and Technology Organization, Proceedings of the Systems Concepts and Integration Panel (SCI) Symposium, Budapest, Hungary, "Strategies to Mitigate Obsolescence in Defense Systems Using Commercial Components," June 2001, T-3.

[17] Universal Technology Corporation, "AFMC Case Resolution Guide, Version 2.0," Contract Report presented to the Air Force Materiel Command, DMSMS Program Office, 31 March 2001, 2.

[18] ARINC, "Resolution Cost Metrics for Diminishing Manufacturing Sources and Material Shortages," Contract Report presented to Defense MicroElectronics Activity, 31 December 2001, 1.

[19] Bumbalough, 2044, 2046.

Chapter 3

Obsolescence Solutions Process and Analysis

Obsolescence Resolution Process

It is important to understand that the steps described by most experts to resolve an obsolescence problem regardless of its life cycle stage make the process seem fairly easy. First, an item is identified as a potential obsolete item or a manufacturer sends notification of intent to discontinue production of the item. This notification and potential problem would be disseminated to all users. In the second step, the potential obsolescence problem would be verified while determining the extent of the problem—affected end items, usage rate, expected future requirements, etc. Third, once the problem has been verified, the options analysis is performed to determine the best alternative for resolution of the specific obsolescence case. Finally, the most cost-effective resolution option is implemented.

Although the steps described above make the choice for resolution appear to be a simple matter of selecting the least costly option, the answer is not that simple. Cost-effectiveness implies the option achieves optimal effectiveness at the minimum cost—"the most effect for the dollar." In performing the cost-benefit analysis for the options, many factors and variables that are unknown or not easily identifiable can make the decision a very difficult one. One such example is a system's service life. Many times systems scheduled for deactivation have their system service life extended when funds are not available to procure replacement systems.[1]

Resolution Options for Obsolescence

Many experts point out that the question is not how to solve obsolescence but how to manage the problems economically in the best interest of the program. As shown below, there could be many options available for a program/item manager to resolve an obsolescence problem, and determining the most economical for a given situation can be difficult.

DoD materiel management requires item material managers implement the most cost-effective solution consistent with mission requirements when an item is identified as DMSMS or obsolete and lists solution options in order of preference. DoD 4140.1-R lists the following options:

1. Encourage the existing source to continue production.

2. Find another source. A smaller company might undertake production that no longer is profitable for a larger company.

3. Obtain an existing substitute item that will perform fully (in terms of form, fit, and function) in place of the DMSMS item.

4. Obtain an existing substitute item that, while it would satisfy one or more functions, might not necessarily perform satisfactorily in all of them (limited substitute).

5. Redefine military specification (MIL-SPEC) requirements through applicable engineering support activities, and consider buying from a commercial source. That redefinition may include MIL-SPEC tailoring. Such a course of action might induce the emergence of additional sources.

6. Use current manufacturing processes to produce a substitute item (form, fit, and function) for the unobtainable item. Through microcircuit emulation, inventory reduction may be achieved as obsolete items may be replaced with state-of-the-art devices that may

be manufactured and supplied on demand. Emulation may be considered a more preferred alternative to 3. and 4. above, if the part may be used in a wide variety of functions.

7. Make a “bridge” buy of a sufficient number of parts to allow enough time to develop another solution.

8. Make a Life-of-Type (LOT) buy. Based on estimated life-of-system requirements, the DoD Components may make a onetime procurement of enough material to last until the end items being supported are no longer in use. LOT buys shall include sufficient material to be provided as Government Furnished Material (GFM) for repair and for piecework applications in the procurement of additional systems, equipment, spare assemblies, and subassemblies. Before adopting that alternative, managers should take into account the potential for criticism of excessive levels of on-hand inventory.

9. If a contractor using Government Furnished Equipment (GFE) stops production, use the GFE to set up a new source.

10. Reclaim DMSMS part from marginal or out-of-service equipment or, when economical, from equipment that is in a long supply or potential excess position.

11. Modify or redesign the end item to drop the part in question or replace it with another.

12. Replace the system in which the DMSMS item is used. [This] alternative would require extensive cost analysis.

13. Require the using contractor, through contractual agreements, to maintain an inventory of DMSMS items for future DoD production demands.

14. Obtain a production warranty, if possible, from the contractor to supply the item or items for a specified time (life of equipment) irrespective of demands.[2]

These methods reflect the currently documented solutions for resolution of an obsolescence problem. Each of these resolution options was also included in the Air Force case resolution guide as alternatives.

Cost-Benefit Relationships Analysis

To analyze the cost-benefit relationships of the obsolescence resolution options, it is important to understand the function of obsolescence management. If obsolescence is viewed as inevitable, then the function of managing obsolescence is reducing its consequences or costs. "Obsolescence management is primarily a tool for reducing or avoiding downstream costs, rather than generating immediate savings."[3] Another factor that must be considered in analyzing the costs or benefits of the resolution options is risk—the risk of downstream obsolescence and the technical risk associated with redesigning the component or system.

The *DoD Material Management Regulation* lists the resolution options in order of preference beginning with the simplest and least costly (potentially) and progressing through options with increasing costs, complexity, and difficulty. Since the options are listed by increasing cost and budgets are normally limited, a program manager's reactive approach to a notification that a manufacturer plans to discontinue production of an item generally would be to start with the least costly option and proceed down the list until the problem is resolved. However, this approach does not consider the total system implications and may cost more over the life of the weapon system. For example, finding an alternate source may solve the current obsolescence problem but the fix may only be temporary. Likewise, a LOT buy would also resolve the current obsolescence problem but only temporarily if the demand rates increase or system service life is extended.

While the options that involve redesign and replacement may cost more in the short run, replacing obsolete technology with more current technology could reduce the total ownership cost of the weapon system in the long run. Additionally, the redesign may improve system performance and reliability. Unfortunately, the technical and schedule risk associated with redesign/replacement options make them less desirable when easier solutions are available. In exploiting these redesign resolution options, it is important to take a proactive approach to predict and identify obsolete items to allow for adequate planning and scheduling the technology upgrades during normal maintenance cycles.

The Under Secretary of Defense for Logistics and Materiel Readiness during a briefing on Transforming Logistics stated, “It makes no sense to continue to pay increasing maintenance and support costs for out-of-date equipment nor to spend money updating equipment that is no longer relevant.”[4] As stated earlier, resolving obsolete parts problems are incorrectly identified primarily as reliability and maintainability issues that provide no improved capability or reduced cost; however, the objective of the obsolescence management program is to select the most cost-effective solution. Program/item managers in managing obsolescence should consider each of the resolution options in light of the total ownership cost of the weapon system to avoid more costly problems downstream. This consideration does not imply that the system must be changed or upgraded; however, in certain circumstances, redesign options may include technology insertion/upgrades, which should be considered a measurable benefit if the overall operation and maintenance costs can be reduced. Therefore, it is critical that program/item managers have the necessary financial tools to fully analyze the resolution options and justify higher funding priorities with defendable cost avoidance’s and benefits.

Notes

[1] Reliability Analysis Center, “Service Life Extension Assessment,” Contract Report presented to Rome Laboratories, September 1995, 1.

Notes

[2] Department of Defense (DoD) Regulation 4140.1-R, *DoD Materiel Management Regulation*, May 1998, C1.4.2.4.

[3] Philip Hamilton and Gorky Chin, "Aging Military Electronics: What Can the Pentagon Do?" *National Defense*, March 2001, 3.

[4] Honorable Jacques S. Gansler, undersecretary of defense, acquisition and technology, Office of the Secretary of Defense, lecture, U.S. Army War College Center for Strategic Leadership, Carlisle Barracks, Pa., 14 January 1998.

Chapter 4

Tool and Model Analysis

Model/Tool Description

"The *AFMC Case Resolution Guide* provides an approach to assist in analyzing and resolving DMSMS situations throughout weapon system acquisition and life cycle support."[1] Additionally, the guide incorporates past obsolescence case resolution successes and encourages tracking and documenting DMSMS cases and resolutions. The contractor-developed case guide, which is referenced in Air Force guidance but not included on the DMSMS web pages, is maintained by the DMSMS Program Office.

The case guide addresses obsolescence management from a life cycle management perspective emphasizing a proactive approach to managing the risk associated with obsolescence issues. The guide is not only tool for resolving obsolescence problems but also a guide for establishing an active obsolescence management program to identify and address obsolescent parts throughout a system's life cycle.

Analysis Criteria

Any criteria used to analyze a cost-benefit analysis model of the solutions discussed in the previous chapter should take into consideration the prime objectives of the obsolescence management program. These objectives, as listed in material management guidance, are basically twofold. First, the solution identified should be the most cost-effective solution for the life of the system to minimize future impacts to the system. Second, the solution should be consistent with mission requirements as stated in terms of performance (speed, reliability, etc.).[2] These objectives are represented in the questions identified below which will be used as criteria to help analyze the case resolution guide identified during the literature review.

Members of the MITRE Corporation developed a life cycle cost model for one of the solutions, a LOT buy. MITRE is a not-for-profit corporation or 'think tank' that works in partnership with the Government to address difficult issues through systems engineering and information technology. In developing the cost model, they developed six questions that should be considered when selecting a resolution option. These MITRE-developed questions, which will be used as criteria for evaluating the cost-benefit analysis model, included:

1. How many years must the solution last?
2. How well does the system, board, or box function in terms of both operations and reliability?
3. How many other integrated circuits in the board, box, or system are also obsolete, or will become obsolete during the remaining service life of the system?
4. How many of the obsolete integrated circuits are likely to be needed?
5. What options are available, and what are their relative costs?
6. What is the impact of the chosen replacement strategy on operations and maintenance costs?[3]

These questions adequately emphasize the cost side of the cost-benefit analysis and while the benefits are considered, they are addressed primarily as cost avoidance. It is important to give adequate consideration to the benefits derived from a potential resolution option. As stated earlier, the primary benefit is typically viewed as continued sustainability of the existing system; however, if the DoD is to break out of the loop of paying increasing maintenance and support costs for out-of-date equipment, another question should be included: What are the measurable benefits of the solution? Since the objective of the obsolescence management program is to select the most cost-effective solution for the life of the system consistent with mission requirements, this question will also be used as criteria to evaluate the cost-benefit analysis model.

Model/Tool Analysis

Question 1

The case guide does consider the service life of the system. In each of the resolution options, the guide emphasizes computing the future requirements based on the projected life of the equipment/system.

Question 2

The case guide includes reliability and operational capability of the system, board, or box. The guide emphasizes that each option considered should not degrade the performance of the system.

Question 3

The case guide does include consideration for other integrated circuits in the board, box, or system for the service life of the system. The case guide not only considers other integrated circuits for the board, box, or system but also provides focal points to help identify other DoD users of the same integrated circuit.

Question 4

The case guide does include the number of integrated circuits required.

Question 5

The case guide process recommends all options be considered/calculated and provides worksheets to estimate the relative cost of each option; however, the worksheets are not electronic. The worksheets would have to be printed and completed or developed in an electronic spreadsheet program.

Question 6

The case guide does include steps to calculate the total cost of each option and refers to total ownership cost; however, the worksheets do not specifically include a resulting impact of the chosen replacement strategy on operations and maintenance costs in the worksheet calculations and comparisons.

Question 7

The case guide does not emphasize or calculate measurable benefits for each option. The case guide lists general pros and cons for each of the options; however, the worksheets do not include consideration of the benefits for each option.

Summary of Analysis

Overall, the case guide provides an adequate cost-benefit analysis of the resolution options. Specifically, the case guide emphasizes the obsolescence management program objectives--identifying a cost-effective obsolescence resolution option while maintaining performance integrity consistent with mission requirements. Additionally, the guide satisfies five of the seven criteria questions for selecting a resolution option. Although the case guide has slight provisions for the remaining two criteria questions, the guide does not calculate or emphasize the consideration of the measurable benefits or include the impact on operations and maintenance costs for each option in the decision/comparison process. Finally, the guide is very detailed in providing guidance to the program/item manager on specific cost considerations for each option and ideas of where and how to obtain the data when completing the analysis.

While the *AFMC Case Resolution Guide* is an adequate tool, the tool's process is manual and does not allow "what if" scenarios to perform sensitivity analysis and determine how sensitive the analysis results are to anticipated changes in the estimated costs or benefits. An automated cost benefit analysis tool would allow the program/item manager to save time on developing the comparison calculations for the part, board, and/or assembly level and formatting analysis results and to spend more time on the data and issues that matter.

Notes

[1] ARINC, "Resolution Cost Metrics for Diminishing Manufacturing Sources and Material Shortages," Contract Report presented to Defense MicroElectronics Activity, 31 December 2001, 11.

[2] Department of Defense (DoD) Regulation 4140.1-R, *DoD Materiel Management Regulation*, May 1998, C1.4.2.4.

[3] Virginia Day and Zachary F. Lansdowne, "Impact of Electronics Obsolescence on the Life Cycle Costs of Military Systems," *Air Force Journal of Logistics*, vol. 17 no. 3 (Summer 1993): 30.

Chapter 5

Summary and Conclusion

Summary

An increase in electronic combat technologies, the extension of weapon system service life, rapid technology advancements, and the shrinking military market have increased the historical problems of obsolete parts. With limited defense funding, the cost-benefit analysis of obsolescence resolution options is critical to selecting a lasting solution at the most economical cost.

Many experts point out that the question is not how to solve obsolescence but how to manage the problems economically in the best interest of the program. Several automated tools designed to predict future obsolete parts early in the system's life cycle are available; however, these tools do not include cost-benefit analysis of the obsolescence resolution options. If obsolescence is viewed as inevitable, then the function of managing obsolescence is reducing its consequences or costs while minimizing the risks of the resolution option selected. Only one existing cost-benefit analysis tool, the *AFMC Case Resolution Guide,* is identified by this project to assist program/item managers in making the difficult and complex decision of identifying the most cost-effective solution for an obsolete part.

While the *AFMC Case Resolution Guide* is an adequate tool, the tool's process is manual and does not allow "what if" scenarios to determine how sensitive the analysis results are to anticipated changes in the estimated costs or benefits. An automated tool would allow the program/item manager to save time on developing the comparison calculations for the part, board, and/or assembly level and formatting analysis results and to spend more time on the data and issues that matter. Additionally, the guide does not calculate or emphasize the consideration of the measurable benefits or include the impact on operations and maintenance costs for each option in the decision/comparison process.

Conclusion

Program/item managers need the financial tools to compare the monetary benefits and costs of the many options available for resolving an obsolete part. Adequate automated tools to perform cost-benefit analysis do not currently exist. The AF does have an ongoing effort to develop an automated tool. In the interim, the case guide is an adequate model for program/item managers to use to perform cost-benefit analysis of the obsolescence resolution options.

Recommendations

The Air Force should include in the *AFMC Case Resolution Guide* emphasize on and calculations for the measurable benefits associated with a resolution option and consideration for the impact on total operations and maintenance costs for each option on the calculation worksheets.

The Air Force should continue development of automated cost-benefit analysis tools to include impact to overall operational and maintenance cost and consideration for measurable benefits.

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