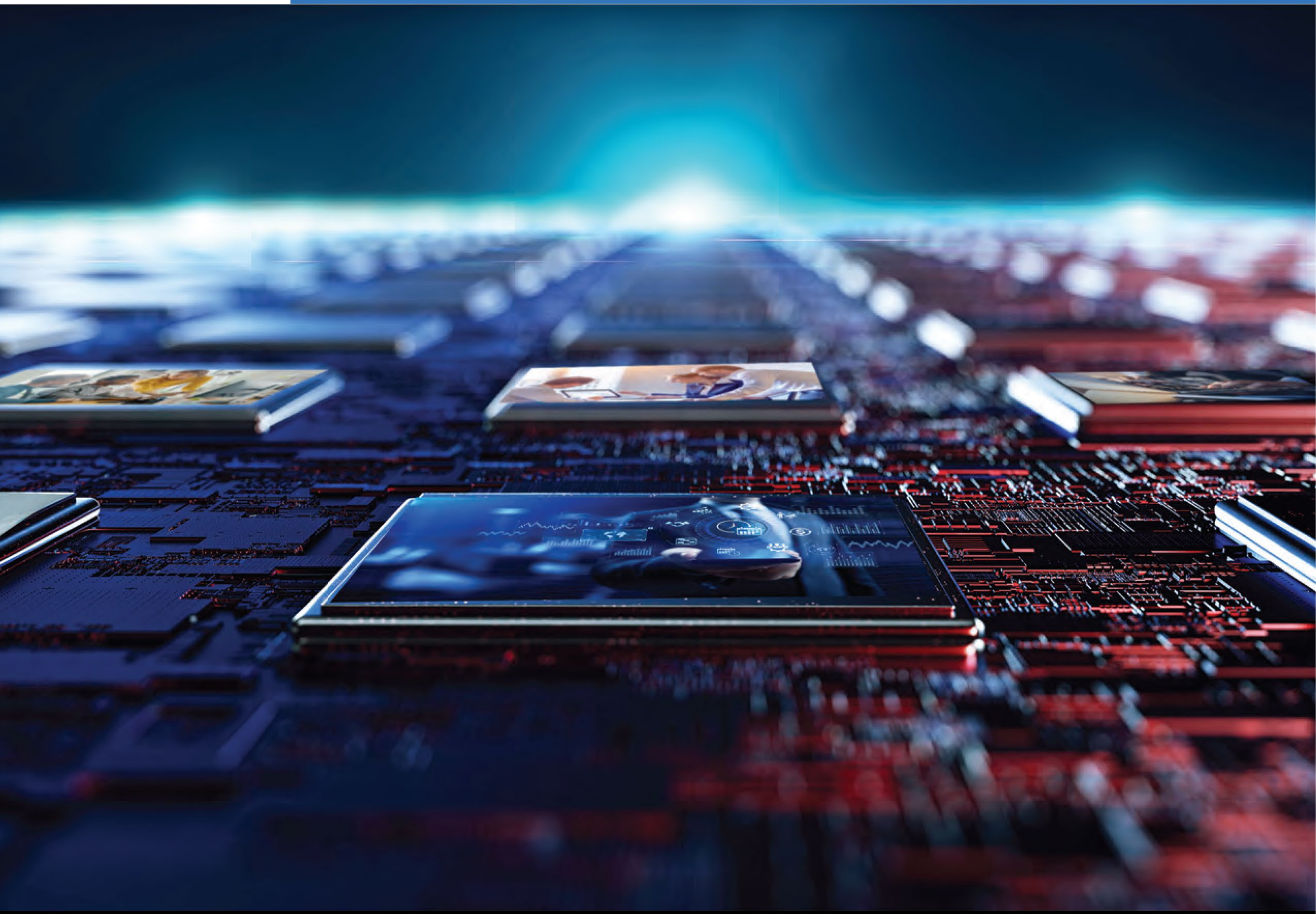
SD-22

Diminishing Manufacturing Sources and Material Shortages

A Guidebook of Best Practices for Implementing a Robust DMSMS Management Program



DEFENSE STANDARDIZATION PROGRAM OFFICE

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Foreword

The proactive, risk-based best practices for DMSMS management in this guidebook apply throughout the DoD enterprise, from DMSMS practitioners, engineers, logisticians, and program managers to Program Executive Officers and headquarters organizations. Their use, over the life cycle, will

1. Delay the occurrence of DMSMS issues via strategic technology refreshment,
2. Enable longer windows of opportunity to resolve DMSMS issues by identifying them sooner,
3. Increase the availability of lower cost resolutions because there will be more time available to resolve them, and
4. Minimize negative effects on schedule and readiness due to DMSMS issues by resolving them prior to impact on the system.

This version of the SD-22 updates the January 2021 version. The first principal change modifies DMSMS resolution types. The resolution formerly called “development of a new item or source” is split into three categories (development of a new source, design refreshment, and redevelop the item) to reflect specific situations better.

The second principal change incorporates additional best practices on interfaces among the people involved in DMSMS management, product (improvement and supportability) roadmaps, technology roadmaps, and programming and budgeting for modifications reflected by technology refreshment and technology insertion to the system. The DMSMS community uses roadmaps to formulate resolutions to issues and improve forecasts of future issues. The DMSMS community’s monitoring for current and near-term obsolescence issues are the most important contributor to supportability roadmaps. Furthermore, synergies exist between programming and budgeting for DMSMS issues and technology refreshment and insertion. Taking advantage of these synergies will improve cost effectiveness for the entire program office.

Recommended changes to this document should be addressed to the Defense Standardization Program Office, 8725 John J. Kingman Road, Stop 5100, Fort Belvoir, VA 22060-6220, or via email to DSPO@dla.mil.

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Contents

Figures

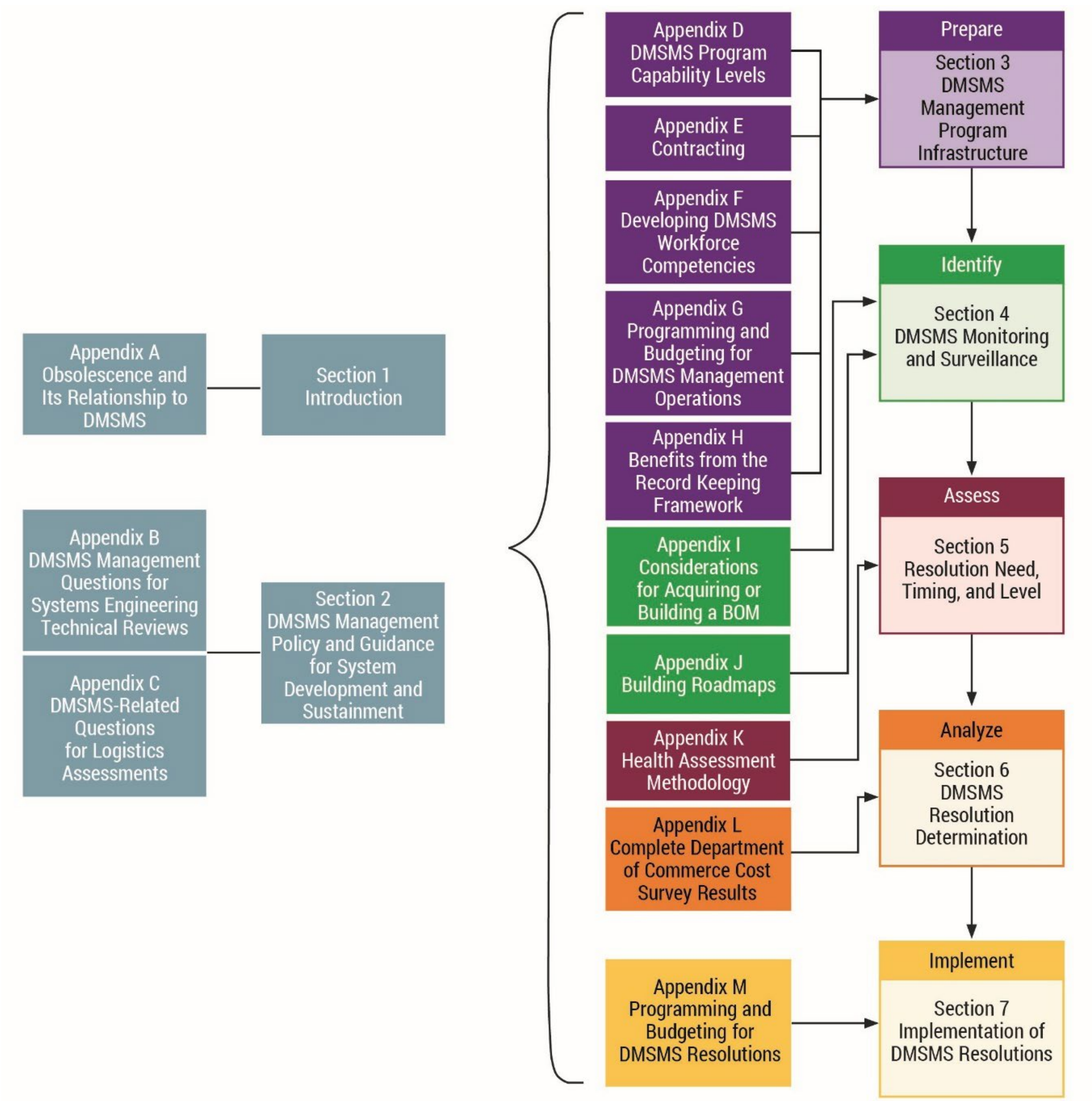
Tables

1. Introduction

1.1 ORGANIZATION OF THIS DOCUMENT

This document is organized around the five steps of the management process for Diminishing Manufacturing Sources and Material Shortages (DMSMS)—prepare, identify, assess, analyze, and implement. Figure 1 shows the high-level interrelationships of the five steps, the corresponding sections of this document, and the supporting appendixes.

Figure 1. Mapping the DMSMS Processes into This Document's Sections



The following paragraphs describe the content of this document and highlight the major changes to the January 2021 version of Standardization-related Document 22 (SD-22).

Section 1 provides an overview of DMSMS as both a concept and a multidisciplinary process. Specifically, it describes the DMSMS scope and objective, the mechanisms that drive DMSMS, the importance of establishing a DMSMS management program, and an overview of the DMSMS management process steps.

What's new
No major change.

Section 2 discusses policy and guidance pertaining to DMSMS management. This section provides important input to and context for the rest of the document.

What's new
Incorporates the latest policy changes.

Section 3 addresses the *Prepare* step of DMSMS management. Specifically, it describes best practices for establishing a strong infrastructure—data, people, processes, management reports, and financial resources—for successful DMSMS management.

What's new
No major change.

Section 4 focuses on the *Identify* step, which encompasses DMSMS monitoring and surveillance throughout the life cycle and includes best practices for determining where to focus DMSMS management efforts.

What's new
Streamlines Section 4.6 on forecasting future DMSMS issues. Refers to a new Appendix J on building roadmaps.

Section 5 discusses the *Assess* step of DMSMS management. It begins with a discussion of the monitoring and surveillance data collected as well as other supporting programmatic and logistics data. The Section 5 assessment describes how to determine whether a case should be opened, and if so, how to prioritize and whether a resolution should be considered at a higher level of assembly.

What's new
No major change.

Section 6 focuses on the *Analyze* step, which deals with analyzing alternative approaches for resolving DMSMS issues and identifying the preferred alternative. This chapter lists DMSMS resolution options and provides a basis for estimating their cost. It also identifies risk factors associated with these options.

What's new
Significantly expands the material on selecting the preferred resolution, to include the interactions among the DMSMS management community, modification planning, and roadmaps. Replaces the development of a new item or source resolution type with three better defined resolution categories (development of a new source, design refreshment, and redevelop the item). Updates DMSMS resolution cost factors to fiscal year (FY) 2022 dollars.

Section 7 addresses the *Implement* step, which covers the implementation of the preferred resolution option. It discusses potential sources of implementation funding, the roles of the DMSMS management team (DMT) during implementation, and some considerations associated with common implementation issues.

What's new
Revises and moves material on modification planning from Section 7.2 to Section 6. Updates modification programming and budgeting material.

Appendixes A through M contain supporting detail about DMSMS activities, such as questions for systems engineering technical reviews (SETRs) and independent logistics assessments (ILAs),[1] DMSMS contract language, DMSMS workforce competencies and the capabilities of a robust DMSMS management program, DMSMS implications of counterfeit parts, how to construct a BOM[2] if it was not received on a contract, building roadmaps, working capital funds (WCFs) and other sources of funding for DMSMS resolutions, programming and budgeting for DMSMS management operations, budget execution considerations, DMSMS record keeping benefits, and health assessments. Appendixes N and O list the abbreviations and references used in the preparation of this document.

1.2 SCOPE AND OBJECTIVE

This guidebook provides best practices for implementing an effective DMSMS management program throughout the entire life cycle of a system. All systems are susceptible to DMSMS issues. A DMSMS issue is the loss, or impending loss, of manufacturers or suppliers of items, raw materials, or software.[3] The DoD loses a manufacturer or supplier when that manufacturer or supplier discontinues production and/or support of needed items, raw materials, or software or when the supply of raw material is no longer available.

DMSMS issues affect materiel readiness and operational availability, which, in turn, affect both combat operations and safety. A robust risk-based DMSMS management program, using practices outlined in this guidebook, can minimize the negative impacts of DMSMS on program costs, schedule, and system performance—and ultimately warfighter readiness and lethality.

Consequently, robust risk-based DMSMS management is needed. DMSMS management is a multidisciplinary process to identify issues resulting from obsolescence,[4] loss of manufacturing sources, or material shortages; to assess the potential for negative impacts on schedule and/or readiness; to analyze potential mitigation strategies; and then to implement the most cost-effective strategy.

This guidebook replaces the January 2016 version, and is intended primarily for the DMSMS management practitioner community. However, successful DMSMS management benefits others. Therefore, program office managers (PMs), engineers, life-cycle logisticians (including supply chain

[1] Formerly, the term logistics assessments had been used instead of independent logistics assessments in Department of Defense (DoD) policy and guidance. This document generally uses the newer terminology except where it references older documents that have not been updated.
[2] A bill of materials is a list of the original equipment manufacturer (OEM)–assigned part numbers within a higher level of assembly.
[3] The term "software" encompasses commercial off-the-shelf (COTS), custom, or any combination thereof of firmware, middleware, wrappers, gateways, firewalls, application programs, and operating systems.
[4] The term "obsolescence" is similar, yet different, from DMSMS from a *dictionary* perspective. The differences are small—DMSMS encompasses 1) items that are not obsolete but where there are shortages and 2) obsolete items that are out of production and there is demand. Because there is no difference between DMSMS management and obsolescence management from a *process* perspective, both terms are used interchangeably throughout this document with a distinction being made only where needed for clarity. For more information on the relationship between obsolescence and DMSMS, see Appendix A.

managers, inventory managers, and maintainers) and their associated policymakers are also part of the intended audience.

The purpose of this document is as follows:

- Create awareness of the extent and impact of DMSMS issues on DoD systems;
- Provide best practices to PMs for implementing a robust, risk-based DMSMS management process, and building a cost-effective DMSMS management program;
- Encourage DMSMS resilience by using a modular, open system design approach along with other supportability-related design considerations in conjunction with part selection procedures that choose items with significant time left in their life cycle and with viable replacement options whenever possible in order to reduce the likelihood that a design will experience near-term DMSMS issues and increase the probability of a quick recovery when issues do occur;
- Define DMSMS support metrics to measure the effectiveness, efficiency, and return on investment (ROI) of a robust DMSMS management program;
- Promote affordable and efficient program office[5] support through rapid and cost-effective DMSMS management best practices and resolutions that take into account equipment life cycles, technology changes, and planned obsolescence; and
- Promote the exercise of best practices to address obsolescence risks throughout the life cycle.

1.3 DMSMS MECHANISMS

DMSMS issues are inevitable and can occur at any point in a system's life cycle. They affect short- and long-lived systems; reparables and consumables; and space-based, air-based, ground-based, and sea-based equipment (including support and test equipment). DMSMS issues are not confined to piece parts or devices; obsolescence may occur at the part, module, component, equipment, or system level. DMSMS issues are also not limited to defense-unique items; COTS items represent a significant obsolescence problem, because such items are most susceptible to market forces. While traditionally thought of as applying to electronic items, DMSMS can affect any item within a system, including software and
non-electronic components—materials and structural, mechanical, and electrical (MaSME) items. Consequently, DMSMS management should address materials, mechanical items, and software[6] in addition to traditional electronic items.

DMSMS issues can be caused by many factors—such as low-volume market demand, new or evolving science or technology, changes to detection limits, toxicity values, and regulations related to chemicals and materials—that significantly affect the DoD supply chain and industrial base. Another aspect of DMSMS is when an item, although still available commercially, no longer functions as intended because of hardware, software, and/or requirements changes to the system. This is often referred to as functional

[5] In general, DMSMS management is performed by organizations which include acquisition program offices and other organizations responsible for performing DMSMS management activities in support of those program offices. The general terminology used is: DMSMS management performing organization. This document uses the term program office throughout to imply all types of DMSMS management performing organizations.

[6] Generally, the use of the word "item" in this document is intended to be all-inclusive of parts, assemblies, software, and material.

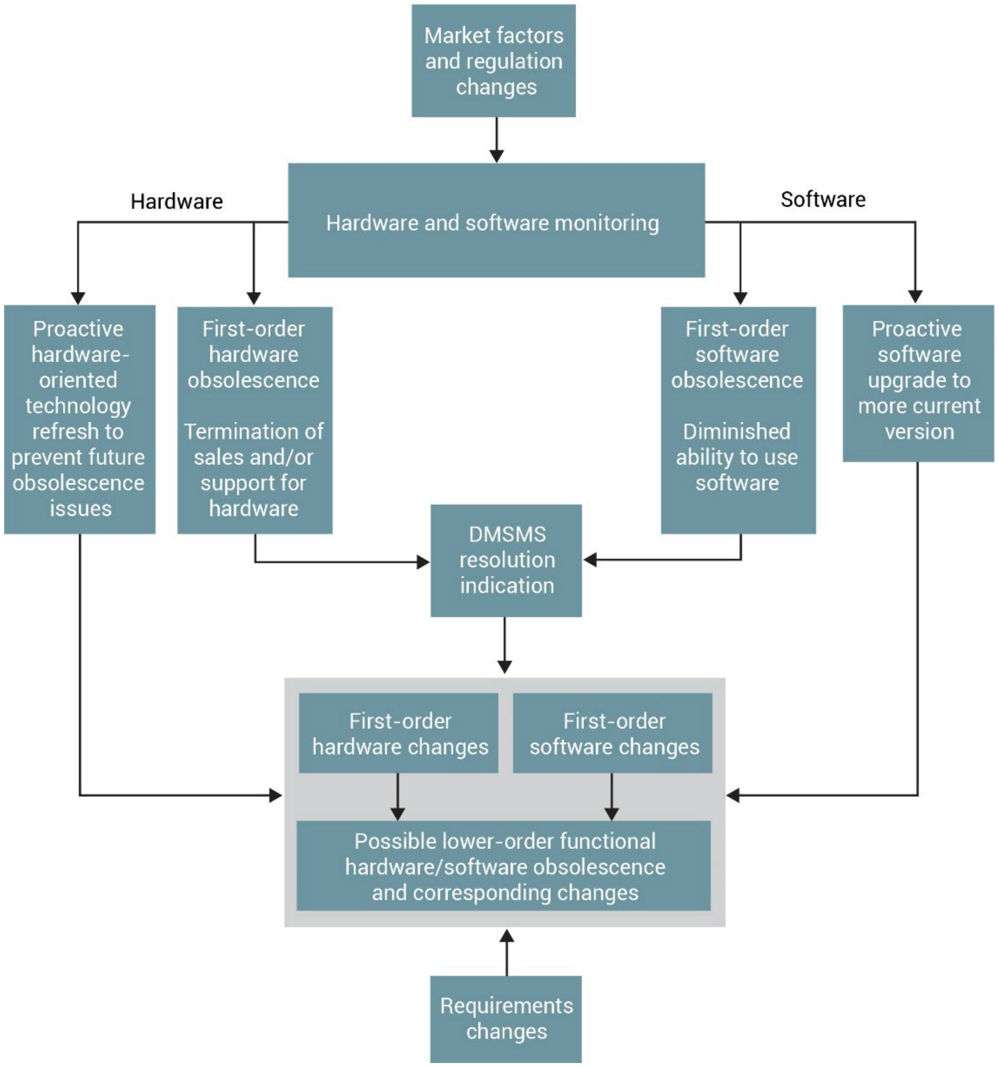
obsolescence. Any of these situations may endanger an ongoing production capability, the life-cycle support of a weapon system, or training, support, and test equipment already in the field.[7]

Whether dealing with hardware[8] items or software, obsolescence is ultimately driven by one of a number of DMSMS mechanisms, influenced by the short life cycle of technology as compared to the long life cycle of defense systems. Figure 2 illustrates the symmetrical nature of both first-order and lower-order obsolescence mechanisms for hardware and software. Although the figure may give an impression of a sequential progression of events, that is not the case. Hardware and software obsolescence may occur simultaneously. To help drive home the point that both hardware and software are part of the same process, the figure shows "hardware and software monitoring" and "DMSMS resolution identification" as single boxes, rather than hardware- and software-specific boxes. Both hardware and software may also become functionally obsolete, as a secondary impact of some other change to the system.

There are two broad obsolescence mechanisms: first-order obsolescence and lower-order, or derived, obsolescence. First-order obsolescence is directly driven by market factors and regulation changes that affect DoD's ability to buy, license, obtain support for, or use hardware and software.[9] Lower-order obsolescence is functional obsolescence caused by hardware or software changes made to resolve first-order obsolescence issues, perform a proactive upgrade, or respond to a requirement change. Hardware and software monitoring identifies instances of first-order obsolescence. This monitoring also identifies functional obsolescence, resulting from proactive upgrades to hardware and software, in addition to, at least in part, driving the need to make proactive upgrades.

[7] The word "system," as used in this document, encompasses weapon systems and training, support, and test equipment.
[8] Hereafter, except if otherwise specified, if "hardware" is used alone, it refers to both electronic and MaSME items.
[9] Once an item is identified as becoming obsolete, an additional market factor further limiting DoD's ability to buy is the potential for increased demand to acquire the remaining supply matter.

Figure 2. Mechanisms for Hardware and Software Obsolescence



First-order obsolescence situations should be identifiable from hardware and software monitoring of the effects of market forces. Leading causes of first-order obsolescence are as follows:

- Hardware—electronic items. Sales and support may be terminated because of some combination of low demand, demand for new technologies and capabilities, lack of profitability, vulnerabilities, loss of production capability because of modernization or disposal of manufacturing equipment or mergers/acquisitions, unavailability of items, unavailability of materials, loss of repair support expertise, and so forth. For example, manufacturing tooling may be disposed of after production is completed.
- Software. Competitive market forces can also lead to software obsolescence. Companies discontinue software sales and support for a number of reasons:
  - Lack of sufficient profitability,
  - A preference that customers upgrade to the most recent products,
  - Mergers and acquisitions,

- – Loss of the skilled personnel needed to support older versions of the software, and
  - – Unavailability of software development tools for building, testing, and integrating the software (e.g., compilers, databases, regression testing capability,[10] and configuration management (CM) software).

  A program office's ability to use software is inextricably linked to obtaining a license and receiving support. Software support includes product enhancements to increase capability or to decrease vulnerability to malicious attacks, error correction, and general support for its application in particular environments. If support is no longer obtainable, updated security patches will not be available, bugs cannot be fixed, routine maintenance cannot occur, and modifications can no longer be made.

- Hardware—MaSME items. Market forces also lead to DMSMS issues for hardware—MaSME items, but not quite in the same way as for electronic items and software. Unlike electronic items, MaSME items are typically on the market for long periods of time and, depending on the situation or support posture, are often repairable. Manufacturing processes for structural, mechanical, and electrical items have also remained relatively stable over time. Principal factors for DMSMS issues pertaining to materials (including critical materials resident within the supply chain) and structural, mechanical, and electrical items include the following:
  - – Hazardous materials are being used. Regulations on hazardous materials may become stricter (e.g., Restriction of Hazardous Substances [RoHS]). Such materials may be banned completely or become difficult and/or prohibitively expensive to use or obtain (e.g., Freon or lead [Pb]).
  - – The supplier goes out of business or through a merger and acquisition in which the existing product line no longer fits in the new product portfolio. This is more likely with small and/or financially vulnerable suppliers that supply items to larger companies that use the items to assemble their product. Item lines that are sold from original companies to other businesses are vulnerable to being discontinued.
  - – The supplier's business case is no longer viable. This may occur with low-demand products potentially containing exotic materials that are difficult to manufacture or involve major disruptions to more profitable business activities. This may also occur as a result of regulation changes (e.g., tungsten rhenium wire was affected because of energy-related regulations on the disuse of incandescent light bulbs; Freon).
  - – Supply-constrained materials are used. There may be U.S. or foreign regulations or supplier policies that affect availability. For example, a foreign source may limit its exports or not be willing to sell its product for a DoD application. The United States Code (U.S.C.), Title 10, §2533b imposes restrictions on some specialty metals, for example, steel (specific mixes); metal alloys containing nickel, iron-nickel, and cobalt base alloys; titanium and titanium alloys; and zirconium and zirconium base alloys.[11]
  - – The tooling is no longer available. Depending on the specific situation, resolving this issue may involve substantial time and cost.

Figure 2 also includes a resolutions block because implementing changes (which are called first-order hardware and software changes) to resolve first order obsolescence can lead to lower-order or derived obsolescence. Similarly, when a program office takes an action to proactively upgrade or to satisfy new requirements, the changes implemented have the potential to cause lower-order obsolescence. Following

[10] Regression testing seeks to ensure that software changes have not introduced new faults.

[11] 10 U.S.C. § 2533b, "Requirement to Buy Strategic Materials Critical to National Security from American Sources; Exceptions," available via the Cornell University Legal Information Institute, www.law.cornell.edu/uscode/text/10/2533b.

are descriptions of the different factors that influence the need for hardware or software changes and how such changes can cause lower-order obsolescence:

- First-order hardware changes. These changes can result from one of three factors. First, robust DMSMS management seeks to refresh items before they become obsolete. Proactive technology refreshment results in a hardware change. Technology refreshment is a “technology-related, periodic, planned change of items within a system’s design to ensure continued access to the items necessary for system’s support.”[12] Second, hardware changes may be driven by implementing engineering resolutions to address DMSMS issues such as the termination of sales or support of existing hardware. The resulting engineering resolutions range from the use of a simple substitute with an existing replacement item to the redesign of the item to redesign at a higher level of assembly. Finally, a new performance requirement may necessitate a hardware change. Regardless of the factors influencing first-order hardware changes, lower-order hardware or software obsolescence may result because the existing hardware or software no longer functions as intended. For example, legacy software may not work, or may not work correctly, on new hardware configurations for a variety of reasons, such as data transmittal, storage, access, processing, display, interface issues, operating system capability issues, or timing concerns. Similarly, legacy hardware may suffer from physical incompatibility.
- First-order software changes. These changes can result from factors that are analogous to the three factors that cause first-order hardware changes. Software upgrades or technology refreshments are not always compatible with other software applications that have been tested on or with earlier versions. For example, an upgrade to a COTS operating system may no longer support the assumptions made by the existing firmware; consequently, the firmware may become functionally obsolete. DMSMS resolutions implemented because of the inability to use software also lead to a first-order software change. Finally, first-order software obsolescence may be driven by changes to performance requirements that necessitate a software change. For example, scalability may be an issue if the transaction volume changes significantly. Greater processing power and memory size may also be required. The above rationale for first-order hardware changes leading to lower-order software or hardware obsolescence is directly applicable to first-order software changes leading to lower-order software or hardware obsolescence.

1.4 THE IMPORTANCE OF A DMSMS MANAGEMENT PROGRAM

Ultimately, DMSMS management is important for a simple reason: it protects systems. Robust DMSMS management of inevitable obsolescence is the most cost effective and efficient way to minimize the negative effects of DMSMS for all acquisition pathways throughout a system’s life cycle. As discussed in Section 2.2, the following objectives of DMSMS management minimize the impact on the cost, schedule, and performance of a system:

- Ensure DMSMS resilience during design,
- Minimize the scope of DMSMS-related out-of-cycle redesigns when they cannot be eliminated or avoided,
- Eliminate DMSMS-caused production schedule impacts, and
- Eliminate readiness degradations caused by DMSMS issues.

[12] Mandelbaum, Jay and Christina Patterson, “Be Strategic!—Leverage Technology Insertion and Refreshment on DMSMS Issues,” *Defense Acquisition Magazine*, Defense Acquisition University, July–August 2021, p. 38.

Because DMSMS management has a significant effect on many aspects of a program office, it is not a standalone function, nor does it benefit a single stakeholder. DMSMS management is inherently linked with reliability, maintainability, supportability, and availability. Within this context, it is important to plan for, minimize, and manage the risks associated with DMSMS issues, due to their detrimental impact on materiel readiness, operational mission capability, safety of personnel, and affordability.

Materiel readiness is an immediate and urgent concern for the warfighter. Missions are affected if equipment cannot be supported; either the equipment is not available for the mission, or it cannot be sustained throughout the mission. DMSMS issues can negatively affect supportability if the items needed to repair a system are not available or are in scarce supply. It is unacceptable for a system to be non-mission-capable due to a DMSMS issue. To allow a DMSMS situation to progress to the point of affecting a mission (because items are not available) is contrary to DoD policy and is an indication of ineffective DMSMS management as well as poor sustainment planning. In addition, ineffective DMSMS management can cause the costs for items to rapidly escalate.

A robust DMSMS management program is the most effective and efficient way to minimize readiness risks due to DMSMS issues, deliver better buying power, and improve overall life-cycle management. DMSMS resolutions are based on the most cost-effective approach to managing the problem before operations are affected. The cost avoidance by being proactive can be substantial, as discussed below:

- The Terminal High Altitude Area Defense (THAAD) program office in the Missile Defense Agency (MDA) faced an obsolescence issue with its existing one-color seeker—a redesign was determined to be the only feasible solution. However, a redesign to upgrade the seeker to a two-color capability was being considered for five years in the future. The THAAD obsolescence team recommended a one-time redesign of the seeker to mitigate the current obsolescence, while providing the ability to upgrade the THAAD system later. This effort added capability benefit without increasing risk to the production line or production timelines. That resolution avoided $100 million in potential future, redundant, seeker redesign costs while accelerating two-color capability. Additionally, these actions enabled timely production cut-in to support both U.S. and foreign military sales (FMS) obsolescence cases equally, establishing a foundation for future THAAD improvements and overall ballistic missile defense capability across all architectures.
- The Virginia-class submarine program integrated DMSMS management into the construction program early in the design/build process. To ensure consistency and repeatability of results, the program office established a technology refreshment integrated product team (IPT), formalized a standard operating procedure, developed a memorandum of agreement with the Naval Supply Systems Command for the advanced procurement of spares, and established a budget. Over the past 19 years, the program office has evolved and now operates jointly with other submarine platforms under a joint submarine DMSMS management plan. As a result, the program has resolved more than 1,775 obsolescence issues and reaped more than $188 million of documented cost avoidance by being proactive since inception.
- The Black Hawk UH/HH-60M is an Acquisition Category 1C program that is currently in Multi-Year IX production with plans to be sustained until 2075. The Black Hawk DMT provides analysis and resulting recommendations related to DMSMS/obsolescence and is responsible for 17 line replaceable units (LRUs). One notable area of success was creating the data needed to be proactive; the team worked with the program office to open up an unserviceable LRU to identify active components on each board and then develop an indentured BOM. Through its proactivity in general, advanced warning time for DMSMS issues has increased. This allows time to develop optimum solutions that yield the lowest total ownership cost to the program office. All of these efforts have not only prevented an impact to the production line, but also resulted in closing 232 obsolescence cases which led to $44.1 million in cost avoidance.

Without a robust DMSMS management program, a program office will likely incur unnecessary cost as the following example shows:

- A contract was awarded to produce five low rate initial production lots for an Air Force lead joint program office. Unfortunately, the contract did not clearly require the contractor to proactively monitor and manage obsolescence effecting future production lots. While the contractor was contractually committed to delivering all units, the contractor had no contractual obligation to preserve future production capacity. This resulted in 19 different DMSMS contract actions that threatened the program office's ability to successfully ramp up to full rate production quantities and cost $40 million to resolve. Because of this negative and costly experience, the program office now operates and addresses DMSMS in a proactive manner by conducting health assessments every six months and assessing and planning how best to resolve each DMSMS case. In addition, the program office audits supplier's awareness, practices, and procedures regarding DMSMS to reduce the occurrence of pop-up obsolete parts. Finally, the program office initiated a Technology Refresh trade study to identify critical components, sub-assemblies and sections of the system that have a limited production life.

These examples demonstrate how DMSMS management can result in better value for the taxpayer and the warfighter. However, benefits extend well beyond these examples. The following excerpt from the 2018 National Defense Strategy[13] is part of the third tenet of DoD's strategic approach to achieving its National Defense objectives—reforming the Department's business practices for greater performance and affordability

> *The current bureaucratic approach, centered on exacting thoroughness and minimizing risk above all else, is proving to be increasingly unresponsive. We must transition to a culture of performance where results and accountability matter. We will put in place a management system where leadership can harness opportunities and ensure effective stewardship of taxpayer resources. We have a responsibility to gain full value from every taxpayer dollar spent on defense, thereby earning the trust of Congress and the American people.*

DMSMS management helps target affordability and control cost growth in several ways. By accounting for DMSMS issues during design (trades), future operating and support (O&S) costs will be controlled and possibly reduced. For example, the use of standardized parts and the latest technologies can reduce the impact of DMSMS issues during sustainment by enhancing the interchangeability, reliability, and availability of items.

Robust DMSMS management includes cultivating long-term relationships with suppliers. Given such relationships, suppliers should be less likely to discontinue an item, and if they decide to discontinue the item for business reasons, the government is more likely to have advanced warning, placing it in a better position to plan an alternative course of action.

Furthermore, DMSMS management results should be a key driver of technology refreshment plans. The ultimate goal is to replace items before they become obsolete. This is enabled by both open systems architecture and data rights in designs which enhance competition by providing a framework for decomposing a system into items and obtaining the necessary technical information for them. Modular open systems architecture is also an important DMSMS-related design consideration, because identification and standardization of major system interfaces makes substitution of alternative

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[13] DoD, *Summary of the 2018 National Defense Strategy of the United States: Sharpening the American Military's Competitive Edge*, January 19, 2018, p. 10, available via https://dod.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf.

technologies easier. Robust DMSMS management will secure data rights and necessary technical data for items highly likely to face DMSMS issues and likely to be good targets for technology refreshment.

1.5 OVERVIEW OF THE DMSMS MANAGEMENT PROCESS

The DMSMS management process is straightforward and ultimately constitutes DMSMS risk management. As described in Section 1.1, the DMSMS management process has five tailorable steps that are detailed in Sections 3 through 7. In the *Prepare* step, a program office develops the foundations for DMSMS management and a DMSMS management plan (DMP) with resources to implement it. Through near-term monitoring and surveillance and longer term technology forecasting of the *Identify* step, a program office finds items with obsolescence risks. For the *Assess* step, a program office determines whether it should open a case for the identified items, as well as when and at what level (i.e., the item or a higher level of assembly) to resolve the DMSMS issue. The program office determines the most cost-effective resolution during the *Analyze* step and then executes that resolution in the *Implement* step.

Each of these steps applies throughout the system life cycle, from early technology development through sustainment. Although it is best to begin these activities early in the life cycle, they may be initiated at any point in the process. Robust DMSMS management is a dynamic process that continues over the system's life cycle. The five steps represent a sequence of discovery and resolution. Once a program office resolves one issue, it should move on to the next. When a program office has gone through its list of issues, it should start again; due to the dynamics of the market, something will have changed. A program office should repeat this cadence on an established rhythm until system retirement.

Figure 3 depicts the five DMSMS management steps. Within those steps, strategic processes increase the likelihood of implementing low cost resolutions while delaying and preventing the occurrence of DMSMS issues in concert with system modification[14] planning. Strategic processes also include the use of evaluation results for the program office's DMSMS management processes to improve effectiveness and efficiency. Since the strategic processes relate to five DMSMS management process steps, Figure 3 depicts "strategize" as a circle encompassing them.

[14] This document uses the term "system modification" to mean any change to the configuration of the system.

Figure 3. Steps in the DMSMS Management Process

2. DMSMS Management Policy and Guidance

This section summarizes DoD DMSMS management policy and guidance. In addition to Department-level policy, the DoD Components also have their own DMSMS management policies and guidance. The DMSMS Knowledge Sharing Portal (DKSP) contains all of these policy and guidance documents.[15]

2.1 DMSMS MANAGEMENT POLICY

2.1.1 High-Level DMSMS Management Policy

DMSMS management policy for the DoD has historically existed in DoDI 4140.01, "DoD Supply Chain Materiel Management Policy," and volume 3 of Department of Defense Manual (DoDM) 4140.01, "DoD Supply Chain Materiel Management Procedures: Materiel Sourcing." Recently, DMSMS management policy migrated from DoDI 5000.02, "Operation of the Adaptive Acquisition Framework," to DoDI 5000.85, "Major Capability Acquisition." Table 1 contains the DMSMS management-related policy language from these three DoD issuances.

Table 1. High-Level DMSMS Management-Related Policy

Document	Section	DMSMS Management Policy Statement
DoDI 5000.85	Section 3: Major Capability Acquisition Procedures	"3.1. GENERAL PROCEDURES. a. Program Planning. (1) A rapid, iterative approach to capability development reduces cost, avoids technological obsolescence, and reduces acquisition risk. Consistent with that intent, acquisitions will rely on mature, proven technologies and early testing. Planning will capitalize on commercial solutions and non-traditional suppliers, and expand the role of warfighters and security, counterintelligence, and intelligence analysis throughout the acquisition process."[16]

[15] The DKSP can be accessed at www.dau.edu/cop/dmsms/Pages/Default.aspx.

[16] DoDI 5000.85, "Major Capability Acquisition," November 4, 2021, p. 8.

Document	Section	DMSMS Management Policy Statement
DoDI 5000.91	Section 4: General Product Support Procedures Over the Program's Life Cycle	"4.3. THE PSS [PRODUCT SUPPORT STRATEGY] AND THE LCSP [LIFE CYCLE SUSTAINMENT PLAN]" b. The LCSP is the primary program management reference governing operations and support planning and execution from program inception to disposal. An LCSP is required for all covered systems and is the principal document establishing the system's product support planning and sustainment, pursuant to Section 2337 of Title 10, U.S.C. For covered systems, a detailed LCSP will include: (6) Sustainment risks, SCRM [supply chain risk management], and diminishing manufacturing sources and material shortage (DMSMS) risk management and proposed mitigation plans. (7) Engineering and design considerations, including DMSMS resilience, that support cost-effective sustainment for the system."[17] "4.11. ADDITIONAL PRODUCT SUPPORT ACTIVITIES: a. Materiel Management and Materiel Storage. The PM, through the PSM [product support manager], will evaluate and select materiel management solutions that balance support goals, total supply chain costs, and performance factors IAW [in accordance with] DoDI 4140.01, DoDI 4140.69, Volume 5 of DoD Manual 4140.01, DoDI 4245.15, and DoD Manual 4140.70. The PSM will use existing organic storage and warehousing facilities (DLA [Defense Logistics Agency] or other similar organic warehousing and storage) to the maximum extent practicable before establishing additional capacity at either organic or private warehouse or storage facilities. Additional requirements for DMSMS, SCRM, and materiel, equipment, and inventory management are detailed in DoDI 4140.01, DoDI 5000.64, and DoDI 5200.44. Serialized item management instructions are detailed in DoDI 8320.04."[18] "f. DMSMS The PM, through the PSM, will develop, ensure funding, and execute a DMSMS management plan and conduct proactive risk-based DMSMS management per that plan to identify current DMSMS issues, forecast future DMSMS issues, program and budget for resolving DMSMS issues, and implement those resolutions IAW DoDI 4245.15. Implementing DMSMS issue resolutions will take into account a parts management process that considers SCRM, supportability, loss of technological advantage, and obsolescence when selecting parts used in DMSMS resolutions. In addition, the PSM will use both current and forecasted DMSMS issues in developing product roadmaps for supportability."[19]

[17] DoDI 5000.91, "Product Support Management for the Adaptive Acquisition Framework," November 4, 2021, p. 13.
[18] Ibid, p. 18.
[19] Ibid, p. 19.

Document	Section	DMSMS Management Policy Statement
DoDI 4140.01	Section 2: Responsibilities	Assigns responsibilities to: "2.3. Director, Defense Pricing and Contracting. … c. Establishes procurement policies, procedures, and guidance to support timely solutions to diminishing manufacturing sources and material shortages (DMSMS), including obsolescence."[20] "2.5. USD(R&E) [Under Secretary of Defense for Research and Engineering]. … c. Provides technical advice and assistance, as necessary, to the ASD(S) [Assistant Secretary of Defense for Sustainment] on matters; … (2) Pertaining to the timely identification of technical solutions to DMSMS."[21] "2.7. DoD Component Heads… f. Establish programs for monitoring and mitigating the risk of: … (2) DMSMS, including obsolescence."[22]
DoDM 4140.01, Volume 3	Section 2. DMSMS Responsibilities	Assigns responsibilities to: "2.3. Secretaries of the Military Departments, Director, Missile Defense Agency (MDA), and Director, Defense Logistics Agency... f. Establish and implement, for their military department or agency, a standard strategy and program for diminishing manufacturing sources and material shortages (DMSMS) that: (1) Reduces or eliminates the cost and schedule impacts of all identified DMSMS problems. (2) Helps ensure that DMSMS problems do not adversely impact weapon system readiness."[23]
	Section 9: DMSMS	Identifies procedures for DoD Components, and more specifically for the Military Departments, DLA, and MDA, for: "9.1. DMSMS Requirements" "9.2. Actions for Minimizing the Impact of DMSMS "9.3. Resolution of DMSMS Issues."[24]

2.1.2 Detailed DMSMS Management Policy

While, the above high-level policy remains in effect; on November 5, 2020, the Department issued a more specific, stand-alone DMSMS management policy. DoD Instruction 4245.15, "Diminishing Manufacturing Sources and Material Shortages (DMSMS) Management,"[25] promulgates DoD policy to:

a. *Establish and implement risk-based, proactive DMSMS management throughout the life cycle of all DoD items.*

b. *Evaluate all DoD system designs and redesigns for potential DMSMS issues that could arise during the life cycle of a DoD item.*

c. *Implement resolutions if necessary to minimize or eliminate risks and negative impacts (e.g., cost, schedule delays, readiness) from DMSMS issues throughout the life cycle of DoD items.*

[20] DoDI 4140.01, "DoD Supply Chain Materiel Management Policy," March 6, 2019, p. 5.
[21] DoDI 4140.01, p. 6.
[22] DoDI 4140.01, p. 7.
[23] DoDM 4140.01, "DoD Supply Chain Materiel Management Procedures: Materiel Sourcing," Volume 3, October 9, 2019, pp. 5–6.
[24] DoDM 4140.01, Vol. 3, pp. 33–37.
[25] DoDI 4245.15, "Diminishing Manufacturing Sources and Material Shortages (DMSMS) Management," November 5, 2020.

d. Implement improvements to DMSMS management processes throughout the life cycle of all DoD items across the DoD enterprise.[26]

Furthermore, DoDI 4245.15 identifies responsibilities and procedures pertaining to DMSMS management. The instruction specifically identifies DMSMS-related responsibilities for—

- Under Secretary of Defense for Acquisition and Sustainment (USD(A&S));
- Assistant Secretary of Defense for Acquisition;
- ASD(S);
- Deputy Assistant Secretary of Defense for Industrial Policy (DASD(IP));
- Director, Defense Contract Management Agency;
- USD(R&E);
- DoD Component Heads; and
- Secretaries of the Military Departments; Director, DLA; Director, MDA; and Director, Defense Health Agency (DHA).[27]

The procedures section of DoDI 4245.15 identifies DMSMS management-related procedures for "acquisition and item management program offices and other DMSMS management performing organizations".[28] These procedures address the following topics:

- Development and update of DMSMS management plans;
- The collection and maintenance of DMSMS case and operations data;
- The consideration of DMSMS during system design (i.e., new designs and redesigns);
- The identification, documentation, and mitigation of DMSMS risks;
- Programming and budgeting for DMSMS management operations and resolutions;
- The inclusion of DMSMS management-related provisions in contracts;
- The timely resolution of DMSMS issues to minimize cost, schedule, and readiness impacts;
- Communication with supply organizations and other external DoD Components to mitigate DMSMS issues and risk;
- Training the DMSMS management workforce and other stakeholders; and
- Evaluation of DMSMS management activities in engineering and logistics processes and practices.[29]

A forthcoming DoDM will identify additional responsibilities and procedures pertaining to DMSMS management, and will serve as a companion document to DoDI 4245.15.

[26] DoDI 4245.15, p. 3.
[27] DoDI 4245.15, pp. 4–7.
[28] DoDI 4245.15, p. 7.
[29] DoDI 4245.15, pp. 8–9.

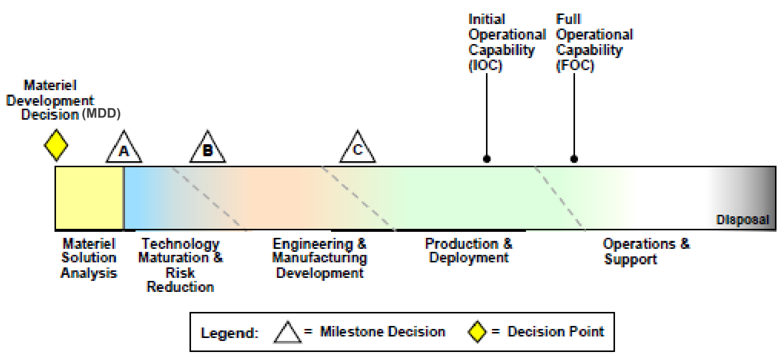
2.2 DMSMS MANAGEMENT GUIDANCE THROUGHOUT THE SYSTEM LIFE CYCLE

As stated previously, the policy formerly captured in DoDI 5000.02, "Operation of the Adaptive Acquisition Framework" has migrated to a set of new Department instructions. The following new instructions contain policy pertaining to the acquisition pathways—

- DoDI 5000.81[30] governs the Urgent Capability Acquisition (UCA) pathway,
- DoDI 5000.80[31] governs the Middle Tier of Acquisition (MTA) pathway,
- DoDI 5000.85 governs the Major Capability Acquisition (MCA) pathway,
- DoDI 5000.75[32] governs the Defense Business Systems (DBS) pathway,
- DoDI 5000.87[33] governs the Software Acquisition (SWA) pathway, and
- DoDI 5000.74[34] governs the Acquisition of Services pathway.

The Defense Acquisition University's (DAU's) "Adaptive Acquisition Framework" web page at: https://aaf.dau.edu/ provides more detailed policy and guidance pertaining to the acquisition pathways.

Figure 4. Phases of Major Capability Acquisition[35]



In the past, DMSMS management has mostly related to the MCA pathway (see Figure 4); however, a program office can tailor the best practices conveyed in this document to all acquisition pathways (except acquisition of services) as a function of risk. Section 2.2.3 describes this tailoring.

Given the long life cycles of defense systems, the exclusion of obsolete items from the designs of those systems and the continuous monitoring for obsolete items throughout the life of systems represent obvious best practices. Even in the early stages of the life of a system, program offices can examine a preliminary parts list to identify whether the system design contains any obsolete or near obsolete parts. Doing so offers an acquisition program office the opportunity to lower the cost of redesigns, identify items to design out before causing a detrimental impact, and also provide guidance on what to preserve, in terms of technical data, tooling, and insurance spares to hedge against future obsolescence. Even when a

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[30] DoDI 5000.81, "Urgent Capability Acquisition," December 31, 2019.
[31] DoDI 5000.80, "Operation of the Middle Tier of Acquisition (MTA)," December 30, 2019.
[32] DoDI 5000.75, "Business Systems Requirements and Acquisition," January 24, 2020.
[33] DoDI 5000.87, "Operation of the Software Acquisition Pathway," October 2, 2020.
[34] DoDI 5000.74, "Defense Acquisition of Services," January 10, 2020.
[35] This figure is adapted from DoDI 5000.85, p. 10.

program office cannot prevent the use of obsolete items, having properly vetted a system's design can enable the preparation of a mitigation strategy to address the known obsolescence at a lower cost. For all of these reasons, DMSMS management, at the direction of the PM and PSM, should begin early and continue throughout the life cycle of the system. Table 2 summarizes DMSMS management-related content outlined in the Defense Acquisition Guidebook (DAG), organized by life cycle phase.[36]

Table 2. DMSMS Management-Related DAG Content

Life Cycle Phase	DMSMS Management-Related DAG Content
Pre-Development	The DoD does not specifically reference DMSMS management; however, program offices should employ DMSMS management support[37] prior to the start of system development to: • Assist in drafting mitigation strategies, possible technology refresh plans, and supportability risk analysis. • Research (in conjunction with contractors) planned parts lists, technology, materials and the industrial base and determine potential obsolescence risks throughout the system's life cycle. • Include part selection criteria that consider DMSMS in the request for proposal.
Engineering & Manufacturing Development (EMD)	Systems Engineering • "Identify the process to proactively manage and mitigate Diminishing Manufacturing Sources and Material Shortages (DMSMS) issues in future life-cycle phases."[38] Life Cycle Sustainment • "[T]he PM's program schedule and budget should include planning for obsolescence beginning in EMD."[39] • With respect to reliability and maintainability, "[t]he contract should require the design delivery data package include a complete bill of materials to support the PSM's obsolescence tracking and management responsibilities (see FY14 NDAA, Sec 803)."[40]
Production & Deployment	Systems Engineering • "Identifying long-lead items and critical materials; plan for obsolescence and implement DMSMS measures to mitigate impacts to production and sustainment."[41] • "[T]he Systems Engineer should identify and plan for potential obsolescence impacts (i.e., Diminishing Manufacturing Sources and Material Shortages (DMSMS)). DMSMS problems are an increasing concern as the service lives of DoD weapon systems are extended and the product life cycle for high-technology system elements decreases."[42] Life Cycle Sustainment • "The PM assesses ECPs for impact on the sustainment plan and O&S cost. The PM can request that the FRP RFP include maintenance of the Logistics Supportability Analysis database (where applicable) or other support and supply data, to support future modifications and obsolescence re-designs."[43]

[36] The vocabulary of Major Capability Acquisition is used because that is the current vocabulary used by the DAG. Although the terminology may be different, the concepts of these phases apply to all pathways.
[37] Often this support is provided by a contractor.
[38] DAU, *DAG*, at Chapter 3, "Systems Engineering," available at https://www.dau.edu/tools/dag, accessed April 2, 2020.
[39] *DAG* at Chapter 4, "Life Cycle Sustainment."
[40] Ibid.
[41] *DAG* at Chapter 3, "Systems Engineering."
[42] Ibid.
[43] *DAG* at Chapter 4, "Life Cycle Sustainment."

Life Cycle Phase	DMSMS Management-Related DAG Content
Operations and Support (O&S)	Systems Engineering • "[T]he Systems Engineer should identify and plan for potential obsolescence impacts (i.e., Diminishing Manufacturing Sources and Material Shortages (DMSMS)). DMSMS problems are an increasing concern as the service lives of DoD weapon systems are extended and the product life cycle for high-technology system elements decreases."[44] • "Conducting analysis to identify and mitigate potential obsolescence impacts (i.e., Diminishing Manufacturing Sources and Material Shortages (DMSMS))."[45] • "Performing engineering analysis to investigate the impact of DMSMS issues."[46] Life Cycle Sustainment • "Monitoring the supply chain for obsolescence and diminishing manufacturing sources is part of this activity. FY17 NDAA Section 849(c) and correspondingly DoDI 5000.02, Encl 6, Para. 6, requires each Military Department to conduct major weapon system Sustainment Reviews not later than five years after achieving initial operational capability and throughout the life cycle."[47]

The following sections describe several more specific DMSMS management-related considerations for system development and system sustainment.

2.2.1 DMSMS Management Considerations for System Development

Systems engineering encompasses "a methodical and disciplined approach for the specification, design, development, realization, technical management, operations, and retirement of a system."[48] "Per the DAG, program office's should consider DMSMS as a design best practice in its technology management strategy in order "to reduce DMSMS cost and readiness impacts throughout the life cycle."[49] The following two sections focus on two types of systems engineering activities—Systems Engineering Plans (SEPs) and SETRs[50]—that highlight additional DMSMS management-specific considerations.

2.2.1.1 SYSTEMS ENGINEERING PLAN

DoDI 5000.88, *Engineering of Defense Systems*, establishes policy that includes the requirement for Major Defense Acquisition Programs, acquisition category II and III programs to have a SEP.[51] Lead systems engineerings, "[u]nder the direction of the Program Manager"], develop a SEP in order to document and guide the program's specific systems engineering activities."[52] "A SEP comprises key technical risks, processes, resources, metrics, SE products, organizations, design considerations and completed and scheduled SE activities."[53] DMSMS issues represent risk to a system's schedule, performance, and life-cycle cost. For this reason, program offices should incorporate DMSMS management into their SEPs, in order to ensure coordination with other planned technical processes and activities.

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44 *DAG* at Chapter 3, "Systems Engineering."
45 Ibid.
46 Ibid.
47 *DAG* at Chapter 4, "Life Cycle Sustainment."
48 DoDI 5000.88, "Engineering of Defense Systems," November 18, 2020, p. 8.
49 *DAG* at Chapter 3, "Systems Engineering."
50 The concept of Systems Engineering Plans and Systems Engineering Technical Reviews are best practices that apply to all acquisition pathways.
51 DoDI 5000.88, p. 4.
52 Ibid., p. 12
53 DAG at Chapter 3, "Systems Engineering."

Section 3 of the *Systems Engineering Plan (SEP) Outline* describes the portions of a SEP to document various aspects of technical risks.[54] As one example, Section 3.2 of a SEP should incorporate the following content related to the risk management process:

- Roles and responsibilities associated with identifying risk,
- Risk tools,
- Risk and mitigation planning, and
- Risk reporting.[55]

Unless waived by the approving authority, a SEP's software development approach should include software obsolescence as one of a number of activities for implementation,[56] Obsolescence represents one of several considerations for identifying severable components when "[t]he PM will use an appropriate open business model and system architecture that allows major system components to be severable at the appropriate level for incremental addition, removal, or replacement over the system's life cycle."[57] Furthermore as a best practice, program offices should consider DMSMS management and the risk posed by DMSMS issues when assembling the relevant portions of a SEP.

2.2.1.2 SYSTEMS ENGINEERING TECHNICAL REVIEWS

SETRs represent event-driven technical reviews that occur throughout the system life cycle to provide leadership the opportunity to evaluate the technical maturity and risk of the system design and how maturity and risk impact the cost, schedule, and performance of the system.[58] The DAG specifically highlights that a program office should have a DMSMS plan in place by the time of its Production Readiness Review (PRR); however, program offices would also have in place a number of additional DMSMS management-related issues of importance by the time of other SETR events. Table 3 summarizes specific issues of interest from a DMSMS management perspective at the time of each technical review.

Table 3. Summary of DMSMS Management-Related Issues of Interest by SETR

Review Type	Specific Issues of Interest from DMSMS Perspective
Alternative Systems Review (ASR)	DMSMS management planning has been initiated and is focused on the most likely preferred systems concepts. DMSMS impacts may be a consideration when performing an analysis of alternatives (AoA) to ensure that the preferred system is cost-effective, affordable, operationally effective, and suitable and can be developed to provide a timely solution at an acceptable level of risk.
Systems Requirements Review (SRR)	The program office has begun to develop its DMSMS management strategy and plan, which begins to identify the roles and responsibilities of the government, prime/subcontractor, and third-party vendors. Some members of the DMT and contracting strategies have been identified. Technology development contracts require the delivery of data necessary for DMSMS management and define the contractor roles and responsibilities.

[54] Office of the Deputy Assistant Secretary of Defense for Systems Engineering (ODASD[SE]), *Systems Engineering Plan (SEP) Outline*, Version 3, Washington, DC, May 12, 2017, pp. 10–28.
[55] ODASD(SE), Systems Engineering Plan (SEP) Outline, p. 14.
[56] DoDI 5000.88, pp. 12–13 and p. 20.
[57] Ibid., pp. 2–26.
[58] *DAG* at Chapter 3, "Systems Engineering."

Review Type	Specific Issues of Interest from DMSMS Perspective
System Functional Review (SFR)	The DMP has been developed and a partial DMT has been formed. The development of DMSMS processes and metrics is underway.
Preliminary Design Review (PDR)	The DMP, including the documentation of all operational processes, has been formally approved by program office leadership. Monitoring and surveillance for DMSMS issues, using predictive tools and vendor surveys, is being conducted for notional or preliminary parts lists/BOMs. An assessment of whether and when obsolescence issues need to be addressed and if a resolution at a higher level of assembly should be considered, resolution determination and resolution implementation have begun. Technology roadmaps and refreshment strategies are being factored into DMSMS management processes.
Critical Design Review (CDR)	Monitoring and surveillance for DMSMS issues, using predictive tools and vendor surveys, are being conducted based on the indentured BOM for the build baseline/final design. An assessment of whether and when obsolescence issues need to be addressed and if a resolution at a higher level of assembly should be considered, resolution determination and resolution implementation are taking place. Technology roadmaps and refreshment strategies are being factored into DMSMS processes. Case management and the capture of metrics are taking place. EMD contracts require the delivery of data necessary for DMSMS management and define the contractor roles and responsibilities.
PRR	Monitoring and surveillance for DMSMS issues, using predictive tools and vendor surveys, are being conducted. An assessment of whether and when obsolescence issues need to be addressed and if a resolution at a higher level of assembly should be considered, resolution determination and resolution implementation are taking place. Technology roadmaps and refreshment strategies are being factored into DMSMS processes. Case management and the capture of metrics are taking place.

Appendix B identifies a number of specific DMSMS management-related questions a program office can use in support of technical reviews. The DMSMS management-related questions offered in that appendix provide a basis for the DMSMS management community to inform DMSMS-related discussions prior to technical reviews and to highlight DMSMS issues to address during those reviews. Systems engineering checklists for technical reviews already incorporate DMSMS management-related questions; however, DMSMS management practitioners have undertaken an effort to expand upon them systematically.

The program office should review and oversee the DMSMS management efforts of its prime contractor and ensure the review of all obsolescence issues and their resolution before the decision to proceed to the next phase in the life cycle, particularly before moving into production. To enable this, program offices should incorporate the necessary language into contracts to ensure that they are able to review all designs and redesigns in relation to SETRs.

2.2.2 DMSMS Management Considerations for System Sustainment

"Life cycle sustainment comprises the range of planning, implementation and execution activities that support the sustainment of weapon systems."[59] Through life-cycle sustainment planning, readiness can be maximized and product support can be provided at the lowest cost.[60] As a best practice, program offices incorporate DMSMS management into their life-cycle sustainment planning. A program office's activities to monitor and assess the health of its system's supply chain should include DMSMS risk.[61] The

[59] *DAG* at Chapter 4, "Life Cycle Sustainment."
[60] Ibid.
[61] Ibid.

following two sections focus on two types of sustainment activities—ILAs and Sustainment Reviews[62]—that highlight additional DMSMS management-specific considerations.

2.2.2.1 LIFE-CYCLE SUSTAINMENT PLAN

Life-Cycle Sustainment Plans (LCSPs) document a program office's planning and execution pertaining to the operation and sustainment of its system. PMs and PSMs start to develop LCSPs for the initiation of an acquisition program and maintain these plans throughout the system life cycle.[63]

Section 3.1 "Sustainment Strategy Considerations" of the *Life-Cycle Sustainment Plan: Sample Outline* highlights obsolescence management, including DMSMS management as one type of consideration to address.[64] DMSMS issues can cause in-service problems and require funding to support the implementation of resolutions. As a best practice, a program office's planning for its system's sustainment should include planning for the inevitability of DMSMS issues and their mitigation. One element of this DMSMS-related consideration includes understanding and continuing to monitor a system's supply chain, particularly after production ends.

2.2.2.2 DMSMS CONSIDERATIONS IN INDEPENDENT LOGISTICS ASSESSMENTS

Although only a requirement for the major capability acquisition pathway, all acquisition pathways should use ILAs to ensure a focus on product support and sustainment planning.[65] An ILA represents an analysis of a program office's supportability planning, which serves as

> *[A]n effective and valid assessment of the program office's product support strategy, as well as an assessment of how this strategy leads to successfully operating a system at an affordable cost …. Conducting the LA early in the program phase where the design can be influenced, and reassessing the planning at each milestone and periodically thereafter as the design matures, is critical to fielding a sustainable system.*[66]

Because DMSMS issues have a bearing on the sustainment of a system, DMSMS should be considered within ILAs. Table 4 summarizes the focus of the ILAs before-fielding and during-operations.

Table 4. Summary of ILAs

Assessment Type	Specific Issues of Interest from DMSMS Perspective
Before-Fielding	Monitoring and surveillance for DMSMS issues, using predictive tools and vendor surveys, are being conducted to identify immediate and near-term obsolescence issues associated with the system BOM. An assessment of whether and when obsolescence issues need to be addressed and if a resolution at a higher level of assembly should be considered, resolution determination, and resolution implementation are taking place. Technology roadmaps and refreshment strategies are being factored into DMSMS processes. Case management and the capture of metrics are taking place.

[62] The concepts of Life Cycle Sustainment Plans and ILAs apply to all pathways.
[63] *DAG* at Chapter 4, "Life Cycle Sustainment."
[64] Office of the Assistant Secretary of Defense for Logistics and Materiel Readiness (OASD(L&MR)), *Life-Cycle Sustainment Plan: Sample Outline*, Version 2.0, January 19, 2017, pp. 18–19.
[65] Guidance on this subjective may be found in DAU's *Logistics Assessment Guidebook*, July 2011, available at https://www.dau.edu/tools/t/Logistics-Assessment-Guidebook.
[66] Ibid., p. 6.

Assessment Type	Specific Issues of Interest from DMSMS Perspective
During-Operations	Monitoring and surveillance for DMSMS issues, using predictive tools and vendor surveys, are being conducted to identify immediate and near-term obsolescence issues associated with the system BOM. An assessment of whether and when obsolescence issues need to be addressed and if a resolution at a higher level of assembly should be considered, resolution determination, and resolution implementation are taking place. Technology roadmaps and refreshment strategies are being factored into DMSMS processes and reviewed for potential updates and adjustments. Case management and the capture of metrics are taking place.

Appendix C identifies a number of specific DMSMS management-related questions a program office can use to support ILAs. As was the case for SETRs, the DMSMS management-related questions offered in the appendix provide a basis for the DMSMS management community to inform DMSMS-related discussions prior to ILAs and to highlight DMSMS issues to address during those ILAs. Checklists for assessment already incorporate DMSMS management-related questions; however, DMSMS management practitioners have undertaken an effort to expand upon them systematically.

2.2.2.3 OTHER SYSTEM SUSTAINMENT GUIDANCE FOR DMSMS MANAGEMENT

Additional documents provide guidance on system sustainment for the DoD enterprise. The following lists some of these guidance documents, their purpose, and how they relate to DMSMS management. DAU's tools catalog contains the complete interconnected suite of product support guidebooks.[67]

- Integrated Product Support Elements Guidebook.[68] This guidebook provides additional guidance to PSMs, particularly with regard to the 12 integrated product support elements.[69] Three sections devoted to the integrated product support elements—sustaining engineering, supply support, and computer resources—mention DMSMS.[70]
- Product Support Manager Guidebook.[71] This guidebook provides PSMs with guidance on the development and implementation of a program support strategy for their programs. A PSM , along with a PM, has the responsibility for planning for a risk-based approach to DMSMS management for the program office. An "Obsolescence/DMSMS Mitigation" section on key product support considerations refers to DMSMS.[72]
- Product Support Business Case Analysis Guidebook.[73] This guidebook describes a methodology to assist in decision-making when considering product support alternatives. A table focused on analytic tools includes some DMSMS and obsolescence-related tools.[74]

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[67] DAU, "Integrated Product Support Guidebook Suite," available at https://www.dau.edu/tools/p/integrated-Product-Support-Guidebook-Suite.
[68] DAU, *Integrated Product Support (IPS) Elements Guidebook*, July 31, 2019, available at https://www.dau.edu/tools/t
/Integrated-Product-Support-(IPS)-Element-Guidebook-.
[69] The 12 integrated logistics support elements are: Product Support Management; Design Interface; Sustaining Engineering; Supply Support; Maintenance Planning & Management; Packaging, Handling, Storage, and Transportation Planning & Management; Technical Data; Support Equipment; Training & Training Support; Manpower & Personnel; Facilities & Infrastructure; and Computer Resources. *IPS Elements Guidebook*.
[70] IPS Elements Guidebook.
[71] DAU, *Product Support Manager (PSM) Guidebook*, December 23, 2019, available at https://www.dau.edu/tools/t
/Product-Support-Manager-(PSM)-Guidebook.
[72] PSM *Guidebook*, p. 93.
[73] DAU, *Product Support Business Case Analysis (BCA) Guidebook*, March 1, 2014, available at https://www.dau.edu
/tools/t/Product-Support-Business-Case-Analysis-(BCA)-Guidebook.
[74] Product Support BCA Guidebook, pp. 47–103.

2.2.3 Tailoring DMSMS Management Considerations for Different Acquisition Pathways

DMSMS management applies to five of the six acquisition pathways—MCA, UCA, MTA, DBS, and SWA. The first four pathways lead to the deployment of hardware systems and their associated software (with the DBS pathway being the most software intensive). The fifth pathway applies exclusively to software. The bulk of the remainder of this section deals with the first four pathways. The last part of this section briefly describes some unique DMSMS considerations associated with the SWA pathway.

There are differences among the four hardware-associated acquisition pathways:

- Terminology unique to each pathway,
- Different selection criteria for determining which pathway to follow, and
- Inclusion of phases differing in number and length.

Despite these differences, each of these four pathways encompasses similar generic life-cycle activities—development, production and deployment, and operations and support. These life-cycle activities should incorporate DMSMS management operations.

The following describes the DMSMS management implications of those generic activities for each of those pathways. DMSMS management content for each pathway represents the tailoring of the best practices for DMSMS management operational processes described in Sections 3 through 7 of this document. Tailoring of DMSMS management operational processes depends on:

- The specific hardware characteristics of the system of focus,
- The associated acquisition and sustainment strategies,
- The prevalence and complexity of software in the system, and
- The amount of risk that the program office is willing to tolerate.

The DMSMS management processes, summarized earlier in this section and detailed in Sections 3 through 7 of this document support the MCA pathway. Consequently very little tailoring is needed and this section does not elaborate further on DMSMS management for the MCA pathway. The one exception is when it is useful to compare the application of DMSMS management with MCA to that for the other three hardware-associated pathways.

2.2.3.1 DMSMS MANAGEMENT PLANNING

Regardless of the chosen acquisition pathway, all program offices should have a DMSMS management team (although it may be small under certain circumstances) that oversees the execution of a DMSMS management plan that answers some basic questions.

- What is the expected life cycle of the system? If a system will only be utilized for a short period, DMSMS management activities may be highly tailored because of the limited time horizon. For example, initial spares may have been purchased in quantities estimated to be sufficient to support the system through its planned life. Consequently, DMSMS management may be limited to the verification that those assumptions continue to hold.
- What items should be monitored proactively? From a risk-based perspective, the bulk of this list will reflect mission critical, high failure rate, and DMSMS-prone items without substitutes readily available in the commercial market.

- To what extent will the program office rely on its major suppliers to conduct DMSMS management? The answer to this question scopes the extent of DMSMS activities that the program office will conduct/oversee. This question applies only to the items selected for proactive monitoring.

  In the case of COTS assemblies, there may be a high reliance on suppliers for two reasons. First, BOMs are generally not available for COTS assemblies and therefore the complexity of DMSMS management operations that the government is able to have performed will be significantly limited. Second, commercial suppliers may automatically remove obsolescence from the items they sell because it is a good business practice to do so.

  For non-COTS items, the program office will typically want to have greater control over DMSMS management operations.

  A further consideration for both COTS and non-COTS items is the program office's assessment about the suppliers' capability to identify and resolve DMSMS issues in a timely and cost-effective manner.

The answers to these questions have an impact on what DMSMS management functions are and are not performed internally within the program office. Different pathways will have vastly different DMSMS management contract requirements. Regardless of the pathway selected, it is important to put the appropriate contract language in place as early as possible.

2.2.3.2 URGENT CAPABILITY ACQUISITION PATHWAY

The UCA pathway represents a set of highly tailored acquisition activities designed to support fielding of a quick reaction capability usually within two years. There is a $525 million limit on the amount of research, development, test, and evaluation funding allowed for a single acquisition for this pathway.

Once an urgent requirement is approved, a UCA program is initiated. The *pre-development* phase determines the course(s) of action for fielding. This is similar in concept to a combination of the analyses performed prior to Milestone A and the *technology maturity risk reduction* phase of the MCA pathway. Because the UCA development effort is so small and short, most if not all subsystems of the UCA will be mature during the *pre-development* phase. Thus the supportability analysis conducted at that time should focus on DMSMS management planning. Considerations for answering the DMSMS management planning questions are as follows:

- The life of the system should generally be assumed to be short to coincide with the length of the contingency that generated the UCA. Although there can be a decision at a later point in time to extend system life, that decision will normally not be made at the time of pre-development activities.
- Which critical items should be monitored is situation specific. DMSMS-prone items may not be of a high concern at this time because of assumptions about the system life. DMSMS may be considered unlikely over a system's short life cycle.
- Since most of the equipment will be commercial assemblies and the system life is expected to be short, it will be common to rely on commercial equipment suppliers to resolve any DMSMS issues that occur. There are likely, however, to be a few subsystems where more rigorous DMSMS management should be performed/overseen by the program office.

The *development* phase follows the *pre-development* phase of a UCA. The idea of design resilience applies to DMSMS management, however, given the minimal scope of the development effort, a significant portion of the design will have already been completed and assemblies will have been produced. Monitoring items in the system for obsolescence during *development* will be constrained by the lack of availability of parts lists associated with commercial assemblies and the reliance on commercial suppliers. Design changes to remove obsolete or near-obsolete items may not be feasible. Policy indicates that such deficiencies may be addressed later in the life cycle because of the urgency of the need to field the system. The UCA policy is also silent about the development of prototypes, but due to the compressed nature of the schedule, any prototypes are likely to be closer to engineering design models.

As a precaution, technology roadmaps should be obtained in the development phase (and it may even have started in pre-development). The roadmap should examine the technologies currently being used and forecast when they will become obsolete and what technology will replace them. The principal precautionary reasons for developing roadmaps are

- To verify that commercial suppliers will be in a position to maintain viability of commercial assemblies over the expected service life and
- To prepare (both from a DMSMS-related technology refreshment perspective and a performance-improvement perspective) for service life extension if it were to occur.

The DMSMS management processes associated with the *production and deployment* and the *operations and support* phases continue the activities begun during *development*. Monitoring to identify issues may increase; any issues should be resolved before they impact the system as DMSMS issues can interfere with production. The constraints on data available for monitoring commercial assemblies may continue to apply and therefore monitoring processes will be tailored accordingly. Resolutions may involve refreshing the technologies as indicated by technology and product roadmaps.

For a UCA, a disposition analysis takes place after one year into the *operations and support* phase. At that point in time, a determination is made to either terminate the system, continue operations until the end of the current contingency, or transition to a program of record. The results of this decision informs technology and product roadmaps and other DMSMS management processes on the length of the planning horizon. When termination is near, DMSMS management involves far less forecasting and focuses on more short-term resolutions to the extent that they are necessary. If the system life is extended, then it is likely that there will be a transition to another acquisition pathway; DMSMS management activities should adjust as needed.

2.2.3.3 MIDDLE TIER ACQUISITION PATHWAY

The MTA pathway applies to systems that have a level of maturity that allows them to be fielded within five years. MTA policy includes only two acquisition phases—*rapid prototyping* followed by *rapid fielding*. Depending on the maturity of the technology, some MTA programs may only have virtual prototyping and some may skip the first phase entirely. When there is no *rapid prototyping* phase, production should begin within six months of MTA program initiation. MTA policy makes no mention of an operations and support phase of the life cycle.

A tailored LCSP is a requirement for the approval of *rapid fielding* for major systems. Consequently, supportability, which includes DMSMS management, should be considered during *rapid prototyping* and in the time leading up to production. Even though no LCSP is required for non-major systems, supportability should not be ignored.

DMSMS management planning (including the development of a plan and the formation of a team) should occur immediately after MTA program initiation. The scoping questions listed for the UCA pathway apply.

- Since an MTA system will be in production for about five years and then in operation for some period of time beyond that, in general there is no reason to tailor DMSMS management activities based on the length of service. The life cycle is long enough to experience obsolescence issues that must be resolved.

- The items to be monitored will be selected from a risk-based perspective. Expectations are that monitoring will be needed for both COTS and non-COTS items.
- Because of the minimal amount of design and development time associated with an MTA, a large percentage of the items in the system is likely to be commercial items or currently fielded systems, so much of the DMSMS management functions will be assumed to be performed by suppliers early in the life cycle or is already being performed somewhere else in DoD. Later in the life cycle, the program office should plan for technology refreshment for when commercial support is no longer available. There may potentially be a need to prepare for greater in-house DMSMS management support and oversight.

Prior to a production decision, program office DMSMS management operations should be focused on assessments of DMSMS resilience in the designs that it controls, and obsolescence in the build-to-print designs it controls. In an MCA acquisition, the program office has control over many more designs. Therefore, design reviews, smart parts selection, and obsolete part replacement will have been taking place, in conjunction with the prime contractor, as the designs mature. Since the final designs will be completed within a few months of program initiation, there are unlikely to be many opportunities for conducting these activities on preliminary versions of the design for the MTA pathway. There may also be limited options for eliminating obsolete or nearly obsolete items from designs. However, since production may last for more than four years, every effort should be made to do so.

Once in production and during operations and support, the use of technology roadmaps should be a significant element of DMSMS management activities. For a UCA, using technology roadmaps was labeled precautionary. In the MTA pathway, it should be considered mandatory. Some COTS assemblies (especially electronics assemblies) are likely to become obsolete during more than four years of production. More will become obsolete during operations and support. Consequently, there will be a need for technology refreshment. Furthermore, there may also be requirements for capability enhancement which will also be informed by technology roadmaps that reflect commercial and DoD research and development.

For other items, the program office should conduct/oversee activities to identify obsolescence issues as early as possible and resolve them before they impact the system.

2.2.3.4 DEFENSE BUSINESS SYSTEMS PATHWAY

The DBS pathway, as its name suggests, governs the acquisition of business capability by the DoD. Of the hardware-associated pathways described in this section, this pathway is the most heavily software oriented and most closely aligns with commercial best practices. Customization of commercial products is minimized by policy. No time limits on fielding are imposed and the size of the budget authority defines the decision authorities.

The first phase of the DBS pathway is *capability need identification*. Once a need is identified, a decision is made on whether to invest resources in the development of a capability to meet that need. There are no DMSMS management considerations in this phase which corresponds to pre-MDD activities in the MCA pathway.

Solution analysis is the second phase of the DBS pathway. Activities in this phase generally align with pre-MDD analyses for the MCA pathway. The characteristics of the business system necessary to satisfy the needs is established. Industry analysis and market research play key roles in keeping requirements for new development to a minimum. Although supportability may be a consideration, the level of detail does not involve DMSMS management.

The *functional requirements and acquisition planning* phase follows *solution analysis*. Some parallels can be drawn to the *technology maturity and risk reduction* phase in the MCA pathway. In this phase, system requirements are determined, an acquisition approach is formulated, and an acquisition strategy (AS) is developed. Prototypes may be used to demonstrate technological capabilities. DMSMS management planning activities begin at this point in the life cycle. Considerations for the DMSMS management planning questions are as follows:

- What is the anticipated life cycle of the system? Usually DoD business systems are long-lived.
- What should be monitored? As was the case for the other pathways, the decision on what should be monitored is based on criticality and DMSMS risk.
- To what extent will the program office rely on industry to perform DMSMS management? Often this will be quite high for the DBS pathway, because of the reliance on commercial systems to meet DoD’s needs. The availability of BOMs is typically quite low because of the commercial nature of the system and its subsystems.

Monitoring should also be initiated in this phase. Because of the prevalence of commercial software and commercial business equipment, support for many of the elements of the business system is often readily available. As a result, only a small number of items may need to be monitored. The program office will rely heavily on commercial suppliers to automatically resolve obsolescence issues for a period of time. Design resilience is generally not a large component of DMSMS management because most of the business system complexity is in the software, as opposed to hardware. One exception might be the discovery of a cybersecurity vulnerability. Such a situation should be addressed prior to deployment. Finally, technology roadmaps should also be obtained to identify when technology refreshments (as well as capability enhancements in product roadmaps) should be considered because of changes in commercial markets (or advancement from military research and development).

The fourth phase is *acquisition testing and deployment*. This phase aligns with the *engineering and manufacturing development* phase in the MCA pathway. Prototypes may be created as part of the development effort. Over the course of this phase, the business system is deployed, usually in two sub-phases—limited deployment and full deployment. Support activities are also baselined.

From a DMSMS management perspective, this is the point in the life cycle where proactive monitoring could begin as preliminary parts lists are delivered and refined for non-commercial equipment. Both long-term and short-term issues would be considered and resolved when deemed appropriate to do so. However, for the most part, due to the nature of defense business systems, typically (but there may be exceptions) the monitoring and resolving functions would be automatically done by the contractors providing software as part of their normal commercial business operations. With the current trend of using commercial cloud systems, DMSMS may not be a concern for hardware. If DoD decides to own and maintain business system hardware, it will typically be refreshed periodically. The DMSMS management community, through technology and product roadmaps, may contribute to the determination of an optimal refreshment cycle in combination with plans for capability enhancement through technology refreshment.

Capability support is the last phase, analogous to the *operating and support* phase for the MCA pathway. More items may have to be monitored when commercial suppliers are no longer willing to support the hardware and software in the DBS. Availability of data is a limitation on the program office’s ability to do this. Consequently, there should be greater dependence on technology roadmaps. When the system is modified, DMSMS management activities should change accordingly.

2.2.3.5 SOFTWARE ACQUISITION PATHWAY

The SWA pathway is designed for the acquisition of custom software for DoD. There are two phases to an SWA—*planning* and *execution*. The policy governing this pathway emphasizes the use of modern, iterative software development techniques and tools. Program offices acquiring software through the DBS pathway or independently via the MCA pathway may elect to follow this policy.

The SWA pathway includes two sub-pathways. The first applies to software installed on commercial hardware. The other pertains to situations where the software is embedded in a weapon system or other military unique hardware.

Because of the custom nature of software acquisitions using this pathway, DMSMS management considerations are often concerned with functional obsolescence of the acquired software as a result of several potential factors. For example,

- Changes to hardware or software in the system that interfaces with the acquired software.
- Changes in policy on the use or applicability of the acquired software.
- Discovery of new cybersecurity weaknesses or vulnerabilities in the acquired software.

The corollary to this situation applies as well. The installation of software acquired through this pathway may lead to the functional obsolescence of other hardware and software in the system.

DMSMS management planning and monitoring should therefore monitor and test for potential functional obsolescence issues during both the planning and execution phases. They may occur during software development, fielding, maintenance, and upgrade activities. When functional obsolescence is detected, appropriate resolutions should be immediately implemented.

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3. Prepare: DMSMS Management Program Infrastructure

This chapter describes the *Prepare* step of the DMSMS management program. It encompasses establishing the foundations for robust DMSMS management, developing a DMP, forming a properly trained DMT to carry out all DMSMS activities, and establishing DMSMS operational processes—

- Secure resources for DMSMS management operations,
- Establish interfaces to advocate for DMSMS-resilient designs,
- Establish a DMSMS management evaluation process,
- Establish a Quality Management System (QMS),
- Establish a case monitoring and tracking process, and
- Establish supporting contracts.

As the first step, *Prepare* lays the groundwork for the other five DMSMS management process steps.

3.1 ESTABLISH THE FOUNDATIONS FOR DMSMS MANAGEMENT

The PM should establish the foundations for DMSMS management for the program office. This strategy sets the priorities for the DMSMS management approach to be pursued by the program office's DMT[75] and documented in its DMP.

Program office leadership may be tempted to delegate the establishment of the strategic direction to the DMT. However, doing so could result in a DMSMS program with a scope of effort documented in its DMP that does not match the funding obtained and available to support DMSMS management or program office management's expectations. Therefore, program office leadership should engage early (before the DMP is finalized) to define the objectives for DMSMS management, the roles and responsibilities of DMT members, and DMT operating guidelines as well as the procedures for and frequency of DMT meetings.

In addition, program office leadership should refine and elaborate upon the four overarching objectives of DMSMS management (Section 1.4). Finally, program office leadership should provide its expectations to the DMT and contractors with DMSMS responsibilities for the following:

- The relative relationships among DMT members;
- The relative relationships between government and contractor DMT members;

[75] This document assumes that the program office's DMT will have the lead for DMSMS management. Having the lead however does not imply that the DMT (or even the program office itself) will be doing most of the work. In many instances, much of that effort is conducted by production or sustainment contractors. In such cases, the DMT is primarily responsible for oversight. Therefore the priorities for the DMSMS management approach would also be pursued by contractors with DMSMS management responsibilities.

- Communication between DMT members and program office organizational entities that do not participate in DMT meetings;
- The artifacts, data, and deliverables to be produced; and
- The ground rules regarding when program office leadership and other key stakeholders should be briefed and the PM's role in decision-making.

More detailed information on DMTs can be found in Section 3.3.

Program office leadership should establish risk-based operating guidelines. For many program offices, operating guidelines will consist of similar, relatively generic statements such as the following:

- Maintain case management data on all DMSMS issues,
- Assess whether and when obsolescence issues need to be addressed and if a resolution at a higher level of assembly should be considered,
- Analyze ways to resolve the obsolescence issues at the level of assembly that is most cost effective over the life cycle,
- Monitor items and assemblies to identify obsolescence issues, and
- Oversee the implementation of the resolutions.

These generic operating guidelines should be refined by program office leadership to account for risk. To do so, program office leadership should work with DMT experts to address the following questions:

- Which subsystems should have priority for monitoring? Prioritization should be based on such considerations as mission criticality, safety, or known problem areas. This prioritization will assist in determining which BOMs and associated technical data (along with the necessary IP rights to that data) the program office needs to obtain to support proactive monitoring for DMSMS issues. If a reactive approach to DMSMS management is sufficient for a particular subsystem, then it is not necessary for the program office to acquire or build that subsystem's BOM.
- What items within those subsystems should be monitored? The answer to this question is a function of the risks that program office management is willing to accept. These risks manifest when a determination is made of which items to proactively monitor (and by default, which items should be managed reactively) for a system or subsystem of interest as described in Section 4 as part of the *Identify* step of DMSMS management.

Program office leadership should also address the following questions to refine operating guidelines.

- When should DMSMS management begin? As a best practice, proactive DMSMS management should begin as early as the SRR, whenever preliminary parts lists become available. Pursuing proactive DMSMS management for electronic items early is important, because there have been numerous examples of obsolete electronic items being incorporated into designs, virtually assuring sustainment issues if they are not discovered. Because the market forces driving DMSMS issues for MaSME items operate much more slowly than the competitive commercial electronics market, one might question whether to begin DMSMS management for these items later in the life cycle. It remains a best practice, however, to begin proactive DMSMS management for MaSME items at the same time as electronic items, for several reasons. First, the earlier that monitoring begins, the larger the window of opportunity to address an issue, the larger the selection of less expensive resolutions, and the smaller the likelihood of experiencing schedule and readiness impacts. Second, since a program office will only be monitoring high-risk MaSME items, proactive monitoring of such items should begin early. Third, MaSME item monitoring can be integrated with electronic item monitoring. Finally, beginning to monitor early will enable designs containing high-risk MaSME items to be revised before it becomes much more costly to do so.

- How important is DMSMS management for software? While software, in itself, does not become traditionally obsolete, the following issues may occur that affect the availability of the software and eventually impact the system:
  - The maintenance and support for the software is no longer available,
  - The hardware the software runs on becomes obsolete,
  - The environment and tools used to develop the software are no longer available,
  - The ability to build and test the software no longer exists, and
  - The skill set and knowledge necessary to support the software no longer exists.

  Just like hardware, many types of systems have little or no control over the supply chain for COTS software or the software development infrastructure they depend upon for development and support. In the COTS world, hardware and software have developed a symbiotic supply chain relationship where hardware improvements drive software developers to obsolete software, which in turn cause older hardware to become obsolete. By establishing a software obsolescence program, the following benefits are realized:
  - Identification of potential issues regarding software availability prior to system impact,
  - Increase in software personnel being cognizant of issues that were previously unknown,
  - Assistance with future planning of contracts,
  - Validation of software issue notification, and
  - Greater awareness of cybersecurity weaknesses and vulnerabilities.
- How should risk be taken into account? A risk-based perspective to monitoring is important because robust, proactive DMSMS management everywhere is not cost effective and will be unnecessarily time-consuming. A risk-based approach takes into consideration the differing sizes of (and associated number of items within) the systems and thus the workload required for monitoring for DMSMS issues across all types of items. At one end of the spectrum, everything could be proactively monitored to predict obsolescence before the item is no longer available. However, for many items, the impact of obsolescence is small because alternatives are readily available. A risk-based approach to DMSMS management strikes a balance among high-risk items that should always be proactively monitored, items that are broadly available over a long period of time, and everything in between. Additional information regarding levels of risk-based prioritization can be found in Sections 4.1 and 4.3.2.

3.2 DEVELOP A DMSMS MANAGEMENT PLAN

A DMP documents the foundations of a DMSMS management approach established by program office leadership and identifies the risks associated with deviations from the standard DMSMS management processes described in this document. As such, the DMP establishes a robust DMSMS management framework for a program office. Without an adequate plan, a program office cannot have effective DMSMS management. However, like all plans, the DMP should be based on factors that are known or anticipated, not overly optimistic assumptions. As such, the DMP should be adjusted as actual conditions change.

Developing a DMP requires detailed consideration of how DMSMS management principles should be integrated within the program office's mission. The DMP also describes the DMT and its duties (for detailed information on the DMT, see Section 3.3) within a set of tailored DMSMS management processes ideally designed to avoid miscommunication. The tailoring is a function of each program office's specific infrastructure, record keeping procedures, quality management plans, resources, priorities, and constraints (e.g., the number of people, the amount of funding, access to BOMs/parts lists and associated technical data, and the ability to conduct vendor surveys on item availability). All program offices are required to have a DMP per the DoDI 4245.15.

As the responsible agent for developing the foundations of DMSMS management, the PM is ultimately responsible for final approval of the DMP. This approval demonstrates the senior program office leadership's agreement with and support for the actions prescribed in the plan. This is especially important when the competition for resources within a program office is high. While ultimately approved by the PM, DMT members develop the DMP. The DMT is also the entity that has management authority to put the approved DMP into action. As the DMP develops, members of the DMT ideally can be expected to more clearly articulate their future roles within the tailored DMSMS management activities of their specific program office. The DMP authorizes DMT members to carry out their DMSMS management-related duties; overrides what could otherwise be conflicting duties.

Formulation of the DMP should begin early in the life cycle—preferably, immediately after program initiation for any of the acquisition pathways. DMPs are not static; they should be living plans that reflect the program office's changing circumstances. Changes within the program office, weapon system activities, and other events—such as modifying the roles and responsibilities of DMT members, revisions to DMSMS management contracts, changes to tools and processes, a life-cycle extension, changes in procurement plans, or significant changes in operating tempo—will usually drive revisions to the DMP.

There is no prescribed length. The DMP should include only how the program office specifically intends to accomplish DMSMS management; it should not be a tutorial on DMSMS management. References to other documents should be made as much as possible to avoid duplication.

The following outline and format for the DMP are expected to be used by program offices unless they have a good reason for deviating from them. Development of the DMP should address a set of interrelated questions. The answers to these questions affect the near-term objectives of the DMP and the actions of the DMT in executing the DMSMS management process and its specific tasks. A template is available on the DKSP.[76] Systems Planning and Requirements Software is a multi-service expert system that can guide a program office through the development of a DMP.[77] The remaining sections present a set of tailorable questions that should be considered. They have been mapped to the expected format.

3.2.1 Purpose

- What are the system/program office's near-term and long-term DMSMS management objectives?

  At the most basic level, the DMSMS management objective is to ensure DMSMS-related cost, schedule, readiness, and availability impacts do not exceed an acceptable level. The specific

[76] DSPO, *Diminishing Manufacturing Sources and Material Shortages (DMSMS): Management Plan Template*, October 6, 2020, available at https://www.dau.edu/cop/dmsms/DAU%20Sponsored%20Documents/DMSMS%20Management%20Plan%20Template_6Oct2020.docx.

[77] See https://www.dau.edu/tools/t/Systems-Planning-and-Requirements-Software-(SYSPARS).

definition of "acceptable" is a function of the size, complexity, and cost of the system, as well as the current life-cycle stage, the AS, the LCSP, and the modification plans. Other examples of possible objectives are: no reactive DMSMS cases except where planned, avoid out-of-cycle redesigns, or keep annual resolution costs below a specific number. The DMP should reference the key documents requiring the plan.

3.2.2 Scope and Applicability

- To what program office/systems does the plan apply?

  The program office to which the DMP applies should be described. Areas which should be addressed include acquisition designation and whether there is FMS. It should also be indicated whether this is an initial DMP or a revision.

  The system or subsystems covered by the DMP should be identified and described; the system descriptions should be brief and not a detailed description or concepts of operation, which are already covered in other system documentation (e.g., SEP, LCSP). The system description should include the quantity of systems planned and the timeframe over which they are intended to be supported.

  The determination of what is to be covered will ultimately require BOMs and other technical data for surveillance and analysis of those items which will be proactively managed. Technical data may also prove necessary to verify and validate DMSMS resolutions.

- For each applicable system, what is the AS, where is the system in its life cycle and what are the sustainment strategy, modification plans, and maintenance approach?

  The AS and life-cycle phase of the applicable system can influence the types of DMSMS management operations activities taking place and the relative roles and responsibilities of DMSMS management stakeholders in performing those activities. The current AS and life-cycle phase, as well as any major milestones, of the system should be indicated.

  The long-term sustainment strategy, modification plans, and maintenance approach affect the DMP objectives as well as the composition of the DMT and the availability of technical data. No simplifying assumptions (that count on uncertainties being treated in a specific way) should be made regarding long-term sustainment, modification, and maintenance responsibilities, since this will impact the types of activities that the program office needs to take now to ensure long-term sustainment and maintenance of the system. For example, if the DMP merely assumes that a contractor will provide sustainment support for the life of the system, the government might not have the appropriate DMSMS data to meet the system sustainment requirements if in fact the long-term sustainment approach is for organic support.

3.2.3 DMSMS Management Approach

- For each applicable system, what will be the primary DMSMS management roles of contractors, program office personnel, and independent subject matter experts[78] (SMEs) and how will the program office maintain a life-cycle perspective for its DMSMS management approach?

  Regardless of the relative roles of the government, the prime contractor, and independent SMEs in DMSMS management, the government is ultimately the responsible party. The government and its personnel should ensure that a life-cycle perspective can be maintained. However, if a prime contractor or independent SMEs will be performing some aspects of DMSMS management, the program office should recognize that those entities' responsibilities span the period of

[78] An organization or individual outside of both the program office and the prime/OEMs that provides DMSMS management services such as: obtaining or building BOMs, monitoring items for DMSMS issues, receiving and processing DMSMS notifications, creating and managing DMSMS cases, researching DMSMS issues and recommending resolutions, participating in or facilitating DMTs, assisting in the development of DMPs, and providing oversight of DMSMS related activities.

performance only. The DMP should include provisions that are in place for the program office to be able to have the information necessary to maintain a life-cycle perspective.

As the system moves through the life cycle, the DMP should capture the program office's shifting focus from providing government oversight of contractor DMSMS management processes and delivery of management products to the government for acceptance to conducting organic DMSMS assessments and sustainment planning. For example, in the development function, the government should ensure that the contractor is minimizing obsolescence throughout the contract period of performance by selecting items that avoid or resolve hardware, material, and software obsolescence issues. During production and initial fielding, the government should ensure that the contractor is able to meet schedule as well as ensure that the government will be able to sustain the product over the long term. During O&S, the government may want contractor support for DMSMS management and ensure that the system can be sustained until the next upgrade or replacement.

For many program offices, a prime contractor (and perhaps some original equipment manufacturers [OEMs]) will have responsibility for performing day-to-day DMSMS management, particularly early in the system's life cycle. The program office should not try to duplicate prime contractor activities; the DMP should be aligned with what the contractor is doing based on its own internal DMP. The program office should not make assumptions about what the prime contractor is or is not doing. The facts can be obtained only from a careful examination of contract language, actual contractor processes, and data deliverables. When planned contractor responsibilities were not included on contract, the specific mitigations concerning the government assumption/transfer of those responsibilities should be included in the plan.

If the prime contractor is effectively managing DMSMS risk and similar requirements are being flowed down the supply chain, the program office's role should be focused on oversight. The program office can also contract with independent SMEs to enable the government's oversight and other assigned roles.

- Where should the program office be reactive and where should the program office be proactive?

  While nearly everything will become obsolete or unavailable eventually, a robust DMSMS management approach does not imply being proactive everywhere. Program office leadership should set its expectations regarding the scope of proactive DMSMS management and the desired frequency for monitoring and surveillance activities.

  There are least three types of information that characterize DMSMS risk related to proactivity and reactivity: 1) the overall percentage of the system and/or its subsystems that will be monitored; 2) criteria for those items viewed as high risk from a DMSMS perspective and require monitoring; and 3) the subsystems and commodity classes of items (e.g., software, material, MaSME, COTS, electronics, and support equipment) that the program office has determined it will not proactively monitor should be identified and an explanation of the associated risk provided. Sections 4.1 and 4.3.2.1 provide additional detail on the prioritization of subsystems and items for proactive monitoring and surveillance.

- What mechanisms (i.e., product discontinuance notices [PDNs], predictive tools, vendor surveys, and DMSMS management information systems) will the program office use for monitoring, assessing, analyzing, and performing case management?

  The sources from which the program office intends to receive PDNs (see Section 4.4.1) and the program office's planned process for managing those notices should be identified. The program should further note who is responsible for processing PDNs and its expectations regarding how often and when PDNs are expected to be received (e.g., as soon as discontinuation intent is known, weekly, monthly, and so forth).

The DMP should identify all tools (see Sections 3.4 and 4.2) to be used by stakeholders in performing DMSMS monitoring, assessment, analysis, and case management. For each tool, the organization to employ the tool should be identified, along with when the tool will be placed into service to perform the intended function and who will have access to the tool. It is particularly important that the government have at least visibility of the tools being used by a contractor providing DMSMS management services to the program office. Otherwise, the government will need to employ its own tool(s) and this should also be documented.

Because not all items are conducive to monitoring via predictive tools, the DMP should document whether vendor surveys (see Section 4.4.2) will be used to monitor other types of items, such as software, MaSME items, and COTS assemblies.

- What contingency plans are in place for potential programmatic changes?

  A program office can and often does face any number of programmatic risks that can derail its plans. For example, a program office's funding by appropriation may vary. Its plan for contractor support for the life of the system may be determined to be less desirable and thus cause a shift to an organic method of support. A system may have its planned service life extended. Any of these (and other) programmatic events can impact DMSMS management. The DMP should identify any programmatic risks that are anticipated and describe whether plans have been developed to mitigate their DMSMS impact.

3.2.4 DMT

The DMT members conduct the core DMSMS operations for the program office. Members of the team typically represent core program teams and activities. The DMP should answer the following questions, discussed in Section 3.3, about the program office's DMT:

- Who are the stakeholders for the robust management of DMSMS issues for the program office (including other DMSMS management program offices that interact with the DMSMS management program office for the system in question)?
- What are the roles of the DMT members and who will fulfill those roles?
- What communication is required of the DMT internally and externally?

3.2.5 DMSMS Management Operations

- How will the program office's DMSMS management efforts be integrated with other strategies, planning, and reviews (e.g., product support strategies, the systems engineering design and review process, and modification planning)?

  There are numerous activities that take place throughout the life cycle of a system that could benefit from a DMSMS management perspective, while at times also providing inputs or opportunities for leverage that can improve DMSMS management. Example activities include—

  - Ensuring that the DMSMS community is establishing interfaces to advocate for DMSMS-resilient designs (see Section 3.4.2.);
  - Assessing preliminary designs for DMSMS risk (see Section 4.5.);
  - Providing the results of health assessments to inform and integrate DMSMS resolution funding with funding for program office modification plans (see Sections 5.3 and 7.2.);
  - Participating in design reviews and the engineering change proposal approval process; and
  - Performing supply chain risk management to identify, assess, and address potential obsolescence risks.

The DMP should identify in a few sentences these activities and how they will be integrated to the benefit of DMSMS management and the program office overall. The processes that will be used to ensure that the program office strategists and planners reach out to the DMT should also be included.

- What DMSMS management intensity levels will be used?

  Program offices sometimes use DMSMS intensity levels to identify the current state of their DMSMS management practices and to determine a desired future state for those practices. A higher intensity level indicates a more robust approach to DMSMS management. Appendix D contains information to help guide a decision on the target DMSMS management intensity level for a program office. The DMP should then be designed to achieve that target. A program office should consider documenting its planned level for each operating process and provide supporting information for why this is the appropriate capability level for the program office's DMSMS management effort.

- How have DMSMS management processes been tailored for this plan?

  Although many general DMSMS management processes are transferrable from one program office to another at a generic level, the DMP should document processes that are tailored to meet the program office's specific needs at the working level. The DMP should consider the unique needs of the program office, the unique needs of each stakeholder, and the unique flow of communication required among the stakeholders to ensure that the process enables fulfillment of the DMP objectives. Figure 5 in Section 3.4 summarizes the processes. The DMP should only document areas where its processes differ from the standards.

  If a program office is unable to obtain the necessary data, the impact of not having this data should be documented and the DMP revised to reflect the absence of data, as appropriate. It should also be highlighted when a BOM will be constructed when it was not provided on contract (see Appendix I).

- How will the DMT provide oversight of contractor DMSMS management efforts?

  The DMT should establish the types of reporting and the level of involvement in the DMT by the contractor (in accordance with its contract) to ensure that the program office is informed of the contractor's performance in DMSMS management. These things are dependent on the degree of the contractor's responsibility for DMSMS management. If there is minimal responsibility, the reporting may only consist of DMSMS notifications and reports on actions accomplished. Alternatively, if there is significant responsibility, full case reporting, DMSMS health reports, budgetary information, and the like may be needed. Participation in the DMT should be similarly scaled. If the contractor is fully managing DMSMS, it should be very involved in the DMT.

- How will DMSMS issues be detected, tracked, and resolved?

  The DMP should briefly lay out how DMSMS operations will be conducted in the following areas. In many situations, some if not most of this work may be done by the contractor (in accordance with its contract). Even less detail would be needed in the government's plan when that is the case.

  – How BOMs and other programmatic data will be obtained. This should include the data sources (e.g., BOMs obtained on contract) and other inputs necessary to implement the DMSMS management processes, as well as how the necessary data will be obtained and used by DMSMS management processes to produce the DMSMS management products.[79]

[79] It is not a good practice to aggressively pursue technical data and IP rights only when there is an issue. Such data should be obtained when it is available.

– The priority for loading subsystem BOMs into predictive tools. This describes the program office's risk-based methodology for prioritizing which subsystem BOMs and the items on those BOMs (see Section 4.1 and Section 4.3.2.1) to load first into predictive tools. This should also include when the prioritized BOMs will be loaded and the frequency with which or events that could trigger the need to update.

– How item monitoring will be accomplished and at what frequency. Because not all items are conducive to monitoring via predictive tools, the DMP should document how vendor surveys (see Section 4.4.2) will be used to monitor other types of items, such as software, MaSME items, and COTS assemblies. Documentation should include what organizations will be performing vendor surveys and the frequency at which those surveys will be conducted.

– How will DMSMS issue notifications be received and processed. The item monitoring process will normally generate DMSMS notifications and there may be other paths for the program office to obtain these notifications. This area includes how the program office expects to receive notifications, how frequently it expects to receive them, and how it will determine their validity.

– How DMSMS cases will be initiated, managed, and maintained. This encompasses: the processes to assess the readiness, availability, cost, and schedule risks a DMSMS issue poses to the system (see Appendix H.3.); the circumstances that require a case be established based on a DMSMS issue notification (see Section 3.4.5.); how cases will be prioritized (see Sections 5.2 and 5.3.2.); how cases will be analyzed to determine the most cost-effective resolution, including actions at higher levels of assembly (see Sections 5.3.3 and 6.); and how the DMT will oversee implementation of resolutions to ensure that all stakeholders carry out their assigned roles and responsibilities (see Section 7).

3.2.6 Funding

Resource needs (both DMSMS management operations and DMSMS resolution implementation) should be determined without fiscal constraints, taking into account the foundations for DMSMS management. If resource availability does not match the needs, the strategy should be modified and the associated risks should be documented in the DMP.

- What resources have been programmed and budgeted for DMSMS management operations?

  A program office should program and budget for the resources necessary to support DMSMS management operations as planned to be performed by a contractor, independent SME, and the program office itself (e.g., its DMT). The costs associated with DMSMS management operations throughout the Program Objective Memorandum (POM) period should be documented in the DMP.

  Initial planning should not be resource constrained but rather should seek to address the foundations for DMSMS management established by the program office leadership. However, those initial DMP objectives, DMSMS management processes and products, and, to some extent, the DMT composition itself may need to be constrained if the program office's leadership cannot obtain sufficient funding (in-house and for contractors) to support the realization of that initial plan. In such an instance, program office leadership should explicitly acknowledge that it is accepting greater risk and appropriately revise the foundations for DMSMS management, before the final approval of the DMP.

- What resources have been programmed and budgeted for resolutions for known and anticipated DMSMS issues?

  To be able to pay for the implementation of resolutions to DMSMS issues, the program office has to program and budget for the resources to fund those resolutions. The costs associated with the DMSMS resolution implementation throughout the POM period should be documented in the

DMP as well as the availability of resources to meet this demand. Risks and mitigations associated with a mismatch between funding available and funding needs should be included in the DMP.

3.2.7 Contract Requirements

- What DMSMS management operations and/or resolution implementation requirements will be imposed on the contractor and/or independent SMEs?

  Specific DMSMS-related Contract Data Requirements Lists (CDRLs) and data item descriptions (DIDs) should be cited in this section of the DMP. In addition, specific statement of work (SOW) language can be cited to summarize the requirements imposed. These summaries should include performance assessment factors, incentives, and penalties. Examples of DMSMS management-related contract requirements can be found in Appendix E and in Standardization-related Document 26[80] (SD-26).

  Since the prime contractor's work is based on contracts of limited time duration, the prime contractor's period of responsibility corresponds only to the period of performance of the contract. The program office should develop a provision through its DMP (supported by budgets and contracts, as necessary) that enables the government to manage DMSMS issues and their resolution across breaks in contracts (e.g., between production contracts, between a production contract and a sustainment contract, and between sustainment contracts) in a way that coordinates with expected contributions from the involved contractors. The ability to manage across contracts will require the ability to estimate the true life-of-need (LON) (e.g., when the system retires and when the next technology insertion is scheduled, where technology insertion is a type of technology-related change that inserts or integrates technologies to improve the performance of the system[81]). The ability to procure and maintain the stocks of an item or assembly to satisfy through the LON is crucial. This could require the inclusion, in contract language, of a requirement for true LON (not life-of-contract) buys; provisions for handling LON stocks as government-furnished material; or clear, approved plans for alternate resolutions such as system modifications.

  Furthermore, the DMP must include exit strategies established by contract exit clauses to ensure both a smooth transition of responsibilities and the availability of technical data throughout the system's life cycle, not just until the end of the contract.

- Are there any desired DMSMS management requirements not incorporated into the final contract with the prime or OEMs?

  The final contract may not always include all the requirements that the DMSMS community sought; some requirements may be dropped during contract negotiations. The DMP should identify the requirements not included and the associated risk. In addition, the DMP should address that risk to the extent possible. The foundations of DMSMS management should be changed accordingly.

3.2.8 Metrics, Reporting, and Quality

- What data elements will the program office collect?

  There are two levels (see Section 3.4.3.1) of record keeping data elements, all program offices should collect the Level 1 data elements. The DMP should document those data elements it intends to collect. Such data elements focus on cost and operations efficiency. Consideration

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[80] DSPO, SD-26, *DMSMS Contract Language: Guide Book*, October 2019. Appendix E should be reviewed before reading the SD-26.

[81] Mandelbaum, Jay, and Christina Patterson, "Be Strategic!—Leverage Technology Insertion and Refreshment on DMSMS Issues," *Defense Acquisition Magazine*, Defense Acquisition University, July–August 2021, p. 38.

should also be given to the collection of compliance metrics which measure whether processes are being followed and whether they are working as intended.

In addition, the DMP should document where the data will be maintained and how the data will be collected. This latter consideration is especially important because there are occasions where the DMT does not automatically receive feedback on whether a resolution was implemented or what resolution was actually implemented.

- How will the data elements be used?

  The DMP should document how the DMT will—

  – Use Level 1 data elements (or variations thereof) to develop metrics to improve DMSMS management operations, reduce DMSMS-related costs, prevent DMSMS issues from impacting readiness or schedule, and be in a strong position to explain and prove the benefits of the program office's DMSMS management efforts.

  – Use Level 2 data elements to (or variations thereof) to establish metrics that will enhance these benefits by enabling more complex analyses.

  – Use compliance metrics in the context of a QMS (see Section 3.4.4.2).

  The DMP should also indicate the periodicity at which the metrics will be reported, and to whom they will be reported. The DMP should also capture the sources that will be used to collect the data elements.

- What types of deliverables will the program office expect as outputs of its DMSMS management implementation approach?

  The DMP should identify the types of and schedules for deliverables needed to perform its oversight role and also to be able to inform program office leadership decision-making. Such deliverables should include how sustainability analysis results will be provided. Other potential deliverables include notices of obsolescence, status of resolutions, and elements of supportability roadmaps that inform technology refreshments.

  Because DMSMS-related risk is not static and will fluctuate throughout the life of the system, the DMP should document a mechanism for reporting DMSMS issues and associated risk and as appropriate highlighting risk to program office leadership. For example, a top-ten risk ledger that is updated regularly or a risk management data base could be used. However, this reporting may be separate from the program office's formal risk management process.

3.3 FORM A DMT

The PM or PSM should charter the DMT and clearly identify and authorize its activities as well as the roles and responsibilities of its members inside and outside the context of the DMT. The DMT should represent both internal and external organizations that provide routine and recurring support to the DMSMS management program. In some cases, it may be appropriate for representatives of other system DMTs to participate if their DMPs and processes interact. In other cases, multiple layers of DMTs may exist (e.g., at the system level and for some subsystems); in these instances, subsystem level DMTs should participate in and leverage the program office DMT, as appropriate. The program offices near-term DMSMS management objectives will drive the composition of the DMT and the roles and responsibilities of the DMT members.

3.3.1 Roles and Responsibilities of DMT Members

The roles and responsibilities of the program office, the prime contractor, the OEMs, and independent SMEs are among those established by program office leadership in the DMSMS management strategy. The DMP further expands upon the roles and responsibilities of the DMT as well as its composition in overseeing and managing obsolescence, including software, to the extent that it is a strategic priority. For example, the DMP may include information on technology refreshment plans. Such plans may also include software upgrades. Also, they may include requirements for hardware and software vendor surveys or for tracking the extent to which the software satisfies information assurance requirements. Finally, appropriate contract language should be developed to carry out the prime contractor and/or OEM responsibilities.

The roles and responsibilities of the DMT are similar for every program office, but the level of effort required of the team will depend on the complexity of the system and the severity of its DMSMS issues. In general, the activities of the DMT are to gather the necessary data, develop and implement the DMSMS management processes that require those data, produce the management products that result, report metrics that measure the effectiveness of the DMSMS management program when compared to the defined objectives, and apply continuous improvement processes to DMT operations. The roles should be tailored to meet specific program office needs.

The composition of the team will depend on the complexity of the system as well as on other considerations. For example, some team members may have multiple duties. This may affect the amount of time team members can devote to DMT activities, or they may be assigned multiple roles on the DMT. As another example, if the responsibility for the system will be transferred to another agency or activity midway through the life cycle, the stakeholder who will ultimately bear responsibility for sustainment should participate in the DMT during all phases of the life cycle. The DMT composition may evolve over time. Early in the life cycle, before the CDR, a partial team may be sufficient.

If contractors and/or independent SMEs participate in the DMT, their roles and responsibilities should be identified. DMT oversight relationships with respect to contractors and/or independent SMEs can evolve and change depending upon the phase of the life cycle, which may impact the DMT's composition. Ideally, a DMT should consist of the following roles:

- DMT lead. The DMT lead is the spokesperson for the DMT who oversees and has the authority to control DMSMS management operations. The DMT lead is also the champion of DMSMS for the program office and, as a best practice, should be a full-time position. Both of these conditions being present signals the importance placed upon DMSMS management by program office leadership. The DMT lead is responsible for coordinating DMT meetings and managing corresponding action items, identifying potential sources of funding and funding availability, requesting funding and other resources to support the DMSMS management program, overseeing the DMSMS management support contracts and agreements, interfacing with the configuration control board (CCB), and reporting on DMSMS risks at technical, logistics, and programmatic reviews. This role should be filled from logistics, engineering, or program office management organizations by an individual who possesses sufficient knowledge of DMSMS issues to be able to communicate to decision makers on the importance of actions regarding DMSMS cases. This role may sometimes be filled by the DMSMS SME.
- Program office representative. The program office representative represents the views of the PM on the DMT. Normally, this person would be the DMT lead and champion of DMSMS for the program office.
- DMSMS SME. The SME coordinates the execution of DMT management processes and the development of DMT management products. This includes, for example, assessing obsolescence forecasts, processing business case analyses (BCAs), preparing budget forecasts, and presenting solution options to the DMT for discussion and concurrence. In addition, the SME assists with establishing the DMT and with developing and maintaining the program office's DMP as a living document. Furthermore, the SME monitors the effectiveness of the DMSMS management program

and recommends ways to continually improve it by capturing and assessing metrics that accurately measure the success or failure of meeting the defined DMSMS management program objectives.

- Engineering activity representative. The DMT member representing the engineering function (including industrial, mechanical, electrical, and general engineering expertise, as well as a systems integrator perspective) is responsible for managing the incorporation of DMSMS-related technical data into government drawings, technical publications, and documentation. The engineering activity representative provides information to the DMT regarding resource requirements, systems integration engineering, and reliability and maintainability analyses on items selected for use on the system. The engineering activity representative also assesses the suitability and feasibility of proposed technical solutions. Early in the life cycle, the engineering activity representative may also include the prime contractor representative, if that is the source of greatest expertise.
- Logistics representative. Typically this is someone from the program office. Within the DMT, the logistics representative should provide data and technical advice for developing the resolution in conjunction with engineering. The representative would also ensure that resolution data is appropriately updated in logistics systems (e.g., provisioning systems), technical manuals, and associated training.
- Sustainment and maintenance activity representative. The party or parties ultimately responsible for long-term sustainment and maintenance must participate in the DMT to ensure that the appropriate groundwork is laid to meet the long-term objectives of the DMP.
- Software SME. The DMT should include a software SME, but all DMT members should possess a certain set of software obsolescence competencies. Even for those systems that do not place a high priority on software obsolescence, software expertise is valuable because hardware resolutions have the potential to affect software. Robust DMSMS management requires effective communication among all stakeholders. They must be made aware of hardware and software interdependencies and the potential impact of alternative resolutions, including the status quo. Having software expertise on the DMT facilitates the communications necessary to ensure that all resolutions are properly implemented.
- Supply support activity representative. The supply support activity representative is an ad-hoc team member who provides his or her organization's viewpoint on DMSMS issues. The team may have several supply support activity representatives, for example, item managers from DLA. DLA involvement, in particular, can augment a DMT's efforts with research on DLA-managed items, additional but limited DMSMS management expertise and product knowledge, and a cross-system perspective that can highlight impending, otherwise unforeseen problems and potential resolutions.
- Value engineering (VE) SME. A VE representative is an ad-hoc team member who can offer advice regarding the best-value resolutions to pursue to address DMSMS issues, as well as how those resolutions are synchronized with roadmaps to integrate new technologies that add capability or improve supportability.
- Contracting office representative. The DMT member representing the contracting office is an ad-hoc team member who provides guidance and administrative requirements for support contracts and agreements. This person also helps the DMT ensure that there is no ambiguity in the contractor's DMSMS management requirements.
- Prime/subcontractor representative. Assuming this representation is in the company's contract, the prime/subcontractor representative ensures that OEMs fulfill their roles and responsibilities with respect to DMSMS management as established by the SOW. In addition, the prime contractor representative may serve as the DMSMS management lead for subcontractors and present DMSMS issues and risks to the DMT. The prime/subcontractor representative's role may change depending on the phase of the life cycle.

- FMS representative. Where applicable, the FMS representative helps optimize DMSMS resolutions by providing information that enables all users to be considered. Mitigating DMSMS issues in a program office should account for both U.S.-owned and foreign-owned platforms (obtained through FMS or direct commercial sales), because all these assets create demands that affect item availability. In addition, cost-related benefits that exist for one user may be able to be leveraged in the resolutions being developed by another user. Although U.S. and foreign DMSMS management processes are similar, there are additional considerations in an international situation (technology security, information assurance, International Traffic in Arms Regulations, and so forth). The DMSMS SME must interface with the FMS representative and the appropriate international point of contact before taking any actions.

Following are examples of other roles that the DMT could include, depending on the program office's DMSMS management infrastructure and objectives:

- Business financial management office representative,
- Intellectual property subject matter expert,
- Software license management group representative,[82]
- Environmental and materials engineering representative, and
- CCB representative.

Some roles may be combined, while some of the responsibilities may be deleted or new ones added over time. The most effective DMT organization allows for open communication among the team members, whether they are representing the government, the prime contractor, or subcontractors. Such open communication is critical for robust DMSMS management. For example, the following should be documented in the DMP and monitored:

- DMT meeting frequency,
- DMT action items (i.e., assigned responsibilities and suspense dates),
- DMT deliverables,
- DMT interfaces with other program office entities (e.g., IPTs, Business Financial Management, Contracting), and
- DMT plans for interfacing and sharing information with other program offices and Services.

Ultimately, the PM is responsible for DMSMS management for the system. An Accountable/Responsible/Consulted/Informed (ARCI) chart is a good way to depict the relative roles and responsibilities required of each DMT member to implement DMSMS management in line with the program office leadership's established foundations for DMSMS management. Different types of responsibility are defined as follows:

- Accountable (A). Identifies the individual who is ultimately accountable for the completion of the activity and who has the ability to say "Yes" or "No." There can be one and only one "A" for a decision or activity at each organizational level.
- Responsible (R). Identifies the individual or individuals who are responsible at each level of the organization to execute a specific assignment for an activity. The degree of responsibility is determined by the person accountable. There can be multiple "Rs" for one activity at each organizational level.

[82] Unlike hardware, software often requires a license or agreement. Although maintaining software licenses and maintenance agreements are not normally a DMT responsibility, the DMT may want to take responsibility if software presents a critical obsolescence issue for the program office. If a license management group is doing this work, the DMT should maintain an open line of communication with that group to remain cognizant of the status of licenses.

- Consulted (C). Identifies the individual who must be consulted before a decision or activity is finalized. This represents two-way communication. There can be multiple "Cs" for one activity at each organizational level.
- Informed (I). Identifies the individual who must be notified about the completion or output of the decision or activity. This represents one-way communication. There can be multiple "Is" for one activity at each organizational level.
- Not Informed (N). Identifies individuals who do not need to be notified about the completion or output of the decision or activity. There can be multiple "Ns" for one activity at each organizational level.

Table 5 is a notional example (rows and columns are not complete, and entries are hypothetical) of such an ARCI chart, which shows the types of responsibility required relative to a set of roles and DMSMS management activities.

Table 5. Notional ARCI Chart

Activity	Roles							
	DMT lead	Program Office Representative	DMSMS SME	Engineering Activity Representative	Logistics Representative	Supply Support Representative	Contracting Office Representative	Prime Contractor Representative
Meeting coordination	A	I	C	I	I	I	I	I
Funding requirements	R	A	C	C	C	N	I	C
Future budget projections	R	A	C	C	C	N	C	C
DMSMS monitoring	A	I	R	I	I	I	N	C
DMSMS solution implementation	C	A	C	R, C	R	C, I	I	R, C
Contracting	C	R	I	I	N	I	A	C
Supply support	I	I	C	C	I	A, R	I	C, I

3.3.2 DMT Training Needs

All members of the DMT should be trained on their role in supporting DMSMS management for the program office. Not all members of the DMT are expected to be DMSMS SMEs or reach a targeted competency level; however, the DMT lead should identify minimum training requirements for DMT members on the basis of the DMSMS management approach, available resources, and the roles and responsibilities of each DMT member.[83]

DAU has established a new credentials program aimed at providing job specific skills. A forthcoming credential on "Parts and Material Life Cycle Management" applies to DMSMS management. It includes the following DAU courses.[84]

- LOG 0640 DMSMS: What Program Management Needs To Do And Why;

[83] If the DMT membership changes, the new members should receive training on DMSMS management and on their roles and responsibilities within the DMT.
[84] DAU course numbers are in the process of changing. The future course numbers of the credential program courses are provided where known.

- LOG 0650 DMSMS Fundamentals;
- LOG 0660 DMSMS Executive Overview;
- LOG 0630 Introduction to Parts Management;
- LOG 0670 DMSMS Basic Component Research;
- LOG 0320 Preventing Counterfeit Parts in DoD Supply Chains;
- LOG 0380 Provisioning & Cataloging;
- LOG 0390 Additive Manufacturing (planned for FY21 development as future LOG 0390);
- LOG 0470 Sustaining Engineering;
- CLL 051 System Retirement, Disposition, Reclamation, Demilitarization, Disposal (future LOG 0510);
- CLC 004 Market Research (future designation TBD);
- CLE 019 Modular Open Systems Approach (future designation TBD); and
- CLE 026 Trade Studies (future designation TBD).

Table 6 outlines training recommended for the different DMT roles. The DMT lead may use this as a guide but tailor it as necessary to meet the specific needs and constraints of the program office. The important thing is that DMT members have the appropriate knowledge and skill base to carry out their responsibilities effectively.

Table 6. Recommended DMT Training

Role	LOG 0640	LOG 0650	LOG 0660	LOG 0630	LOG 0670	LOG 0320	LOG 0380	LOG 0390	LOG 0470	CLL 051	CLC 004	CLE 019	CLE 026
DMT lead	X	X	X	X	X	X	X	X	X	X	X	X	X
Program office representative	X	X	X	X	X	X	X	X	X	X	X	X	X
DMSMS SME	X	X	X	X	X	X	X	X	X	X	X	X	X
Engineering activity representative	X	X		X			X	X	X		X	X	X
Logistics representative	X	X			X	X		X	X	X	X	X	X
Sustainment and maintenance activity representative	X	X			X	X		X	X	X	X		
Software SME	X	X											X
Supply support activity representative	X	X			X	X	X	X	X	X	X		
VE SME	X	X	X										
Contracting officer representative	X	X		X						X			
Prime/subcontractor representative (if established by contract)	X	X	X	X	X				X	X	X	X	X
FMS representative	X	X								X			
Business financial management office representative	X	X							X	X			
Software license management group representative	X	X								X	X		
Environmental and materials engineering representative	X	X		X			X	X	X		X	X	X
CCB representative	X	X		X									

DMSMS SMEs should have a majority of the following knowledge, skills, and abilities:

- Knowledge of:
  - Logistics management and/or systems engineering, as well as an understanding of DoD policies and procedures as applied to DMSMS management, design interface, maintenance planning, and the acquisition and sustainment of a system;
  - Technical aspects of logistics elements and systems engineering principles and their impacts upon each other;
  - DMSMS management concepts and policies sufficient to provide guidance and direction to logistics and engineering personnel on issues related to or affected by DMSMS issues and concerns at an in-depth level;
  - Developing DMSMS management requirements and projecting funding requirements for an effective DMT at an in-depth level;
  - DMSMS case-tracking system and DMSMS metrics at an in-depth level;
  - BCA processes in the DMSMS decision process;
  - Military and contractor supply chains, especially for commodities of focus;
  - Concepts, theories, and principles of system design, operations, and support;
  - Technology roadmapping and its relationship to the program office modification planning (including technology refreshment and insertion) processes along with their interfaces with DMSMS resolution planning;
  - Part selection criteria and their impact on DMSMS resilience;
  - Relationships among design interface, maintenance planning, engineering design, and DMSMS considerations necessary to create and establish innovative and effective program office policies and procedures for systems as required by DoD activities and authorized FMS organizations at the functional level; and
  - DMSMS management for the development of agency policy, procedures, and processes for mitigating DMSMS issues at the functional level.
- Skills in:
  - Interacting with senior government and industry executives, as well as with other logisticians, engineers, and PMs, both individually and in groups;
  - Resolving conflict and negotiating solutions to complex technical issues;
  - Developing and evolving collaboration among commands and agencies to maximize the attainment of efficiencies to determine best practices and leverage existing processes;
  - Communicating with others to interpret contractual requirements for performance-based logistics (PBL) for DMSMS management support packages;
  - Communicating with others about the prevention of obsolescence of critical items;
  - Communicating clearly and concisely, both orally and in writing; and
  - Perceiving relationships and effects between the subject under discussion and related areas of importance and bringing those relationships to the attention of all concerned.

- Ability to:
  - Provide recommendations to program offices and field support teams to assist with planning and developing the DMP, SOWs, contract language, and ILAs;
  - Provide focused management and coordination across multiple stakeholders in support of DMSMS management;
  - Chair and facilitate a DMT by developing annual goals and agendas and to direct the personnel to meet the established goals;
  - Identify, prioritize, and recommend solutions to the barriers that prevent a PM from establishing a robust DMSMS management program;
  - Apply advanced concepts and theories to DMSMS issues and tasks so they may be resolved effectively and efficiently; and
  - Develop and establish DMSMS management processes and guidelines for all personnel to follow.

Because the DMSMS competency does not exist in a vacuum and must be obtained in conjunction with DAU Defense Acquisition Workforce Improvement Act (DAWIA) certifications, additional courses are required to obtain the entry-level, technician-level, and leadership-level competencies and experience associated with the roles and responsibilities of DMSMS practitioners. Appendix F contains a comprehensive outline of DMSMS competency levels and can be used as a basis for improving DMSMS management workforce proficiency. The courses identified at the beginning of this section as recommended minimum requirements for DMT members are also required courses, corresponding with the achievement of a DMSMS entry-level competency.

3.4 ESTABLISH DMSMS OPERATIONAL PROCESSES

A process is any activity or set of activities that uses resources to transform inputs into outputs. Processes have objectives, inputs, outputs, activities, constraints, and resources. Three foundational DMSMS management foundational processes have already been discussed in this section: 1) establish the foundations for DMSMS management, 2) develop the DMP, and 3) form the DMT. As the DMT develops the DMSMS operational processes, the team must define the basic jobs needed to support the program office or other customers.[85] The team must then define and understand the inputs, outputs, activities, resources, constraints, and schedule. In fact, once the operational processes have been developed, key DMSMS management events should be included in not only the DMP, but all pertinent program office documentation including the integrated master plan, the integrated master schedule, the LCSP, Technology Development Strategy, Product Support Plan, and the AS.

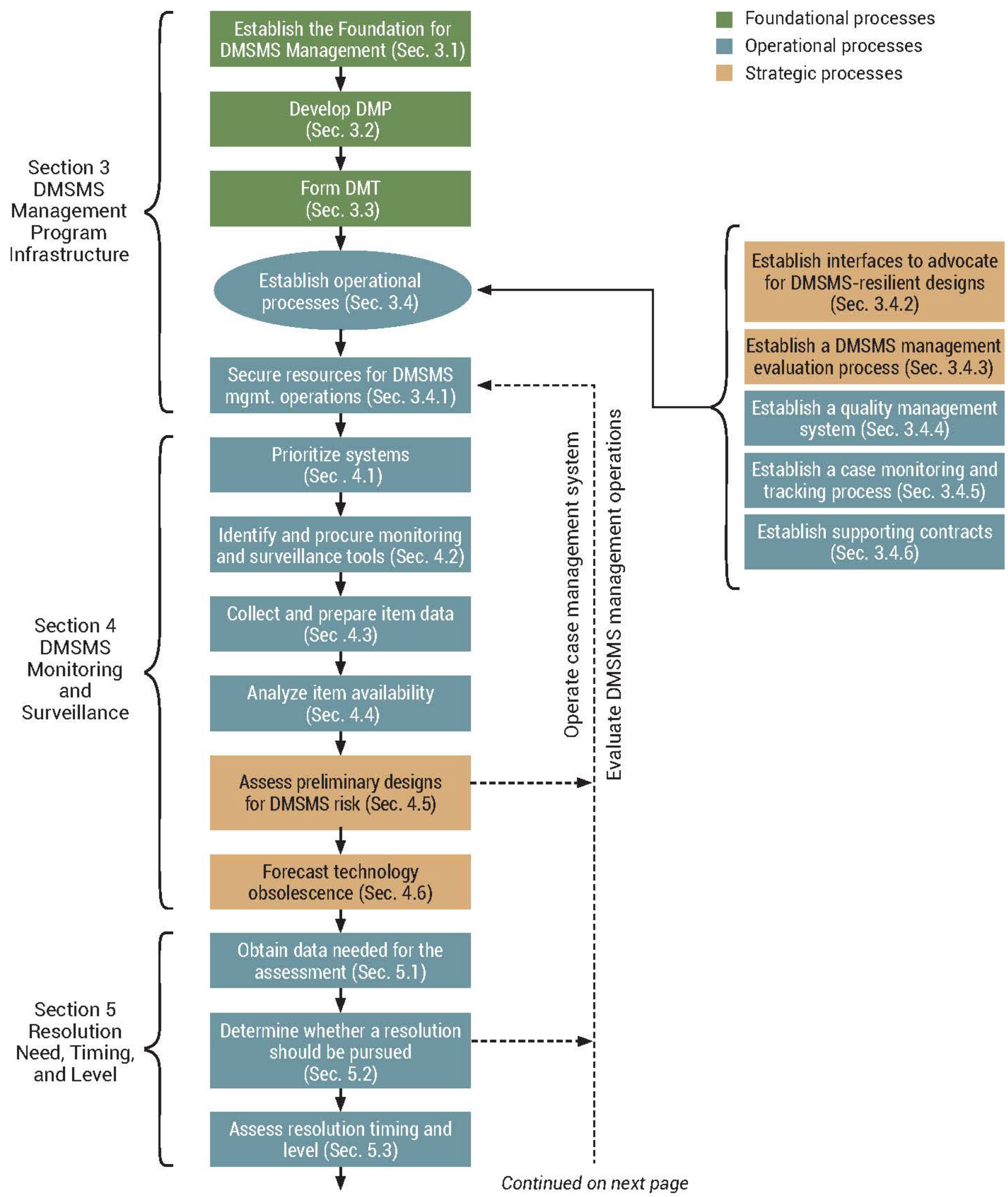
Tools are involved throughout all DMSMS operations to collect, aggregate, store, and report data, as needed, to produce DMSMS management products. It is not necessary (and not recommended) for the program office to develop or purchase its own tools. Program offices need to determine the right tool mix, but can leverage existing DMSMS management systems and their associated service offerings[86] to implement a new DMSMS management program. These systems include management databases that trained DMSMS management practitioners use to integrate, analyze, forecast, and report on data collected from predictive tools, vendor surveys, critical materials analysis, and PDNs received from

[85] As footnoted earlier, contractors may be the ones performing these processes and the DMT will be responsible for oversight. In these situations, contractor collaboration in the development of the processes is necessary.
[86] When determining the appropriate tool mix, the DMT should consider the tools already being used by the contractors.

manufacturers (see Sections 4.4.1–4.4.4, as well as logistics tools (see Section 5.1) and in-house case management tools (see Section 3.4.5). The DKSP contains information on DMSMS tools and resources.

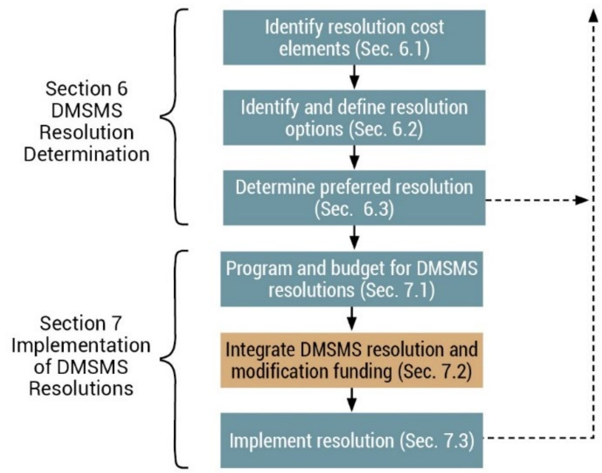
DMSMS management processes can be categorized in many ways. Figure 5 shows the scheme used in this document. The DMT establishes and carries out all the operational processes shown in the figure, but each process is associated primarily with one of the major DMSMS management process steps. The tan shaded boxes indicate the strategic processes distributed across the five steps.

Figure 5. DMSMS Management Processes



Continued on next page

Figure 5. DMSMS Management Processes *continued*



The following sections describe only those operational processes associated with the “Prepare: DMSMS management program infrastructure” step of the DMSMS management process, while the remaining operational processes are addressed in the remaining four sections of the main body of this document.

3.4.1 Secure Resources for DMSMS Management Operations

Section 3.3.1 discussed the roles and responsibilities of the DMT. It described how program offices utilize prime contractors and OEMs as well as independent SMEs to perform the bulk of the work needed for DMSMS management operations. All other DMSMS management activities are performed on an as needed basis by program office personnel. Operations funding is required to support the day-to-day functioning of a program office’s DMT, separate from the funding required for specific resolutions to identified DMSMS issues.[87]

This section discusses the determination of DMSMS management operations funding needs associated only with primes/OEMs and independent SMEs whose services are secured by contract. Funding requirements for program office staff are developed through non-DMSMS-related mechanisms.

Resources for DMSMS management operations contracts are normally obtained through the Component’s programming and budgeting process. The specific procedures to follow are Component dependent, and even within a single Component, those procedures may not be the same across all program offices. Regardless of Component, the inclusion of DMSMS-related resource requirements for both operations and resolutions in the budgets of other activities, such as parts management, reliability and maintainability, or supportability is often a successful approach.

The next section lists DMSMS management operations funding drivers. Appendix G discusses best practices for programming and budgeting for DMSMS management operations.

3.4.1.1 DMSMS MANAGEMENT OPERATIONS FUNDING DRIVERS

The drivers of program office funding requirements for DMSMS management operations (regardless of who performs those tasks) can generally be classified into three categories. The first category primarily consists of one-time tasks focused around DMSMS management program initiation. The second includes

[87] Section 7 discusses funding for implementing DMSMS resolutions.

both startup and recurring efforts associated with data collection and management, research, and forecasting where, for example, the startup tasks are repeated as more items are phased into active monitoring status. The third category mainly consists of recurring activities pertaining to data analysis and oversight.

- DMSMS management program initiation. This category includes the following one-time activities or tasks that drive the need for resources:
  - Developing the DMP, including
    - Defining, documenting, and establishing DMSMS management processes;
    - Defining the required management products and articulating the required formats; and
    - Defining metrics for DMSMS management efficiency and effectiveness;
  - Establishing DMSMS quality management processes; and
  - Obtaining DMSMS analysis tools and case management databases and tracking systems.
- Data collection and management, research, and forecasting. Resources needed for this category of startup and recurring activities are dependent on the following tasks:
  - Obtaining parts lists/BOMs or creating parts lists/BOMs (in instances where a parts list/BOM cannot be obtained);
  - Formatting, cleaning up, and loading parts lists/BOMs;
  - Analyzing BOMs to identify obsolete or near obsolete items;
  - Researching obsolete or near obsolete items to verify their status and potentially identify alternatives;
  - Surveying vendors to identify obsolete or near obsolete software, material, mechanical and COTS items as a function of risk;
  - Processing PDNs;
  - Opening and documenting DMSMS cases; and
  - Developing, analyzing, reviewing and approving resolutions.
- Data analysis and oversight. The following are illustrative recurring activities that consume resources:
  - Developing contract language;
  - Preparing DMSMS budgets;
  - Using technology roadmaps to forecast DMSMS issues and participating in discussions about them;
  - Facilitating and attending meetings, including travel and other logistics, as needed;
  - Conducting health assessments;
  - Preparing reports (both formal and informal) on the health of the system;
  - Reviewing metrics to identify where DMSMS management improvements are needed;
  - Reviewing designs to analyze DMSMS resilience;
  - Monitoring processes and quality management; and
  - Overseeing implementation of the resolutions.

Following are some additional drivers of the activities associated with the second and third categories.

- Monitoring and surveillance scope and level of effort. Monitoring and surveillance are recurring tasks for the DMSMS management of any system. If the program office has adopted a risk-based approach to monitoring and surveillance, then decisions will have been made regarding which subsystems to monitor, which of their items and assemblies to monitor proactively, and where forecasts for technology obsolescence should be made. A program office might also consider the quality of the data available in the BOMs as a factor in determining the level of effort required to enable monitoring and surveillance, particularly in the beginning phases of a DMSMS management program. The scope and level of effort might fluctuate based upon the maturity of the DMSMS management program.

  Examples of startup tasks are obtaining or creating, formatting, and loading parts lists/BOMs and carrying out any additional research and analysis required to ensure the quality of the data for each subsystem being monitored. The scope of a DMSMS management startup effort is also broader, addressing the entire parts list/BOM, all vendors, and all parts, rather than only changes to or periodic updates to a subset of these. Because of those factors, the funding required for startup will be greater than that to maintain a steady-state DMSMS management effort. Table 7 compares the startup and steady-state efforts required for data cleanup, vendor surveys, and item research. Beyond the initial startup spike as new subsystems are phased in, the efforts associated with DMSMS monitoring and surveillance operations tend to be repetitive.

Table 7. Comparison of Startup and Steady-State Effort for a Subsystem

DMSMS Monitoring and Surveillance Activity	Startup	Steady State
Data cleanup	Entire BOM	Only changes to the BOM
Vendor surveys	All vendors	Only on a time-phased, periodic schedule
Item research	All items	Only when certain conditions are met (e.g., item status changes, item has not been researched in a certain period of time, changes in the sources of an alternate item, packaging changes, revisit of a previous “no action required” item)

More information on monitoring and surveillance activities is provided in Chapter 4.

- Assessment and analysis level of effort. Assessment and analysis are recurring tasks for the DMSMS management of any system. The magnitude of the requirement is contingent upon the DMP and the number of items that the DMT chooses to assess. Also relevant is the level of detail required for periodic health assessments of the system from a DMSMS perspective (see Section 5.3), reporting requirements, meeting attendance, and so forth.
- Overseeing implementation. The DMT’s role does not end when a PM decides which resolution option to pursue. The final step of the DMSMS management process is implementation. In the *Implement* step, the DMT should be involved in two final processes: securing a source of funding for implementing the preferred resolution and ensuring that the actions required to implement the preferred resolution are taken. These are recurring tasks for all resolutions.

3.4.1.2 SUPPORTING BEST PRACTICES

There are two best practices that support the performance of these responsibilities. The first best practice is to begin risk-based, proactive DMSMS management operations early in the life cycle and continue those activities throughout the entire life cycle.

Appendix B contains recommended DMSMS management questions for SETRs. According to that appendix, some aspects of DMSMS management operations should begin at the SRR. By the PDR, a forecasting/

management tool and/or the results of manual research should be used to identify immediate and near-term obsolescence issues associated with the version of the BOM available at that point in the life cycle.

There are two implications of this from the perspective of programming and budgeting for DMSMS management operations. First, the programming and budgeting estimates should assume that DMSMS management operations begin early in the life cycle. Second is that these DMSMS management operations should be risk-based.[88] Priority, with respect to identifying issues, should be given to the areas where DMSMS is likely to have the greatest impact. When low risk items are excluded, DMSMS management operations costs can be reduced. There is however a tradeoff involved because being reactive in some instances could have a negative effect as discussed previously.

Being proactive early implies that there is contract language for the prime (and its suppliers) to perform proactive, risk-based DMSMS management operations and as a result report potential DMSMS issues to the program office in a timely manner.[89]

The second best practice is to ensure that the personnel responsible for the program office's IP strategy programs and budgets for obtaining rights to the technical data needed to effectively perform DMSMS management operations and develop DMSMS resolutions.

While the costs of obtaining technical data are not part of DMSMS programming and budgeting, obtaining the data necessary to perform DMSMS management operations is a DMSMS programming and budgeting enabling best practice. The first key technical data requirements are indentured BOMs (with the original manufacturer's part numbers at the component level) necessary for DMSMS monitoring. Before BOMs are finalized, parts lists should be required. The second important requirement is a technical data index along with an option to obtain (through a deferred ordering clause) specific data when needed to research DMSMS issues. This requirement could be used to ensure that all items are included on a BOM because it is a common problem for incomplete BOMs to be delivered. This type of index is similar to a drawing tree, however, a drawing tree is not always created.

Another related best practice is retaining technical data on older systems. Until a system is disposed of, there is always a chance that its service life will be extended and the data will be needed again. Without the data, it will be necessary to rebuild from scratch.

3.4.2 Establish Interfaces to Advocate for DMSMS-Resilient Designs

Design is a complex task that must balance a large number of performance, support, safety, environmental, security, regulatory, and other requirements and constraints. Because it is very difficult to balance all these things in a cost-effective way, the systems engineering process guides design tradeoffs, including the consideration of DMSMS management–related interests and concerns, to develop a design that takes all stakeholder considerations into account.

[88] See Section 4.1 and Section 4.3.2.1. For many items, it is sufficient to be reactive because resolutions are readily available in a short period of time.

[89] The program office should be made aware of all DMSMS issues identified by a prime contractor that has been contracted to perform DMSMS monitoring, even when that same contractor may also be responsible for resolving certain types of classes of DMSMS issues. This visibility enables the program office to maintain oversight over the prime contractor's DMSMS management operations activities, as well as to be able to plan for any actions and/or resolutions that will be necessary to address a given DMSMS issue beyond the prime contractor's period of performance.

DMSMS management is one of numerous priorities and requirements competing for the attention of program management. Part of the DMSMS management community's role (whether working inside the government or working in commercial industry in support of the development of a government system) is to educate program management on the importance of identifying and addressing obsolescence issues as early in a system's life cycle as possible, often by addressing downstream implications. The DMSMS management community should not be thought of as a single-issue community on its own. Instead, DMSMS management should be approached as an integral part of reliability, maintainability, availability, and supportability. Indeed, the DMSMS management community might be able to build momentum and weight behind its recommendations by leveraging the interaction that other communities have with the PMs and chief engineers. Ultimately, the bottom line is that even if the DMT is unable to influence the design in a manner that eliminates "designing in" an item that is or has the potential to soon be obsolete, it will have at least identified DMSMS risks to continue to monitor for potential future mitigating actions.

Members of the DMSMS community have a role in advocating for DMSMS considerations during design in order to generate a DMSMS-resilient design that delays the occurrence of DMSMS issues and/or increases the likelihood of low cost resolutions being available. DMSMS design considerations are not automatically implemented. DMSMS-related design considerations require a business case. To facilitate this, there should be effective interfaces between the DMSMS management community and the design and systems engineering communities. These interactions ensure that design trades are made between design characteristics and that the required capability adequately takes into account obsolescence.

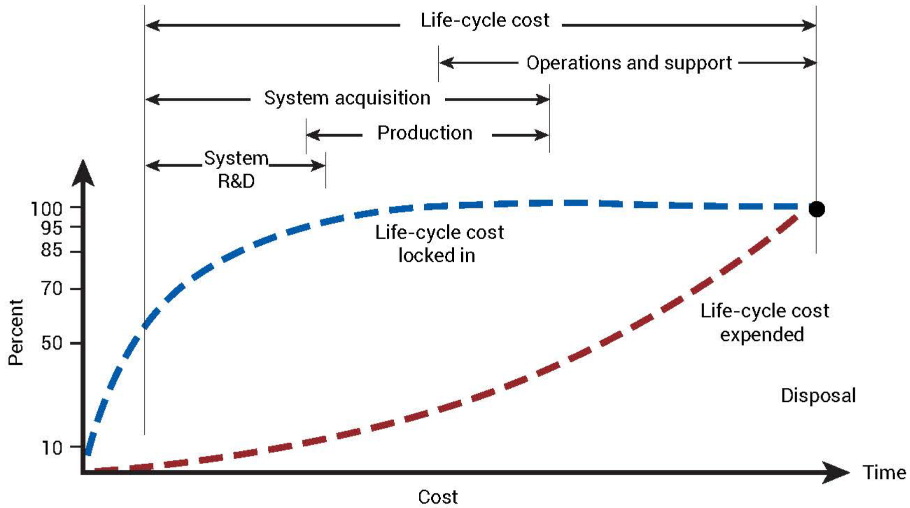
The remainder of this section provides guidelines regarding the DMSMS trade space for initial design and subsequent redesign phases resulting from DMSMS considerations. It discusses design considerations that should be promoted by the DMSMS community to delay the occurrence of DMSMS and increase the likelihood of low-cost resolutions.

DMSMS is one among many product support design considerations. Design decisions made early in the system development have a substantial impact on operations and support costs later in the life cycle. As shown in Figure 6, a high percentage of the life-cycle costs of a system are locked in based on early design decisions.

During the initial design process, performance, supportability, logistics, cost, and other considerations all have to be balanced and trades made to produce the optimal design. For a redesign effort, specifications and interfaces already exist, which may constrain the ability to determine an optimal design. DMSMS is one of the many considerations informing design and redesign decisions.

A DMSMS review of system or product designs provides the opportunity to design out items that are high risk for various reasons. For example, if they are near their end of life (EOL), replacing them would be difficult or complex, and requalifying the system after replacing the items would be costly. As a best practice, program office leadership should actively set the tone for the importance of considering DMSMS risk even as early as the PDR by setting design goals in contracts that consider availability, supportability, producibility, reliability, and maintainability over the fielded lifetime of the product or system. These considerations should be built into a checklist for discussions with the chief engineer and PM leading up to each review. For example, the program office might challenge its design engineers to develop a design that will endure until year X, where "X" is the year in which either the next production block or technology insertion is scheduled. Considering DMSMS risk during design not only will help to avoid the incorporation of obsolete or soon-to-be obsolete items, but will also enable a program office to more easily implement or integrate resolutions to and mitigate the impact of any DMSMS issues that do emerge during each phase of the life cycle. Failure to track and address these issues can have serious impact to cost, schedule, and even system viability.

Figure 6. Relationship between Expended Life-Cycle Cost and Locked-In Cost



Source: Wiley J. Larson and Linda K. Pranke, *Human Spaceflight: Mission Analysis and Design* (McGraw-Hill College, 1999).

Note: R&D = research and development.

DMSMS issues can be delayed and/or resolved in a simpler way if a system's design enables the substitution of readily available alternative items. Following are several design concepts that designers and systems engineers should consider to minimize DMSMS risk throughout the life cycle of a system or product:

- Technology and item selection. New technologies do not capture 100% of the market all at once; there is a period of time when both the new technology and the one it replaces are in use. However, the design should not include anything that is near the end of its functional life. A technology roadmap that anticipates the life spans of technologies and synchronizes both technology refreshment and insertion is useful when designing systems, especially electronic systems. There are, however, tradeoffs associated with selecting new technologies. New technologies can be profoundly more effective at delivering an important defense performance parameter, and thereby enable major changes in defense capability. So it is desirable to be able to insert such new technologies. However, there is often a learning phase associated with a new technology in which issues are discovered.[90] Consequently, choosing the appropriate technology insertion timing where leading capability exists but where early phase problems have been corrected is essential. When feasible to do so, it is also a best practice to avoid the selection of sole-source items.
- Parts management. Parts management is a design strategy for standardization and reuse that can enhance the reliability of the system and mitigate obsolescence.[91] An up-front assessment of the risk of obsolescence should influence parts selection during the design process.[92] Parts selection

[90] For example: In electronic components these issues are often called errata. In specialized manufacturing, there can be issues with a manufacturing process that must be resolved before the product is sufficiently reliable for a specific application.

[91] For more information on parts management, see DSPO, SD-19, *Parts Management*, December 2013, and MIL-STD-3018, "Department of Defense Standard Practice: Parts Management," June 2, 2015.

[92] DoDI 5000.88, "Engineering of Defense Systems," November 18, 2020, establishes a requirement for parts selection to consider DMSMS, p. 25.

encompasses both the selection of new parts and the reuse of parts from previous designs. DMSMS issues can be delayed if part selection in design includes considerations to minimize DMSMS risks. Extending the interval between DMSMS issues and their projected impact on systems will decrease resolution costs over the system's life cycle, because there will be fewer issues to be resolved.

The selection of new parts might seek to standardize the use of parts to the greatest extent possible and minimize the use of custom parts through the recommendation of alternatives. This is a tradeoff, however. Lower power and higher performance for an application-specific integrated circuit (ASIC) designed specifically for a task may be desirable where the volume or performance justifies the ASIC development. If unique, highly specialized parts are used to meet performance requirements, DMSMS issues during operations and support will be more prevalent. The risk assessment should also consider material selection, economic and regulatory trends, unique manufacturing processes, packaging schemes, and so on. Before including a part on a preferred parts list, the identified risks should be assessed and managed to make the BOM stable and sustainable. As the design stabilizes, it should minimize the number of OEM or original component manufacturer (OCM) parts necessary for production. When non-preferred parts are used, their designs should be captured in the proper transportable computer-aided design models.[93] A somewhat higher level of parts management is standardized module development. For example, a common design can be reused over and over for many purposes, perhaps with minor variation in software or minor variation in connected sensors and actuators to enable use in many different applications. Similarly, this same platform can be repackaged in a different shape but otherwise the same design. The net result of standardized module design is, as above, higher volume of product, better factory support from suppliers, and more rapid increase of product reliability and producibility. In the context of DMSMS, the higher volume consumption of components enables a closer connectivity with suppliers to work DMSMS-related sourcing issues.

Other part selection considerations include:

– Parts that are not already obsolete;

– High reliability parts with multiple (and preferably domestic) sources;

– Parts with underlying technologies that are early in their life cycle and expected to be widely adopted;

– Proper parts application (e.g., derating, operation, use of the part, type of environment in which the part will be used);

– Cost-benefit evaluation—critical functions require low risk parts;

– Obtaining qualification test data or past performance data;

– Ensuring compliance with contract performance requirements;

– Technical suitability; and

– Government life-cycle cost optimization.

- Open systems architecture—hardware. An open systems architecture employs technology-independent modular design tenets, uses widely supported and consensus-based standards for its key interfaces, and is subject to validation and verification, including test and evaluation (T&E),

[93] A very useful method of describing many firmware or logic hardware design is through a Very High-Speed Integrated Circuit (VHSIC) Hardware Description Language (VHDL). A VHDL (assuming a satisfactory level of specificity) is easily ported from one generation to the next generation of technology. Life-cycle costs may be reduced significantly through the proper use of VHDL design representation. When dealing with microcircuits, the most common Hardware Description Language is VHDL.

to ensure that key interfaces meet open standards. An open systems architecture thereby takes product roadmaps and technology insertion plans into account. Also, compared with design-specific approaches, it enables readily available alternative items to be used more easily in place of obsolete items, as long as the substitutes have the same form/fit/function (F3) and interface as the ones they replace. Test interfaces must also be considered. An open systems architecture reduces DMSMS resolution costs, because it avoids expensive redesign by facilitating the insertion of advanced technologies.[94] Often, assuming no other proprietary technology is involved, it also enables multi-vendor competition, which will minimize the likelihood of future DMSMS issues.

- Open systems architecture—software. An open and modular design enables the development of "plug-and-play" hardware and software that are interchangeable through industry-standard interface modules. To minimize DMSMS impacts, the software architecture of a system should be designed to take growth, evolving standards, and interfaces into consideration.[95] This provides for change while minimizing the impact on existing system functions. In addition, the design should allow for partitioning of the software into appropriate units that can be tested in isolation and should avoid making software dependent on the hardware through the appropriate isolation of drivers. Plug-and-play interfaces are desirable when appropriate. Low coupling (interdependent relationships) within a system allows a system to rely on information sharing to control, manage, and execute functions. When designing custom software and selecting COTS software, a program office will also want to carefully select interface standards and protocols that are the most stable and have the broadest support, as these will have greater staying power within industry. A program office should also seek to minimize the number of different interface standards and protocols applied across the weapons system, because this will simplify the design configuration and CM issues. The focus of software design can then be to meet the driver interfaces, rather than different, specific hardware items. Transportability of models that capture critical elements of the design is a consideration. The modules of an open system should be discrete, scalable, and reusable with low connectivity to the relationship between internal elements of different modules, simplifying and decreasing the number of interfaces required. Having high cohesion among module functions also enables multitasking and use of identical modules throughout the system. Significant complexities may be associated with using open systems architecture principles for a new software design being incorporated into an existing asynchronous system. One approach to software design is object-oriented design, which can increase portability and reusability of software. Finally, DMSMS issues will often require an update of standards-based protocols (such as Internet protocols). Because standards-based protocols are revised relatively often due to cyber defense issues, it is essential to recognize that the operating system and protocol stack are likely to be revised frequently and therefore any system should provide the required mechanisms for assured updates.

- Use of COTS assemblies. COTS assemblies offer opportunities for reduced development time, faster insertion of new technology, lower procurement costs, and potentially, lower life-cycle costs, due to a more robust industrial base. Consequently, DoD systems increasingly comprise COTS assemblies and software.

  Unfortunately, COTS items present a unique set of challenges for the management of DMSMS issues.[96] These challenges are due, at least in part, to the fact that these items are produced for the commercial market. For example, the rapid turnover of COTS items creates unique obsolescence-induced supportability issues for military systems, because OEMs are likely to replace or stop producing COTS items long before the life cycle of a system is complete.

[94] The ability to use an open systems architecture design approach for a legacy system is limited if not anticipated in the initial design.
[95] Software is the primary focus of integration for the development of open, scalable, and adaptable systems.
[96] SAE International, EIA-933C, "Requirements for a COTS Assembly Management Plan," revised August 8, 2020, includes requirements for obsolescence management.

Furthermore, the DoD community has little influence over the far shorter life cycle of commercial products. Consequently, information on the future availability of COTS assemblies is hard to obtain or track. Changes during the system life cycle may not be documented, increasing the likelihood of CM and DMSMS issues. In addition, depending upon the system and program office management practices, requalification costs associated with replacing COTS assemblies may be significant. For that reason, the initial cost savings from the use of COTS assemblies may be offset by increased costs later in the life cycle when those assemblies have become obsolete or are replaced by a later-generation design. In short, it may or may not be appropriate to include COTS assemblies in critical paths or functions of a system.

Before including a COTS assembly in a design, the designer or PM should assess the risk and suitability (which should consider technology insertion and refreshment strategies).[97] A program office should avoid modification of COTS assemblies or software without careful consideration of the implications and alternatives. For example, modification could make the assembly or software nonstandard and incompatible with any standard updates to correct for deficiencies or errata, to add a feature, or to otherwise optimize performance. A PM would then be faced with choosing between the immediate costs of further revising the nonstandard assembly or software (to incorporate the update) or future high support costs and the inevitable obsolescence.

Managing DMSMS issues due to the introduction of COTS items in a system design calls for effective relationships among all relevant stakeholders: the COTS supplier, the system developer and integrator, the DMT, and the buyer (e.g., the item manager). The DMT must remember that all COTS items are subject to DMSMS issues, but some are prone to specific problems. For example, software, central processing units, memory chips, and disks change frequently. These specific COTS classes aside, a degree of obsolescence is always in place in the form of planned minor upgrades or refreshes, typically at the two- and four-year marks. Beyond that, a major upgrade—a next generation—should be expected at some time in the future.

- Use of alternative grade parts. Alternative grade parts represent all grades of parts other than commercial grade and military grade, e.g., automotive grade. Alternative grade parts may be used instead of military grade parts in certain defense applications as long as the mission and application for these products can tolerate reduced short-term or long-term quality or reliability and a thorough understanding of how the alternate grade part will be used has been made. Many component engineers do not consider the application driven risk tolerance that alternative grade parts may have because they undergo less rigorous screening (quality, conformance, inspection, and testing) than that of a military grade part. Since alternative grade parts often receive significantly more screening than commercial grade parts, additional measures can be employed to reduce the risk of using alternative grade parts by ensuring reliability and performance in the intended application. One example may be conducting additional part qualification and screening and part derating to confirm the part can meet the specific intended application. Another example is the use of existing standards, e.g., Automotive Electronics Council Q specifications, to predict performance and reliability. Effective measures can also be in form of process changes, such as planning for more frequent part refreshment, building in redundancy, and providing additional insulation against environmental extremes. Implementing such additional measures will likely add to overall part acquisition cost and time and that must be weighed against the benefits of using an alternative grade part. Benefits include improved technology or a reduction in size and weight. In addition, an alternative grade part may be more readily available from a larger supplier base than a military grade part, offering future reductions in lead times and costs and some protection against obsolescence.

[97] Ibid. This standard was originally issued by the Electronics Industries Alliance, which dissolved in February 2011 and no longer exists. The standard now belongs to SAE International, which is in the process of updating this document.

In addition to design concepts, the design tools themselves can impact future DMSMS issues. Modern defense systems are designed, built, and manufactured with extremely capable computer-aided design tools. These tools enable exhaustive checking of a design at each design phase. Whether electrical design, software design, firmware design, mechanical design, system design, system validation, production, or life-cycle support, modern tools will be valuable in reducing the cycle time and eliminating many common types of errors. Some of these tools interface with DMSMS resources to provide alerts regarding the latest issues with components or subsystems or with current practices. Some are also able to check rules and checklists for best practices and identify alternate items that may be in an earlier stage of their life cycle. All are able to provide appropriate design documentation.

3.4.3 Establish a DMSMS Management Evaluation Process

The DMT should continually evaluate the effectiveness of its program office's DMSMS management operations measured against the program office's defined DMSMS objectives. This is accomplished by recording and periodically analyzing data. Although data do not provide an answer to program offices in and of themselves, data should be captured and analyzed to generate metrics for a DMSMS program. Metrics also indicate where a program office should investigate further.

The framework for DMSMS record keeping that will be introduced in Section 3.4.3.1 can be used strategically throughout the life cycle of defense systems. These records provide a basis for the identification, calculation, and analysis of DMSMS metrics that can be used. In general, benefits (summarized in Section 3.4.3.2) of using these records and the metrics derived from them include improving the efficiency and effectiveness of DMSMS management efforts, supporting DMSMS management and resolution programming and budgeting decisions, reducing cost, and avoiding DMSMS impacts on schedule and readiness.

Some information collected may have only limited utility for a single program office, often because of a limited number of data points available. For instance, average cost and resolution time for a single program office is useful for self-assessment, but cannot provide statistically significant data representing a wider set of program offices. It is important however to recognize that while program office management is the principal beneficiary of this record keeping framework and resultant evaluations, it is not the sole beneficiary from a strategic perspective. Higher-level organizations, such as Program Executive Officers (PEOs), Service Headquarters (HQ) organizations, and Office of the Secretary of Defense (OSD), profit as well.

For example, given evaluation and current record keeping practices, questions such as the following cannot be answered by today:

- How many program offices have DMPs?
- How many program offices program and budget for DMSMS management operations and resolutions?
- How many program offices are proactively monitoring for DMSMS issues? What portion of those program offices' system is proactively monitored for DMSMS issues?
- How much is DoD spending on resolutions for DMSMS issues?
- How much is DoD spending on DMSMS management operations?
- How would resolution costs change with greater DMSMS management proactivity across the board?

In order to be able to answer such questions, it is therefore a best practice to establish and use a process to capture and evaluate a program office's DMSMS management operations data. By aggregating DMSMS case information across multiple program offices, higher level organizations can determine the need for overarching policy and guidance to both target the most important needs and measure whether the implementation of the policy and guidance is having the desired results.

3.4.3.1 ESTABLISH A DMSMS RECORD KEEPING FRAMEWORK

Data elements in the record keeping framework are kept, typically as part of a program office's case management system and to some extent from aggregate information about its DMSMS management program.[98] The data elements can be categorized into two broad information areas associated with DMSMS management of a given defense system as well as DMSMS management across an enterprise:

- Information associated with the cost of DMSMS resolutions and DMSMS management operations. This includes characteristics of the obsolete item, the resolution and its cost, the amount paid for DMSMS management operations, and benefits associated with implementing the resolution. Such information is useful for cost estimating and programming and budgeting.
- Information associated with the efficiency of DMSMS management operations. This includes case processing time, how DMSMS issues were discovered, and workload measures. Such information will help identify areas where process improvements are needed.

While the distinctions between these two information categories are relatively sharp, the data elements that fall within each are not entirely mutually exclusive. For example, some data elements associated with process efficiency might consider the magnitude of DMSMS management operations cost; similarly, how issues were resolved might impact case processing time. Furthermore, making inferences about an ROI requires both process efficiency and cost data.

All the identified data elements have direct, tangible benefits to program offices, PEOs, Service HQ, and OSD. No superfluous information is included. The data elements are divided into two hierarchical levels. Every program office should be collecting and analyzing the Level 1 data elements to improve DMSMS management operations, reduce DMSMS-related costs, prevent DMSMS issues from impacting readiness or schedule, and be in a strong position to explain and prove the benefits of its DMSMS management efforts. Level 2 data elements enhance these benefits by enabling more complex analyses, sometimes using data that may be more difficult to obtain. In addition, there are some benefits that provide greater visibility of DMSMS management throughout the DoD and raise the gravity and significance of how it is regarded. Program offices with highly robust DMSMS management operations are encouraged to collect and use Level 2 data in addition to Level 1 data. Table 8 lists the Level 1 and 2 data elements. This table is shown here primarily to provide a formatted list of all the included data elements.[99] Appendix H.4 is a data dictionary for the Level 1 and 2 data elements. Section 3.4.3.2 summarizes specific ways in which the framework can be used strategically to benefit all stakeholders.

Table 8. Record Keeping Data Elements

Information Type	Level 1 Data Element Title	Level 2 Data Element Title
DMSMS Cost–Related	• Type of Resolution Approved • Resolution Cost • Source of DMSMS Resolution Cost • Redesign Level	• Commodity Type • Operating Environment of the Equipment* • Product Acquisition Cost

[98] If any of the data will be provided by contractors, it should be asked for in an SOW so contractors can prepare for it.

[99] Although not specifically called out in Table 8, the name of the program office/system to which the data apply would also be needed.

Information Type	Level 1 Data Element Title	Level 2 Data Element Title
	• DMSMS Management Operations Cost Paid to Prime/ OEM* • DMSMS Management Operations Cost Paid to Independent SME Organizations* • Management Operations Cost for Internal DMSMS-related Activities*	• DMSMS Item Type • Value of Management Operations Activities Received at no Cost from a Centralized Service Source*
DMSMS Management Operations Efficiency–Related	• OEM/OCM Part Number • OEM/OCM Commercial and Government Entity (CAGE) Code • Nomenclature • Item Class • Case Proactivity Indicator • Date Alert Received • Date Case Opened • Date Resolution Submitted for Approval • Date Case Resolved • Date Case Closed • Date Implementation Needed • Resolution Avoided • Cost of Resolution Avoided • Subsystems* • Subsystems Monitored* • Components* • Components Monitored* • Reason Issue Was Discovered Reactively • Out-of-Cycle Redesign Avoided Indicator • Level of Out-of-Cycle Redesign Avoided	• LON Buy Preferred Indicator • Monitoring Techniques • Effect on Production Schedule • Effect on Logistics Response Time • Effect on Mission Capability • Resolution Avoided Implementation Time • Consumption Rate • Stock on Hand

Note: The system to which the records apply must also be identified. Most of the record keeping data elements are linked to individual DMSMS cases and therefore would be available from a suitable DMSMS case management system. An * depicts other readily available data elements needed to improve DMSMS management operations and understand their ROI that are not linked to individual cases because they represent the DMSMS management effort as a whole.

3.4.3.2 BENEFITS OF RECORD KEEPING

The beginning of Appendix H provides multiple examples of the benefits of this framework. The remainder of this section is a higher level summary of those benefits.

3.4.3.2.1 Programming and Budgeting Benefits

DMSMS management costs at any level from program office to OSD should not be hidden or within some other function's resource allocation. The inevitability of DMSMS issues and the extreme negative impacts associated with leaving them unresolved imply that the resources needed should be programmed and budgeted for explicitly.[100] Eight benefits of the record keeping framework that relate to improved estimates of programming and budgeting requirements for DMSMS management—both resolutions and management operations follow:

- Greater fidelity cost estimates for DMSMS resolutions,
- Improved cost estimates that better take into account the timing and magnitude of inventory purchased for LON buys,

[100] The degree of explicitness would vary as a function of organizational level. This is not to suggest that there should be a budget line item or program element for DMSMS management activities. However, program office financial documents should identify DMSMS management resources precisely and this information should be visible at least at the PEO level.

- Improved ability to develop and defend programming and budgeting requests for DMSMS resolutions,
- Improved evaluation of contractor cost estimates for resolving DMSMS issues,
- Improved understanding of the link between DMSMS management proactivity and risk,
- Improved cost and workload metrics for DMSMS management,
- Improved ability to develop and defend programming and budgeting requests for DMSMS management operations, and
- Improved evaluation of contractor cost estimates for conducting DMSMS operations.

3.4.3.2.2 Process Improvement Benefits

Increased DMSMS management effectiveness and efficiency as a result of process improvement generally implies lower DMSMS resolution costs. The following benefits apply:

- Improved efficiency for case processing time,
- Improving the effectiveness of item monitoring processes,
- LON buy process improvement, and
- Detection of anomalies in DMSMS resolution cost to identify areas for further analyses.

3.4.3.2.3 ROI Benefits

All the ROI related benefits concern, in one way or another, assessing (either quantitatively or qualitatively) the value of risk-based, proactive DMSMS management. Some support provided to program offices from DMSMS management SMEs such as improved contracts, better decision-making, the potential to obtain hard-to-find parts, the importance of finding the most accurate data, and so forth are not covered. The value of such support cannot be determined from the data elements in the framework. In addition, these types of functions represent additional reasons for securing comprehensive DMSMS management operations support and are often articulated by SME providers as rationale for determining which provider to select.

Figure 7 illustrates the difference between proactive and reactive DMSMS management. The earlier an issue is identified, the longer the window of opportunity to resolve it. A longer window of opportunity reduces not only the likelihood of readiness, schedule, and counterfeit-items or malicious-insertion impacts,[101] but also generally the cost of the resolution. Cost is reduced because more lower-cost options are available, the result of the early detection of the issue.

Benefits is this area are as follows:

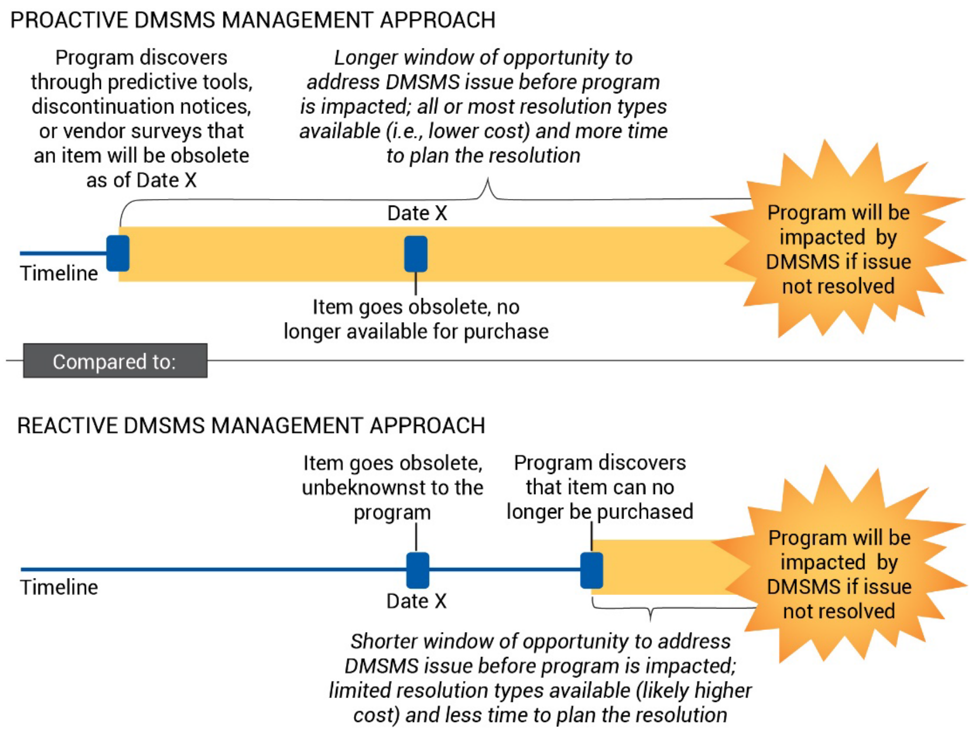
- Estimating the cost of being reactive,
- Estimating the cost avoidance for being proactive,
- Improved understanding of DMSMS impacts on schedule,
- Improved understanding of DMSMS impacts on operational availability,
- Estimating supply system impacts avoided by being proactive,
- Estimating improvements in resolution implementation time from being proactive, and
- Determining an ROI for DMSMS management.

[101] Counterfeit/malicious insertion risks may be reduced because a program may still be in a position to work with primes and OEMs.

Examining trends in such ROI-related areas provide insight on the cumulative impact of proactive, risk-based DMSMS management. This further enhances the value proposition for these associated benefits.

Each benefit has the same fundamental value proposition. For the program office, all the ROI-related benefits provide evidence of the value of fully funding DMSMS management operations. There are instances where the DMSMS management community has had difficulty convincing program office leadership of the importance of risk-based, proactive DMSMS management (relative to other needs), especially during sustainment where there may not be enough operations and maintenance (O&M) funds to meet requirements. The data elements for each of the following benefits should provide sufficient information to raise the priority of DMSMS management operations funding because it is the only way to mitigate the risks. The data should also be used for justification of funds requests.

Figure 7. How Proactive DMSMS Management Increases the Window of Opportunity for Resolving a DMSMS Issue



The PEO perspective is twofold. A PEO organization should ensure that examples of the ROI calculations are disseminated among all the program offices in its portfolio to enforce full funding of DMSMS management operations. In addition, PEOs can use the data to persuade higher-level organizations to approve the requested amounts. A Service HQ would similarly use the data to justify funding requests to OSD as well as potentially establish policy. OSD could aggregate the data to demonstrate the need for high level attention and policy and guidance to all senior level decision makers.

All of these ROI value propositions become more powerful when used in conjunction with the value propositions associated with developing programming and budgeting requirements for DMSMS resolution funding and improving DMSMS management process efficiency.

3.4.4 Establish a Quality Management System

The DMSMS management should operate within a well-defined and functioning QMS. A QMS is an overarching framework that defines the organizational structure, responsibilities, methods, data management, processes, resources, customer satisfaction, and continuous improvement. DMSMS management processes must be controlled in a QMS to receive optimal benefit and ensure consistency over time regardless of who is performing them. A well-defined QMS can also ensure that the same high level of quality service and products can be produced regardless of personnel changes. This section focuses on control of DMSMS management processes. For contractors, it may be necessary to establish requirements to ensure that this is done.

3.4.4.1 QUALITY PLAN

The QMS should call for a quality plan that defines the checks on the system or product necessary to ensure quality; that is, to ensure that processes and product are in control and meet defined requirements. An excellent means of controlling processes is to document the responsibilities and methods associated with the processes in a series of procedures or work instructions and to establish quality checks at optimal points within the process to ensure that the work product meets defined quality standards. Quality checks demonstrate verification of whether the process is operating as defined. The quality plan should include the identification, collection, and monitoring of compliance metrics to ensure that the process is successful. Compliance metrics provide information on whether the process is being followed or must be adjusted to meet the intended outcome.

Different entities may use specific nomenclature for the documented processes, such as standard operating procedures, or work instructions. The nomenclature chosen for this documentation does not matter.

A written procedure outlines how to perform a process. This level of documentation typically applies to the processes common across a function, such as DMSMS management. Because DMSMS management support can vary significantly from one platform to the next, a second tier of process definition should be developed. This second level, often known as work instructions, is used to define how to perform a task. Each platform team should develop its unique DMSMS management work instruction tailored to the support of its specific platform.

As an example of how this may function, consider the processes to collect and disseminate PDNs and obsolescence event data, often referred to as “Alerts.” PDNs are published by manufacturers to inform industry that an item is targeted for discontinuance. A procedure could be written for how to find, confirm, and document this obsolescence event data. The platform teams may take different actions in response to an alert; each team could write work instructions to describe its own specific process.

The general workflow in support of DMSMS management consists of data collection from many diverse sources, data compilation and analysis, risk assessment, and report or briefing development. Because data collection, manipulation, and analysis are at the heart of DMT activities, data standards should be clearly defined. Data standards define such aspects of data management as content accuracy, data content, and data entry standards.

To establish quality checks, the DMT should review all process inputs and outputs. For each data stream, whether input or output, the DMT must decide the acceptable characteristics. The DMT should document these characteristics and make them available to the DMT members who may create or process the data stream.

The DMT determines the method to identify data that do not meet the defined standards. Quality checks can range from automated comparisons to defined standards to simply having an experienced team member review the work of a less-experienced DMT member.

The DMT should review the process flow and determine where to insert quality checks. These locations are the points at which errors can be identified and corrected before additional work is applied and before the customer is affected. The quality plan should include the inspection points, the inspection method, and the error correction mechanism.

To demonstrate a quality check for data content accuracy, consider the availability status of a highly complex electronic item. In general, the obsolescence of such an item, in contrast to an item that is of low complexity, has a greater impact on the mission of the platform, and resolution can be much more difficult. Therefore, the accuracy of the data concerning this type of item is critical. In such a situation, the DMT may decide that verifying the content accuracy of the availability status of this type of item may require manufacturer contact or no less than two predictive tool providers to report the availability status for the item. The quality check to ensure content accuracy could be to check that the availability was verified by contact with the manufacturer or by the use of more than one predictive tool. For example, the DMT may decide that the item description must exactly match the approved list of item descriptions. The quality check would then determine whether, in fact, the entry for an item description matches the entry on the table of approved items.

This same principle can be applied in other data streams, such as the recording of mitigation efforts, often called case data. The DMT may decide that the implementation date for the resolution should be recorded. In this situation, a quality check would verify the presence of an implementation date.

3.4.4.2 COMPLIANCE

Compliance metrics measure the status of processes and activities within a quality plan.[102] Among the reasons that a process fails are budgeting too little time or too little money, inadequate planning, constantly changing goals, lack of process knowledge, and ineffective communication. Often when a process is in danger of failing, management is unaware of the problems.

One of the best tools for avoiding process failures is to track key indicators of process health. The data should be presented in a meaningful way to help process managers make the proper decisions, take corrective steps on processes, or both. It is also important to define the right measurable periods that can cover possible gaps in the control of the measuring indicators, as well as allow control of the situation upfront if a failure occurs within the measurable intervals.

Compliance metrics generally have a target value—such as an industry benchmark or regulatory guidelines—against which they can be compared. Five general criteria are typically used when defining compliance metrics for a process:

- Time,
- Cost,
- Resources (e.g., person-hours),

[102] The compliance metrics discussed in this section are measuring the DMSMS management processes. This discussion does not include cost and operations efficiency metrics presented under case management.

- Quality, and
- Actions.

When compliance metrics are first applied to a process, it is often difficult to separate the categories of time, cost, and resources. Tracking compliance metrics that provide information on combinations of two or more of these concepts is a viable approach. As the QMS matures and the situation necessitates, compliance metrics can be redefined to provide more focused data. Below are two examples:

- Electronic item availability research is necessary for program offices that have item lists or BOMs. This research can be time-consuming. In general, it could be more cost effective and timely to obtain item status data from at least one predictive tool supplier. One measure of resource usage would be to track the percentage of items that the predictive tool companies recognize. By working with the predictive tool suppliers to increase the recognition rate, the team is effectively moving item availability research from an internal and more manual process to a subscription deliverable and, thus, is using resources more effectively.
- Data management in support of DMSMS management contains several distinct processes. Feedback on adherence to schedule could be obtained by tracking the time to perform the intermediary processes, such as the time from receipt of an item list or BOM to identification of the components to be monitored for availability. The time to perform the intermediary processes is then compared to a standard time established for this process. Values consistently over the standard indicate that a problem exists in the process. Results consistently under the standard indicate a need to adjust the standard because the process has been improved.

The quality criterion focuses on whether appropriate actions are taken in response to finding a process defect, not the existence of defects. The compliance metric chosen should provide insight as to whether defects are tolerated or, even worse, ignored. In data management, a defect is a situation in which a defined standard is not met. Below are some examples:

- The DMT may require, in the quality plan, measurement of the conformance of configuration data to defined standards. This could be accomplished by tracking the number of defective configurations periodically and then showing trends. If the number of errors is higher than the acceptable quality level or increases over time, a problem exists with the quality of the CM process.
- The DMT may choose to open a case for each monitored item that has an obsolescence issue. The DMT could then track the number of items with obsolescence issues that do not have an associated case. In this situation, the quality of the program office support process is being measured.

The actions criterion focuses attention on identifying outstanding action items as a means of determining possible barriers to the process success. To use this criterion, the DMT should maintain an action item summary in support of the process steps. This action item summary should then be reviewed to develop compliance metrics:

- Any differences between the action completion date and the projected completion date may indicate that a problem existed for that task. The difference between the action completion date and the projected completion date should be compared to a calculated standard established for support of that platform. This compliance metric is most meaningful for DMT members accustomed to setting reasonable projected completion dates.
- The number of open items measures multiple program office aspects. It may measure the skill of the PM in capturing the steps necessary to support the program office. It also may indicate that a project is experiencing difficulties in completing tasks.

Beyond these general compliance categories are some more intangible signs that a project may be in trouble. These signs include a general lack of interest in the project, poor communication among team members, a fear of talking about project problems, and a generalized lack of project advancement.

To be successful, compliance metrics must be well thought out and consistently interpreted and applied. Finally, the DMT must act upon the conclusions on process health provided by the compliance metrics in a timely manner to correct or improve the process, metric, or both.

3.4.4.3 PROCESS ANALYSIS

A detailed analysis of the DMSMS management processes can be valuable both in eliminating defects in the process and in improving efficiency. One type of business process analysis that has been used successfully to improve a DMSMS management process is Lean Six Sigma (LSS), a methodology that employs a collaborative team effort to improve performance by systematically identifying and removing "waste." In the LSS context, "waste" means any nonproductive, obstructive, or error-causing part of a business process. These components of waste are called "defects." The purpose of an LSS analysis is to identify the defects in the process and to devise approaches to eliminating or mitigating them. The DMAIC approach is one that is commonly used for an LSS analysis: DMAIC means "define, measure, analyze, improve, control," and it comprises the steps in the overarching process used by the analysis team. The final step is to put in place controls that ensure that defects are minimized and thus maintain the overall quality of the process.

Such an approach could be applied, for example, to the DMSMS management of COTS assemblies for which status is determined through vendor surveys. The functions that must be performed are to monitor items for potential obsolescence, identify items impacted, evaluate need for opening a DMSMS case, and implement a case when required. The process to accomplish these functions could be composed of four basic subprocesses:

- Use vendor surveys, vendor contacts, website analysis, and forecasting tools to discover potential obsolescence issues (market surveillance);
- Verify item identity, stocks on hand, and demand trends for the item at issue;
- Determine if the obsolescence issue will impact the program office via analysis of demand and stockage levels; and
- Open and evaluate cases, determine preferred resolutions, and track resolutions.

COTS obsolescence management is characterized historically as a largely manual effort with extensive human reactions that are subject to error, not to mention inefficiencies. Variability and non-value-added steps result in additional labor, schedule delays, and increased costs. Such defects can then be effectively identified and addressed via LSS methodologies. Developing an automated database is a first step toward a faster, more efficient, and less error-prone process.

One DMT that conducted an LSS analysis of its DMSMS management process for COTS items identified 131 defects occurring in an approximate one-year period in market surveillance of COTS items. The LSS analysis team defined a "reactive defect" to be one wherein an identified obsolescence date occurred in the past and "updates within four-months defects" were instances in which the date occurred within four months of the current date (thus limiting the time available for case analysis and determination of resolution, if required). Process changes identified to address these defects resulted in substantial reductions in defects (25% or more) and attendant improvements in process efficiency on the order of 25%–30% or more (depending on the subprocess).

To implement an LSS project for DMSMS management, an LSS team is formed, headed if possible by an LSS "black belt."[103] Team membership should comprise representatives knowledgeable in the various aspects of the process under scrutiny.

Assuming the DMAIC procedure will be followed, in the *Define* phase of the project, the team focuses on the overall process and identifies the overarching "problem" causing inefficiencies and errors. The team comprehensively examines the process and narrows down the areas of deficiency. An initial process map is created, and the data identified that can quantify the problem. It is particularly useful to document the value stream map (VSM) that describes the value-added workflow steps that produce required products. The VSM facilitates identifying non-value-added steps within the process for potential elimination or at least modification to create value. This phase ends with the drafting of a charter for the project containing a broad statement of the problem and the overall goals of the project. In addition, anticipated roadblocks are identified and a plan to overcome them formulated.

The *Measure* phase includes the development of a data collection method to capture pertinent aspects of the current processes and their outputs, the collection of data, and the establishment of a baseline for measuring improvements. For example, the time to accomplish a process segment might be a meaningful measure to examine. Another would be the trend in defect rate over time.

The *Analyze* phase determines the most critical root causes of defects from as many perspectives as possible. Team "brainstorming" sessions generate ideas to bring about process improvement. This process should be wide open, with the objective of identifying as many ideas as possible. The team then filters, sorts, combines, evaluates, and distills the improvement ideas into a feasible, most promising set.

In the *Improve* step, an implementation plan is formulated and initiated. If the list of desired improvements is lengthy, it will likely be necessary to time-phase implementation due to budgetary, operational, or other constraints, such as equipment or software availability.

Lastly, the *Control* step ensures that the improvements are being realized. A process of continuous improvement will seek to identify further improvements.

3.4.5 Establish a Case Monitoring and Tracking Process

The DMSMS management community deals with two types of cases. The first are cases based on known obsolescence (e.g., a PDN is received or predictive tool results). The second type of case could result from the review of a parts list for a preliminary design or forecasted obsolescence. The cases generated based on the review of a preliminary design should be used to inform the system designers so that, to the extent possible, obsolete items are not carried forward in the system design. If those obsolete items are designed out of the system, then there is nothing further for the DMSMS community to do with respect to that case. In other instances, analyses of the underlying technology of items can forecast when those items are likely to become obsolete. Cases may be opened to assess and analyze these forecasted DMSMS issues.

[103] If not available in house, a consultant should be engaged to advise the team.

Case management supports the DMSMS management-related activities in program offices in two interrelated ways as discussed in the following two sections:

- It maintains a source of information on the status of resolutions before a case is closed in order to enable a program office to track, monitor, and expedite the implementation of the resolution. A DMSMS case report contains the relevant information—CAGE,[104] part number, national stock number (NSN), item type, next higher assembly (NHA), and so forth—on DMSMS cases that are open (including all individual variants determined useful by the program office), closed, and composing the watch list. Those reports include a synopsis of assigned priority, potential resolutions, selected resolutions, relevant points of contact, relevant metrics as defined by the DMT, and DMT action items relevant to each case.
- It provides a repository of data on implemented DMSMS resolutions and the DMSMS management program itself that can be used 1) to formulate programming and budgeting needs and 2) to analyze and improve overarching operational effectiveness and efficiency (see Section 3.4.3.). Associated reports can be used for publicizing DMSMS management successes and sharing data among other DoD platforms. Robust case management provides the basis for meaningful DMSMS program metrics. Effective outreach could help obtain funding both for DMT operations and for implementing resolutions to DMSMS issues.

One purpose of case management is to track and manage DMSMS issues from initial identification to implementation of a resolution. A program office will need to document its approach (i.e., any criteria to be applied) regarding when to open an obsolescence case. Should it be for every item for which an EOL notice has been issued? Just for those items for which an EOL notice has been issued and current stocks will not support the system through end of need? Only for those items that will require a DMSMS resolution? Ideally, a program office might want to open a case on every item for which there is an EOL notice, even if a resolution is not necessary, because it will provide more complete documentation and inform future DMSMS management efforts for the program office.

To facilitate DMSMS case management, the DMT should consider the use of a tracking tool or database built upon a case sheet, consisting of basic and status data, for each DMSMS issue. Depending on how software intensive a system is, a program office's case management database may include some additional data elements associated with software. The development of a case sheet would therefore mark the beginning of the case management process. One prime contractor undertook the development of a case management database to standardize and facilitate what had previously been a time-consuming manual process that required months to complete a basic status update for a case. Having a standard case management database enabled the program office to expedite the resolution of issues as well as to ensure configuration control in the presentation of DMSMS issue case information across the program office.

The tracking tool or database should support functions such as the following:

- Tracking by case number for future reference (including an ability to link to a previous, related case).
- Tracking all appropriate part information and nomenclature (configuration and vendor parts) for manufacturer data, including last sale date and demand.
- Documentation of information on an item's higher assemblies and the criticality of impact.

[104] The CAGE codes are five-digit numbers used as a contractor identifier for firms doing business with DoD. These numbers are used as a method of identifying a given facility at a specific location.

- Documentation of the results of research and other engineering notes.
- Selection or identification of a particular DMSMS resolution or set of resolutions for each case.
- Checking whether another platform is affected (potentially across the entire Department).
- Assignment of action items to particular individuals or organizations related to a case. For example, who is responsible for working what aspects of the case.
- Tracking of the length of time to identify and resolve DMSMS issues (e.g., the timing for the next case management action and the alignment of such actions with key dates, such as the dates by which a bridge buy will need to be made).
- Determination of the status of a DMSMS case, such as the following:
  - *Open*. Cases that are actively being worked. Below are potential variants to "open" cases that a program office might want to consider tracking further:
    - *Open: Under Investigation.* Cases that are open and one or more DMT members are actively investigating the identified DMSMS issue. Such an investigation will first seek to validate the existence of a DMSMS issue that has the potential to impact the system and then to identify a recommended resolution.
    - *Open: Decision Pending.* Cases that are open and for which the recommended resolution has been determined and is awaiting final program office decision to proceed and/or funding. Information on opened cases requiring no action should be captured and fed back into the identify phase of the DMSMS management process, so that the case will not have to be investigated again, unless some new information comes to light.
    - *Open: Implementation Pending.* Cases that are open and for which the decision to proceed and funding have been obtained, but implementation of the approved resolution has yet to begin.
    - *Open: Under Implementation.* Cases that are open and for which the approved resolution is being actively implemented.
  - *Closed.* Cases for which the approved resolution has been fully implemented and fielded.
  - *Watch List.* Cases that are closed, but where the program office has chosen to place further scrutiny to monitor if assumptions regarding obsolescence and resolutions remain consistent with new realities in the future. For example, it is important to know if demand for an item is greater than the assumptions used to calculate the size of a LON buy until the next technology refreshment/insertion. This would also apply to cases whose implementation is taking longer than expected.
- Facilitation of communication with the DMT regarding the status of a DMSMS case.

Some program offices may track a resolution until it is completely implemented and fielded. Other program offices may stop tracking a resolution once it has been funded, rather than tracking it through fielding, due to the length of time for implementation. This is a bad practice. It is important for the DMT to receive feedback as to whether or not a resolution was implemented in order to be in a position to determine optimal resolutions for future DMSMS issues.

In addition, depending on the level of detail needed, program offices may combine open and pending resolutions. The decision about the level of detail to be tracked should be made when the program office establishes its case management process. Consideration should also be given to record keeping needs as discussed in the next section.

3.4.6 Establish Supporting Contracts

Contracts and logically similar agreements among government organizations are the mechanisms for enabling the DMSMS management operations discussed in this document. Internal agreements among government organizations may or may not require funding.

3.4.6.1 OBTAINING A PROVIDER FOR DMSMS MANAGEMENT OPERATIONS SUPPORT

Responsibilities may change significantly, depending on how the prime contractor is being used to support DMSMS management activities (see Appendix E). In many instances, the prime contractor is responsible for most of these activities. The program office should understand that the contractor's "standard" DMSMS management process is based on its own internal guidance and best practices. Thus a program office should not assume that a contractor will have operational procedures that mimic what is in this document.

As a best practice, program office leadership should strive to use its personnel as efficiently as possible to implement DMSMS management. For example, in-house engineering personnel should not be diverted to perform routine, day-to-day DMSMS management activities. Individuals with more specialized expertise and experience are located within the prime contractor or the OEM, as well as independent SMEs. These existing resources and resident expertise should be leveraged by program offices to the greatest extent possible. The prime contractor has the most in-depth knowledge of the system and, therefore, should also be involved throughout the system life cycle.

It is likewise a best practice for a program office to employ independent SMEs, even if the prime contractor is already involved in DMSMS management. Independent SMEs can 1) assist the government with overseeing the prime contractor, particularly in terms of ensuring consideration of a life-cycle perspective; 2) provide an independent verification of issues and a neutral third-party validation of resolution recommendations; 3) provide access to specialized tools, processes, data, and unique supplier relationships that may not be available to the prime contractor; 4) advise a program office on formulating contract language, securing BOMs and other technical data, developing an SOW for DMSMS management activities for a prime contractor, and other responsive, tailored support to specific needs; 5) serve as a central linkage to DMSMS management activities and best practices in other program offices; and 6) provide a conduit to improve access to supplier data in a competitive situation. Independent SMEs may also prove helpful during sustainment, if the government is entirely responsible for sustainment support and the prime contractor has little or no role.

Although each DMT should have a DMSMS SME, it is not always necessary to find that expertise within the program office. Centralized DMSMS SME teams reside within various organizations across DoD. These teams have in-house DMSMS management expertise and well-established processes that any program office can easily leverage to implement a DMSMS management program. In addition to having an established knowledge base and documented processes that enable robust DMSMS management, some of these teams own DMSMS management systems that experienced DMSMS practitioners use to integrate, analyze, and report on DMSMS-related data collected using predictive tools, vendor surveys, and PDNs received directly from manufacturers.

3.4.6.2 OBTAINING DMSMS MANAGEMENT OPERATIONS DATA

Contractual or similar arrangements must also be made to obtain DMSMS management data (see Appendix E).[105] Effective DMSMS management requires data for the following DMSMS management functions:

- Selecting subsystems to monitor (see Sections 3.1 and 4.1),
- Selecting the items to be monitored from a risk-based perspective (see Section 4.3.2.1),
- Monitoring the at-risk items and forecasting when obsolescence will occur (see Section 4.4),
- Assessing the impact of known and predicted obsolescence (see Section 5.3),
- Developing recommendations to resolve DMSMS issues (see Section 6.2),
- Tracking whether the assumptions behind LON buys are holding (see Sections 7.3 and 3.4.5), and
- Using technology roadmaps and health assessments as input into the timing for system modifications.

Data beneficial in conducting these functions include:

- Subsystem characteristics, for example,
  - Safety-related,
  - Mission criticality, and
  - Overall cost.
- Indentured BOMs or parts lists that provide the OEM CAGE code and manufacturers' and OEM part numbers.
- Supportability data (mostly item-related, some associated with the systems using the item)
  - Operating tempo,
  - Failure rate,
  - Consumption rate/reliability data,
  - Washout rate,
  - Inventory on hand,
  - Asset visibility (on fielded systems, salvageable),
  - Number used on system,
  - Number of systems manufactured and fielded over time,
  - Maintenance and repair strategies,
  - Provisioning data (e.g., mission essentiality, criticality),
  - Potential DMSMS resolution cost, and
  - Supply chain information (e.g., backorders, sources, cost).

[105] Contractors may consider some data to be proprietary. Therefore obtaining such data may need to be negotiated in the contract SOW. See Appendix E for information.

- Manuals and drawings
  - Maintenance and repair manuals and
  - Hierarchical drawings and data sheets.
- The item itself is also a data source.
- DMSMS prediction data, EOL estimate, prior experience with DMSMS issues on the system (qualitative), technology roadmaps, modification plans.

Table 9 maps the different types of data into the DMSMS management functions to show data needs by function. Although there are numerous data elements portrayed, the BOM is far and away the most important. It answers the question what items are on the system. If that information is unknown, DMSMS management (and even reactive DMSMS management) is extremely limited. In such a situation, even if DMSMS information were obtained, without a BOM, there is no clear way to determine if the obsolete item is on the system.

Table 9. Data Needed to Perform DMSMS Management Functions

Functions Where Data Are Needed	Indentured BOMs or Parts Lists	Supportability Data	Manuals and Drawings	The Item Itself	DMSMS Prediction Data
Select most important subsystems and items within them to monitor	The existence of a BOM or parts list is a necessary factor to facilitate selection Need to know the universe of items to select from	Provisioning data to assess the risk of subsystems and items and to construct BOMs or fill in gaps as needed Cost, demand, sole source and foreign suppliers are measures of risk The repair strategy impacts what is included in provisioning data which in turn impacts the items to be monitored If the above data is unavailable, use of an algorithm is the fallback approach	To construct BOMs or fill in gaps as needed		Historical data pertaining to DMSMS risk of subsystems and items or similar subsystems and items
Monitor	BOMs are the basis for monitoring				What is obsolete (or is about to become so) in predictive tools databases, surveys, and EOL estimates

Functions Where Data Are Needed	Indentured BOMs or Parts Lists	Supportability Data	Manuals and Drawings	The Item Itself	DMSMS Prediction Data
Assess	Indenture structure is used in an impact analysis at the item and higher level assembly levels	Operating tempo, inventory, consumption/ reliability, and number fielded to examine demand to determine when a DMSMS issue will impact the system			What is (or is about to become) obsolete in predictive tools databases, surveys, and EOL estimates
Recommend	Indenture structure to determine the level of the resolution (i.e., at the item level or higher level assembly level)	Operating tempo, inventory, consumption/ reliability, and number fielded to examine demand to size a LON buy Suppliers, maintenance and repair strategies, asset visibility, and resolution cost are considerations in an AoA	To suggest a resolution	To pursue reverse engineering and redesign	Technology roadmaps and modification plans
Track		Operating tempo, inventory, consumption/ reliability, and number fielded to test if LON buy assumptions are holding			
Plan		Operating tempo, inventory, and consumption/ reliability to estimate future demand			Technology roadmaps and modification plans to develop a strategy to deal with inevitability of DMSMS issues and improve DMSMS resilience over the long range

4. Identify: DMSMS Monitoring and Surveillance

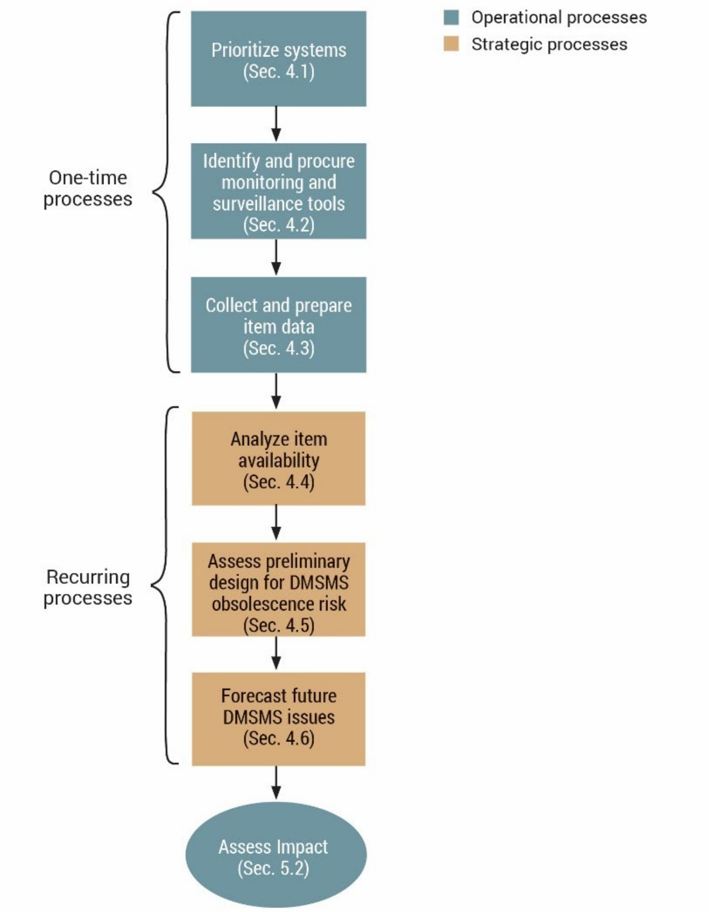
This chapter describes monitoring and surveillance, which constitute the *Identify* step of the DMSMS management process. This second step requires a program office to monitor and survey its items and materials for EOL notices or other indicators of potential discontinuance. DMSMS monitoring and surveillance should begin as early as possible during the design phase and continue throughout the entire life cycle of the system. This section describes the monitoring and surveillance processes (whether accomplished within the government, by a contractor, or preferably as a combined team):

- System prioritization. This process entails the determination of the scope and focus (e.g., which subsystems of the system are of most interest, due to criticality, operational safety, or associated DMSMS-related costs) for the DMSMS management effort.
- Identification and procurement of monitoring and surveillance tools. This process entails identifying and procuring (or procuring access to) the DMSMS predictive forecasting and associated data collection and management tools to support the DMSMS management program.
- Collection and preparation of item data. This process encompasses the collection (or if necessary, the creation) of BOMs and item data and the prioritization of items to eliminate those that can be easily replaced (such as fasteners) through items availability analysis. In addition, the BOM/parts list is prepared and loaded into a predictive tool for analyzing item availability.
- Analysis of item availability. This process includes the combination of market research and the use of predictive tools to determine initial, and subsequent, item availability baselines for immediate and near-term obsolescence issues for the program office.
- Assess preliminary design for DMSMS risk. This process reviews (new and revised) designs for DMSMS risk. It focuses on initial parts selection and recommends mitigating actions when high risk parts have been identified.
- Forecast technology obsolescence. This process uses technology management as a way to forecast obsolescence risk for the system and tentatively identify when issues may potentially occur. It sets the stage for mitigation planning through technology refreshment or insertion.

At the end of the *Identify* step, a preliminary health assessment report (see Section 5.3.1) could be generated to inform program leadership of the immediate results.

Figure 8 identifies the one-time processes and the recurring processes associated with DMSMS monitoring and surveillance. For the most part, system prioritization, identification and procurement of monitoring and surveillance tools, and collection and preparation of item data are one-time processes. However, depending on when the prioritization was done, new data on DMSMS issues may lead to additional systems being given a high priority. The major data cleanup effort during DMSMS management start-up for the program office will also require upkeep to maintain consistency with configuration changes once DMSMS management has reached a steady state.

Figure 8. DMSMS Monitoring and Surveillance Processes



The other three processes—analysis of item availability, assess preliminary design for DMSMS risk, and forecast technology obsolescence—recur when warranted throughout the life of the system.

4.1 PRIORITIZE SYSTEMS

Robust DMSMS management may require monitoring and surveillance of thousands of items simultaneously. It could take months or even years, depending on the size of the system, the availability and format of data, and the program office's manpower to load all BOMs into a predictive tool. Prioritizing the scope and focus for the DMSMS management program, using a risk-based approach, is crucial for a complex platform, which typically has many subsystems, each with multiple units with multiple assemblies, which in turn include many items and software. Prioritization in this process is not a ranking of subsystems to monitor; rather, it is a "yes" or "no" DMT determination of what portions of the system to actively monitor, when, and at what frequency.

Because it is prohibitively expensive to monitor everything, a risk-based perspective should be taken to determine the priority of what to monitor. In reality, some program offices may not even be able to obtain the resources needed to monitor at the desired level of risk. When that occurs, available funding will determine how much risk to accept. However, accepting too much DMSMS risk has led to large, unexpected resolution costs. Initial prioritization of the portions of the system on which to focus the DMSMS management effort can be based upon the following:

- Safety. A top priority for the scope and focus of a DMSMS management program is any subsystem containing a critical characteristic whose failure, malfunction, or absence could cause a catastrophic failure, loss, or serious damage resulting in an unsafe condition. Special attention should be paid to aircraft, missiles, rockets, and airborne systems, as well as to other systems that involve command, steerage, and propulsion of ships or land vehicles. Similar safety concerns on other systems should be identified by the program offices.
- Mission criticality. Another top priority for the scope and focus of a DMSMS management program is any system—whether a primary mission system or an auxiliary or supporting system—whose operational effectiveness and operational suitability are essential to successful completion of the mission or to aggregate residual combat capability. Such systems are critical, because if the system fails, the mission likely will not be completed, especially if there is a known single point of failure or a significant impact on NHAs.
- DMSMS-related costs. Any subsystem experiencing or expected to experience frequent or expensive DMSMS-related issues should be monitored. Considerations for identifying subsystems under this criterion, before actual data are available, include unique fit or materials, closed architecture, modified COTS assemblies, high electronics content, high redesign costs, single source, low reliability, or hard-to-support software.
- Existing problems/historically troublesome. If DMSMS management is already underway, program office management may already have a sense of those subsystems and software that cause the most headaches. If a DMSMS management program is just starting, program office management might still be able to look to predecessor platforms to identify areas that have consistently proven to be trouble spots. Data to review in these instances include the reliability (e.g., low mean-time-between-failure rates or high mean-time-to-repair rates) of the assemblies, software, and other items. Another area of interest are those items that are common across platforms and, therefore, could have a potentially large impact if they fail.
- Life-cycle phase. The system prioritization process may vary as a function of life-cycle phase:
  - For systems in design and production, actual data may not be available to understand where high costs or frequent DMSMS issues are occurring. There may be only some near-term indications of such areas based upon ongoing monitoring and surveillance. These areas are expanded as the system matures. It is especially important to identify DMSMS issues during design or production, because decisions made during those phases can significantly affect the system's life cycle. Furthermore, when obsolete items are not eliminated from product designs, higher risk distributors are more likely to be used to obtain items that are no longer in production. This adds to the risk of finding counterfeit parts in the DoD supply chain and, more important, in DoD weapon systems used by the warfighter.
  - Over time, the sustainment strategy may evolve; consequently, the mix of organic and contractor roles may change.
  - Once a subsystem has been fielded, there is a greater potential that an obsolescence impact on that subsystem could be felt directly by the warfighter in terms of readiness. This may be less of an issue if a program office knows that it has sufficient spares availability.
- Sustainment strategy. A system's sustainment strategy reflects the maintenance or support concept of operations for that system. Such strategies consider impacts on system capability requirements, responsiveness of the integrated supply chains across government and industry, maintenance of long-term competitive pressures on government and industry providers, and effective integration of system support that is transparent to the warfighter and provides total

combat sustainment capability. The DMT should be particularly concerned with these issues if the government is providing sustainment support. If a contractor is required to resolve DMSMS issues, then the DMT's primary role is to oversee the contractor's efforts.

- Availability of technical data. Although a program office may prefer to implement robust DMSMS management over all priority subsystems, the reality is that not all the BOM/parts list data may be available (or can be constructed) to do so, particularly at the start-up of DMSMS management for a system. In such instances, program offices will not be able to scrutinize priority subsystems until sufficient data become available. However, a program office should not postpone or avoid pursuing the necessary data for known, more complex and troublesome subsystems.
- Vulnerability to supply chain exploitations. The potential for supply chain compromise is similar to safety and mission criticality. When an item is in short supply, less trustworthy sources may be used to meet demand. Using these sources increases the chance of exploitation of a supply chain vulnerability, leading to compromised items on DoD systems and in the supply system, potentially affecting safety and mission effectiveness. Consequently, supply chain risk management should prioritize items where the supply chain exhibits weaknesses in asset-based security controls, hardening against digital threats, or life-cycle security management.

Each program office will need to determine the factors of most importance to prioritize its subsystems for DMSMS monitoring and surveillance. Among the factors of interest to a program office, not all will be of equal importance. To address this, a program office might wish to develop a weighting scheme to help sort the system priorities for its monitoring and surveillance effort. A DMSMS management program that already is well underway, and for which historical data are available, could consider establishing a method that considers the likelihood and consequence of a particular subsystem being degraded due to obsolescence.

This prioritization will assist in determining which BOMs the program office needs to obtain to support proactive monitoring for DMSMS issues. If a reactive approach to DMSMS management is sufficient for a particular subsystem, then it is not necessary for the program office to acquire or build that subsystem's BOM.

4.2 IDENTIFY AND PROCURE MONITORING AND SURVEILLANCE TOOLS

The program office should identify and procure predictive obsolescence tools and associated data management tools needed to support DMSMS monitoring and surveillance. Predictive tools may be particularly useful for analyzing certain types of items, such as electronics; however, these tools have limited capability for other types of items, such as mechanical hardware or COTS assemblies. Most DMSMS predictive tools perform the same core functions of monitoring the availability of electronic items in the BOM and forecasting their obsolescence. Each tool has a set of loading criteria and formats, output report formats, and other information that can be ascertained from the loaded BOM.

Beyond predictive obsolescence tools, BOM data management tools, configuration tools, logistics data collection tools, data storage and retrieval tools, and report generation tools are all needed for monitoring and surveillance. Selection criteria include reliability, user friendliness, cost, and usability by multiple systems. As discussed in Section 3, DMSMS management can include both proactive functions and data collection and management functions.

4.3 COLLECT AND PREPARE ITEM DATA

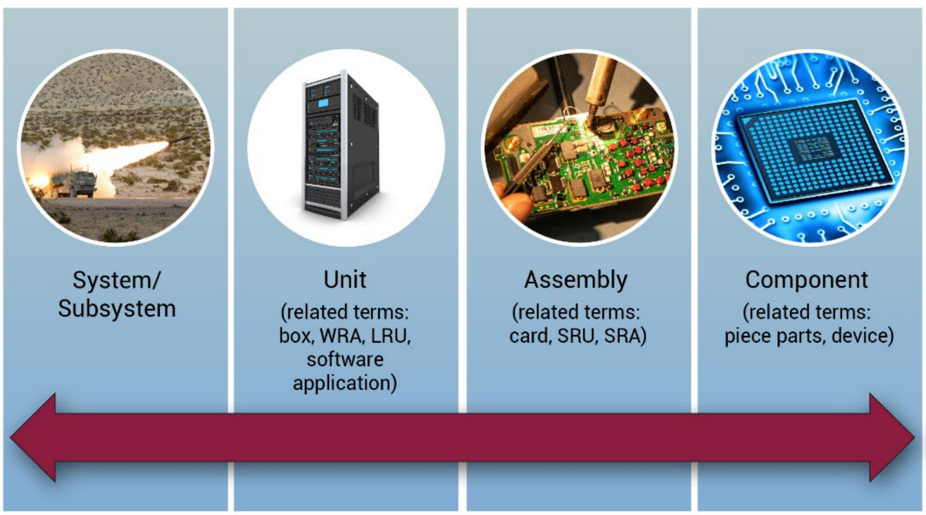
Once the focus and scope of the DMSMS management program have been determined by the prioritization of subsystems based upon mission criticality, operational safety, and so on, the data necessary to support item availability analysis and, ultimately, whether and when an obsolescence issue should be addressed should be identified and collected. Indeed, program office leadership should ensure that the data to support DMSMS management are obtained. Item data, including parts and software lists/BOMs and additional information obtained from market surveys, are used to analyze item availability, resulting in a list of system items that have immediate, or anticipated, near-term obsolescence issues.

4.3.1 Item Data Collection

4.3.1.1 HIERARCHY OF SYSTEM ITEMS

To adequately and cost effectively address obsolescence for a program office, the DMT may have to monitor, assess, and resolve DMSMS issues at different and multiple levels within a system. Figure 9 illustrates the hierarchy of system items. As one moves from left to right across the figure, the system is decomposed into increasingly smaller items, from unit to assembly to component. For each of the items of the system, additional related terms are also provided. So, for example, when a program office is referencing the component level, other terms often used to refer to this level of item are piece parts and device.

Figure 9. Hierarchy of System Items



Note: LRU = line replaceable unit, SRA = shop replaceable assembly, SRU = shop replaceable unit, WRA = weapon replaceable assembly.

4.3.1.2 DIFFERENT TYPES OF ITEM DATA

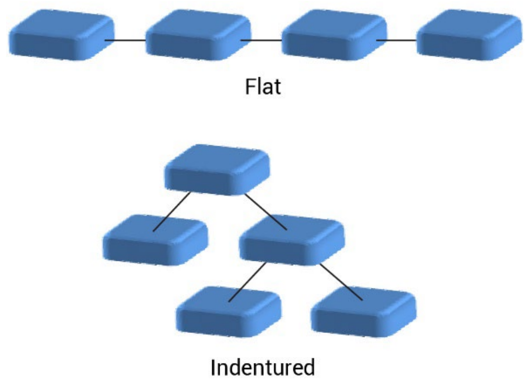
Different types of items are likely to be incorporated into the design of any system. Therefore, the DMT needs to be aware of how different types of data may need to be collected or even suggest different means of collecting or developing and managing the data. The following sections contain such information for both COTS and hardware—electronic and MaSME items and for software.

4.3.1.2.1 Hardware—Electronic and MaSME Items

For hardware—electronic and MaSME items data, a parts list or BOM is an indispensable data resource for robust DMSMS management. BOMs are the basis for monitoring for DMSMS issues, and as such, they are far and away the most important data type necessary for proactive DMSMS management (and even reactive DMSMS management). Without a parts list or BOM, item availability analysis, an assessment of whether and when to address an obsolescence issue, and the continuous prediction of discontinuance by a DMSMS management program are impossible.[106]

A BOM identifies the materials, components, and assemblies used in making a unit. It answers the question: what items are on the system? The list may be in a flat format or an indentured format. A flat BOM is a simple list of items, while an indentured BOM shows the relationships (generally in a top-down breakout format) of components to assemblies to units to the system. Figure 10 depicts the two formats.

Figure 10. Comparison of Flat and Indentured BOMs



Because it provides a bigger picture for identifying and weighing resolution options for an identified DMSMS issue, an indentured BOM format is preferred over a flat format (although there could be IP issues obtaining an indentured BoM from some suppliers). For example, when analyzing item availability, a flat BOM enables the identification of only the number of obsolete items within the unit; it would not provide any indication of whether some of the items are on the same assembly. Not knowing the effect of the identified, immediate, and predicted obsolescence issues on the system's item hierarchy limits resolution options. In some cases, it may be more cost effective to perform a minor redesign of an assembly, rather than undertaking LON buys of multiple components within that assembly. An indentured BOM enables the program office to more readily visualize the relationships of identified obsolescence issues within the system and to use this information to inform the identification and determination of potential resolution options.

In addition to the configuration (indenture) information conveyed through an indentured parts list or BOM, useful item data pertaining to the components, assemblies, and units of the system include the following (sometimes difficult to obtain) elements:

- OEM-approved alternatives,
- OEM technical manuals,
- OEM DMSMS mitigation efforts underway,
- OCM part number,
- Sources of active manufacturing,
- Actual or projected EOL,
- Function (active vs. passive, complexity),

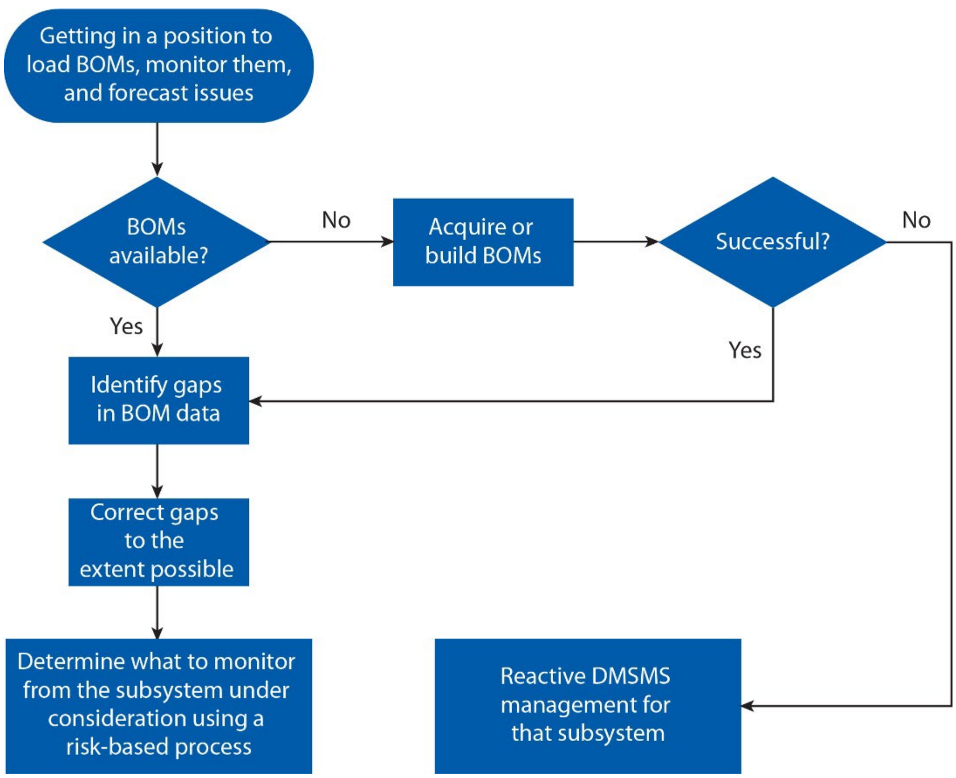
[106] This does not imply that the government must have a BOM. DMSMS can be managed by the prime contractor. See Appendix E.

- Type (custom, hybrid, proprietary),
- RoHS/Pb-free information, and
- F3 details.

For MaSME items, listed on a BOM, the items of interest may be reduced after production is completed by using a Provisioning Master Record (PMR), which includes only those items that are purchased by the DoD supply system. PMRs also provide additional information that can be used to further reduce the number of items to monitor, as described under Section 4.3.2.1.

One of the first tasks is to obtain the BOMs for the system. Figure 11 portrays a high-level process flow of the activities of this task. It focuses on obtaining BOMs and how access to BOMs and the quality of those BOMs will impact the program office's DMSMS management approach. The objective of the process is to position the DMSMS management providers to be in a position to load BOMs into predictive tools, monitor the items in the BOMs, and forecast DMSMS issues.

Figure 11. Preparing for Proactive, Risk-Based DMSMS Management



The DMT's work regarding this task begins with identifying whether BOMs are available.

- *If the program office already has the BOMs or a mechanism in place for accessing them*, then information gaps within them are identified, the gaps are closed to the extent possible, and finally the specific items to be monitored are identified using a risk-based approach (see Section 4.3.2.1).
- *If the program office does not have the BOMs or a mechanism in place to access them,* the BOMs will need to be acquired or developed, where feasible to do so. After such BOMs are acquired or developed, then the same process steps apply as for when BOMs are available. When BOMs cannot be acquired or developed or gaps cannot be closed, items are monitored

reactively, which means DMSMS issues will not be identified until there is a failed attempt to purchase an obsolete item.

The best situation is one in which the government has an established contractual requirement for the BOMs (and for notional BOMs or parts lists during design).[107] Contractual language, including data rights issues, is important to establish up front between the program office and prime contractor. Prime contractors often have to negotiate with OEMs for access to their BOMs, so it is not valid to assume that a prime contractor will automatically be able to make these available to the program office. When a contractual requirement is not in place early in the system's life cycle, all is not lost. Appendix I contains information on considerations (including IP concerns) for program offices that find themselves in the position of needing to acquire (when not contractually required up front) or develop BOMs.

BOMs for COTS assemblies are not usually readily available[108] and may not be cost effective to obtain if available. However, for a COTS-intensive system, a program office may want to investigate whether BOMs can be obtained and, if so, develop the cooperative arrangements necessary to ensure delivery of those COTS BOMs, if cost effective.

4.3.1.2.2 Software

A complete list of software items should be required by contract with associated CDRLs and DIDs. If that was not the case, there are other existing artifacts that could have CDRLs that may provide some or all of the necessary information. The cybersecurity (information assurance) engineering DID[109] requests product, version, and manufacturer data for software. CM documents, drawings, and technical data packages are other potential sources for identifying the software in a system. For a third source, software is often a part of the software version description.[110] A fourth source is a data rights disclosure letter if it is a requirement on the contract. This letter lists all areas for which the government does not have full data rights, including commercial software applications and contractor proprietary software. A final source is a software licensing management group, if one exists.

Just as an indentured BOM shows hierarchical interrelationships among items, software interdependencies should also be captured. For each listed software element, the software and hardware that depend on it and the software and hardware upon which it is dependent should both be identified. Software interdependencies may not be hierarchical; there can be cross-system relationships. An understanding of these relationships will not be found in a BOM; it is best achieved through discussions with systems engineers and/or software developers or may be identified in interface control documents. Consideration should be given to modifying the DMSMS DID or creating a new one for software.

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[107] To understand the data rights, see the original procurement contract and any follow-on contracts. The contracts usually contain specific detail on the data rights for items delivered as contained in DD250 forms. Using product data for government purposes, such as monitoring integrated BOM part numbers for EOL warnings, and using product data for competitive reprocurement are significantly different. DoD should obtain technical data rights commensurate with the sustainment strategies of the systems used in its global defense missions so that it can ensure they remain affordable and sustainable. For more information about data rights, refer to the *Army Data & Data Rights Guide*, August 2015.

[108] In contrast, BOMs may be available for non-developmental items (NDIs) designed for the government.

[109] DI-MISC-80508B, "Technical Report - Study/Services," revised November 14, 2006, available at https://quicksearch.dla.mil/qsDocDetails.aspx?ident_number=204915.

[110] DI-IPSC-81442A, "Software Version Description," revised January 11, 2000, available at https://quicksearch.dla.mil/qsDocDetails.aspx?ident_number=205921.

Given the possibility that multiple sources may be queried to develop lists of software items and their interrelationships with hardware and other software items, it is important to be cognizant of the following challenges that could inhibit DMSMS management for software:

- Inaccurate or incomplete part numbers, nomenclatures, and software descriptions and
- Inconsistent versions captured (e.g., decimal points captured not matching OEM development and product releases).

4.3.2 Item Data Preparation

By this point, the program office has identified and collected all relevant item data as well as selected and procured the appropriate DMSMS predictive tools. Before loading the parts lists/BOMs into the tools, the program office should take several final steps to prepare the item data for recurring analysis of item availability. First, the parts lists/BOMs should be reviewed to identify the items on which the program office's DMSMS monitoring and surveillance activity will focus. This is a second prioritization filter—the first being the prioritization of subsystems on which to focus the DMSMS management effort (see Section 4.1)—that considers the criticality and safety as well as the vulnerability of particular items within the system design.

Because of rapid technology changes, robust DMSMS management and proactive monitoring for electronic items has generally been the primary focus of DoD's DMSMS management guidance and effort. Being the center of attention, however, does not necessarily equate to adequate funding. Program offices often struggle to obtain and maintain budgets for proactive DMSMS management in this area.

Narrowly targeting the items to monitor can have a large impact on the cost of a program office's DMSMS management effort, thereby focusing attention on the higher risk items. For a program office dealing with a larger number of items, applying this second prioritization filter could eliminate large portions of the BOM from the monitoring requirement. Culling out lower-vulnerability items from a DMSMS monitoring effort may be less critical if the program office is not dealing with a large number of items.

4.3.2.1 HARDWARE—ELECTRONIC AND MaSME ITEMS

Parts lists and BOMs may contain any number of items (e.g., fasteners) that do not need to be analyzed with a predictive tool because of the availability of so many alternatives. As described in Section 3.1, to make more effective use of limited resources, program offices should adopt a risk-based approach to proactive monitoring. For items that are listed on parts lists and BOMs, this section contains more details on the application of the first two strategic determinations—applying algorithms based on life-cycle estimates and further analysis of uncategorized items—associated with determining which items to monitor.

The first determination involves applying algorithms based on life-cycle estimates. In some instances, a supply system health analysis is performed to offer up a broad-based supportability picture and identify low-, medium-, and high-risk candidates from a support perspective. The results of applying the first determination to hardware—electronic and MaSME items listed on parts lists/BOMs are the following three categories of items:

- Items to definitely monitor. These items include certain item classes known to have a high propensity for obsolescence issues. These item types include electronic COTS assemblies (e.g., networking gear, computers), active components, radiofrequency components, programmable devices, memory, microprocessors, ASICs, hybrids, and custom electronic assemblies. Assemblies[111] that contain sole-source items that are in low demand also should be proactively monitored. Custom passive items are also prime candidates for monitoring. In addition, if a design contains materials with chemical

[111] Obsolescence of complex assemblies is often caused by obsolescence of their critical items.

properties that are a function of the design, are sole source, and/or are otherwise potentially threatening to the environment, these materials should be monitored. All electromechanical items should also be included in a program office's monitoring efforts. This subset of item types generally introduces high risk to a system if the program office chooses not to monitor them.

- Items not to monitor. There are two types of items not to monitor:
  - *Items where no further action is required.* This subset of item types includes standard/common industrial items, such as mechanical components, connectors, cabling, and certain consumables, that typically do not present a significant risk, because most of these items are easily and quickly replaced when they become obsolete. Generally, these items can be eliminated from monitoring. Some circumstances, however, warrant a DMT's monitoring of these types of items. For example, some items may have something unique about their operating environment, may be identified by the DMT as important, or may require extensive requalification if replaced. The DMSMS SME and engineering activity representative should understand the associated risk before choosing not to monitor such items and should revalidate that decision periodically. Information from suppliers may be needed to fully understand such risks.
  - *Items where preparations should be taken.* Custom-fabricated items (e.g., fenders or castings) that will no longer be produced after final delivery also should not be monitored for DMSMS issues; however, logistics managers and PMs should ensure that enough of these items are acquired for system sustainment through system disposition. As a safeguard, the program office should obtain sufficient documentation to enable the reacquisition of custom-fabricated items in case of future need, through new acquisition contracts.[112]
- Items for which not enough is known to determine the need for monitoring. The final category of items is uncategorized items, because not enough information is known to determine whether the program office should monitor these items.

With regard to this final group of uncategorized electronic and MaSME items, a program office has three options from which to choose:

- Monitor all these items. This is a low risk for being caught off guard with an obsolescence issue, high-monitoring cost approach.
- Do not monitor any of these items. This is a high risk for being caught off guard with an obsolescence issue, low-monitoring cost approach.
- Conduct further analyses to determine which items to monitor. This approach optimizes the risk associated with being caught off guard with an obsolescence issue and monitoring cost.

From a risk-based and resource-constrained perspective, the latter option should only lead to monitoring those uncategorized items where the negative effects of a reactive approach are both most likely and most severe. The decision to pursue a reactive approach to DMSMS monitoring implies that the system will experience no severe ill effects from waiting until an item cannot be obtained before seeking a resolution. A reactive approach should be sufficient unless significant risks are present.

In applying the second determination, a program office performs additional analysis to determine which of the items from the "uncategorized" list to proactively monitor. Three risk categories should be used to

[112] DAU's *Systems Engineering Brainbook* provides guidance on the technical data and the manufacturing processes documentation necessary to reacquire custom fabricated items, https://www.dau.edu/tools/se-brainbook/Pages/Management%20Processes/Technical-Data-Management.aspx.

determine where a proactive approach should be taken for a particular material or item. These risk categories are as follows:

- **Item criticality.** This risk category addresses the degree to which an item (whether it is an assembly or a component used to repair an assembly) is critical to the functionality of the system and ultimately the operational readiness of the unit employing that system. Quantitative and qualitative considerations for this risk category include the following:
  - Critical safety item,
  - Mission criticality,[113]
  - Item essentiality code,
  - High demand (perhaps in top 10%), and
  - High cost.

  The first three considerations are direct indicators of criticality. Obviously items that are mission-critical or critical safety items meet the high criticality criterion. While critical safety items may be clearly identified, mission-criticality items are sometimes more ambiguous. The item essentiality code is an attempt to assist in classifying these items, but these data are not always accurate. There also should be a high correlation between high-cost and/or high-demand items and criticality. These considerations, depending on the system, can therefore serve as factors in their own right or in combination as a reasonable proxy for mission criticality when no other data are available.

  Provisioning and other DLA databases can also be used to identify potentially critical items that should be monitored. One indicator of criticality is the Weapon System Essentiality Code field. Values of 1, 5, 6, and 7 could be considered critical. Those values are defined as follows:
  - 1: Failure of the item will render the end item inoperable.
  - 5: The item is needed for personal safety.
  - 6: The item is needed for legal, climatic or other requirement peculiar to the planned environment.
  - 7: The item is needed to prevent impairment of or temporary reduction of operational effectiveness of the end item.

  Another indicator of criticality is whether the item is technically critical by reason of tolerance, fit restrictions, application, nuclear hardness properties, safety, or other characteristics which affect identification of the item. The Criticality Code field provides some data on these factors. Values of E, F, H, M, and S could be considered to be critical as follows:
  - E: The item is an aviation critical safety item and is nuclear hard.
  - F: The item is an aviation critical safety item.
  - H: The item is nuclear hard.
  - M: The item is nuclear hard, and it has other critical features such as tolerance, fit restrictions, or application.

[113] For the Army, the Rand Corporation has developed a readiness indicator that could contribute to this factor. The Rand Readiness Indicator uses an Army deadline report that shows the number of times a part has appeared in that report and the total number of days that the part was in the report. See Eric Peltz et al., *Diagnosing the Army's Equipment Readiness: The Equipment Downtime Analyzer*. (Santa Monica, CA: RAND, 2002), pp. 46–48.

– S: A failure of the item will result in serious damage to equipment, or serious injury or death to personnel.

The Special Procedures Code (SPC) field also provides data on some of these factors. Pertinent SPC values are 1, 3, 4, and 5. They are defined as follows:

– 1: Aircraft launch and recovery equipment.

– 3: Navy critical safety items.

– 4: Intercontinental ballistic missile item.

– 5: Army critical safety item.

In addition, requisition data may provide insight on criticality because a requisition identifies high priority orders, orders that imply a non-mission capable supply (NMCS) or equivalent situation, and the tactical status of the unit placing the order as indicated by the Joint Chiefs of Staff project code (e.g., wartime conditions). Requisition data also provide some insight on the impact of DMSMS risk on systems. Highest priority orders are those with priority designator code (PDC) values of 01, 02, or 03. When one of these PDC values has been assigned, the required delivery date (RDD) will indicate a mission capable (MICAP) incident in three circumstances:

– When the RDD is 999, implying expedited delivery;

– When the first character of the RDD is N, implying NMCS status; and

– When the first character of the RDD is E, implying anticipated NMCS status.

When a Navy requisition is associated with a casualty report, there may be a "W" in the fourth position from the right of the requisition number.

- Supply chain vulnerability**.** This risk category represents a key difference between electronic items and MaSME items. In the former case, the item often becomes obsolete because of technology changes. For the latter, obsolescence is usually related to a source going out of business or changing its product line. Quantitative and qualitative considerations for this risk category include the following:

– Source related (e.g., no identified source, sole source, or only foreign sources),

– Financial health of the supplier (e.g., as measured by Dunn and Bradstreet),

– Persistent backorders (perhaps as indicated by an increasing number of backorders for at least eight consecutive months),

– Long customer wait times (perhaps top 10%),

– Recent substantial price increase,

– Time since last order (perhaps if more than three years),

– Low demand, and

– Life cycle of the items.

The first three considerations examine the supply chain directly. A supply chain is potentially vulnerable if there is no source, just one source, or only foreign sources identified. Even if there are multiple sources, all unhealthy suppliers are a situation of concern. In some high risk situations, it may be useful to conduct a specific financial analysis on a particular supplier, since sources such as Dunn and Bradstreet are not always current. Similarly, long customer wait times, especially when there are persistent backorders are indicators of a potential problem.

The fourth and fifth considerations not only exacerbate the risk further, but also indicate other less obvious supply chain vulnerabilities and scarcities. Long wait times may be indicative of more serious problems. Similarly, a sudden price increase may imply something is changing in the supply chain that will have an effect on availability. Either of these factors may represent an early warning of future problems.

If a long time has passed since the last order, there may be substantial uncertainty about supply chain vulnerability. A source may make a financial decision that it is not profitable to keep producing an item, if the demand signal for that item is low. Finally, if the item has a short technological life cycle, its supply chain is more vulnerable.

As was the case with critical items, provisioning and other DLA databases have fields that indicate potential supply chain vulnerabilities and consequently should be monitored. Risks and fields indicating those risks are as follows.

– Items with explicit procurement risks

  Suspended, cancelled, obsolete, or discontinued items fall into this category. The Reference Number Variation Code (RNVC) field is one indicator of this. A value of "9" implies that the item of supply is inactive.

  When DLA receives a discontinuation notice from an item's last viable source, the DLA Columbus DMSMS Office sets a DMSMS flag. The flag may also be set when a Military Department transfers an item to DLA and it was indicated to be obsolete by the transferring Military Department. Presumably, the RNVC would be set to 9 if this happened.

  The Acquisition Advice Code (AAC) field may indicate that an item is not procurable. When the AAC is set to "V," future procurement is not authorized, but there is inventory in stock. When there is no inventory on hand and future procurement is not authorized, the AAC is set to "Y." In the case of NSNs where the AAC is "X," the services have not provided the necessary information to DLA in a timely manner to enable procurement. This code may be used on a temporary basis.

– Items with limited sources

  There may be a difference between what DLA data indicates as a sole source and an actual commercial industry sole source since there could be sources unknown to DLA. Sole source items can be identified in DLA data when three conditions are met.

  - First, the Acquisition Method Code field must be 3, 4, or 5. A value of "3" means that the item must be acquired directly from the actual manufacturer, whether or not the prime contractor is the actual manufacturer. When the Acquisition Method Code is "4," DLA must acquire, for the first time, directly from the actual manufacturer rather than the prime contractor who is not the actual manufacturer. Finally, if DLA, can only acquire through the prime contractor although the engineering data identifies another source, the Acquisition Method Code is "5."
  - Second, there is only one item associated with that NSN.
  - Third, the Reference Number Category Code–RNVC combination is either 3-2, indicating a primary source, or 5-2, indicating a secondary source.

  Data rights issues may also prevent DLA from procuring an item from another source. The Acquisition Method Suffix Code (AMSC) field identifies this situation. When the government's rights to use data in its possession is questionable, the AMSC is set to "A." An AMSC of "D" indicates that the data needed to procure the item is not available. If the rights to use the data needed to make a purchase are not owned by the government and cannot be purchased, an AMSC value of "P" is assigned. Lastly, when the AMSC is "R," the data or rights to use the data needed for purchase from additional sources are not owned by the government and it has been determined that it is not economical to purchase them.

A CAGE code beginning with an “alpha” character indicates a foreign source. There is a risk if an NSN is only associated with a foreign source items.

- Low inventory items

  NSNs where the inventory is zero and some yet to be determined long lead time and/or high demand present a DMSMS risk. A subcategory for zero inventory items that represents an even greater risks are backordered items. The risks increase when the backorders are persistent.

- Time to implement a resolution**.** The risk category addresses how long it will take to implement a resolution to a DMSMS issue for an item or material in comparison to the stocks on hand. If there is more than enough stock on hand and the time to implement is short, then the risk would be viewed as lower; however, if there is a long lead time to implement a resolution and the stocks on hand are not sufficient, then this indicates high risk. Quantitative and qualitative considerations for this risk category include the following:

  - Technical data package (TDP) availability for structural, mechanical, and electrical items or electronic items (e.g., not available or limited data) or availability of the material specification for an engineered material[114] (knowledge of material composition will shorten cycle time),
  - Source controlled,
  - Manufacturing difficulty,
  - Long lead time to requalify,
  - Manufacturing cycle time,
  - Availability of tooling and test equipment,
  - Cost to implement a resolution, and
  - Defense unique.

  If technical data are not available, reverse engineering will be required. This takes a long time and adds significantly to the risk. Reverse engineering of a MaSME item or electronic item is almost always feasible. Many items can be reverse engineered in three to six months, but some take much longer. Also, source-controlled items (e.g., items where the allowable or qualified sources are listed on the drawing) typically involve a longer time to implement a resolution.

  Measuring manufacturing difficulty is subjective. Factors such as the need for specialized skill and high capital equipment costs are indicators of potential manufacturing difficulties for all items. Sometimes this is a reason for a source-controlled designation. For structural, mechanical, and electrical items and electronic items, manufacturing difficulty may be associated with unique manufacturing processes and/or demanding requirements, such as extreme tolerances. For materials manufacturing, difficulties may be associated with the presence of hazardous materials or processes, which require special handling; the use of other exotic materials that are not commercially available and with little demand outside this application; demanding requirements (e.g., long shelf life, compatibility with other materials, replacement materials must be the same material, performance outside of normal operating environment); and material that cannot be reliably recycled for use in another form.

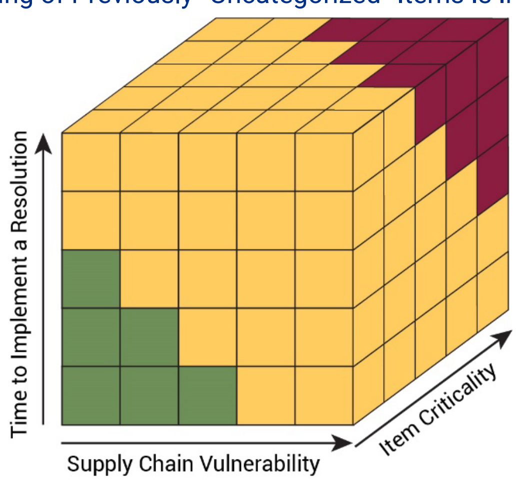
[114] An engineered material is designed to perform a specific function and is composed of multiple raw materials.

Other measures of the time to implement axis include a long lead time for requalification, manufacturing cycle time, and/or the lack of tooling or test equipment. For example, shipboard testing may be proposed, which requires scheduling ship availability. The cost to implement a resolution can be an indicator of the time required. Finally, resolutions for defense unique items are likely to require more time to implement.

Figure 12 depicts a risk cube illustrating where proactive monitoring of uncategorized items is important. Using this risk cube, if an item is not mission or safety critical, then there will be little operational impact from a DMSMS issue. Resolutions for such items can be developed and implemented without time sensitivity. If the item is critical, but the supply chain is robust, the likelihood of a DMSMS issue is also small, because other suppliers should be able to satisfy demands. Even if the supply chain is not healthy for a critical item, proactive monitoring is only needed when the time to implement a resolution exceeds the length of time covered by the on-hand inventory for that item. A best practice is that a program office should only expend resources to proactively monitor those previously uncategorized items that are high risk across all three risk categories (in other words, red/red/red).

Once a program office has determined which of the above considerations within the three risk categories to use, a best practice is to categorize the items that were previously uncategorized based on the use of applicable algorithms. These items should be evaluated based upon those considerations suitable for evaluation through automated databases. Each consideration should also be assigned a weight. For all items being evaluated, the weights of all considerations should be summed and the items above a predetermined cut-off point should be monitored, while those below that cut-off point should not. Both the weights assigned to the considerations and the cut-off point should be determined by the program office, based on its unique needs.

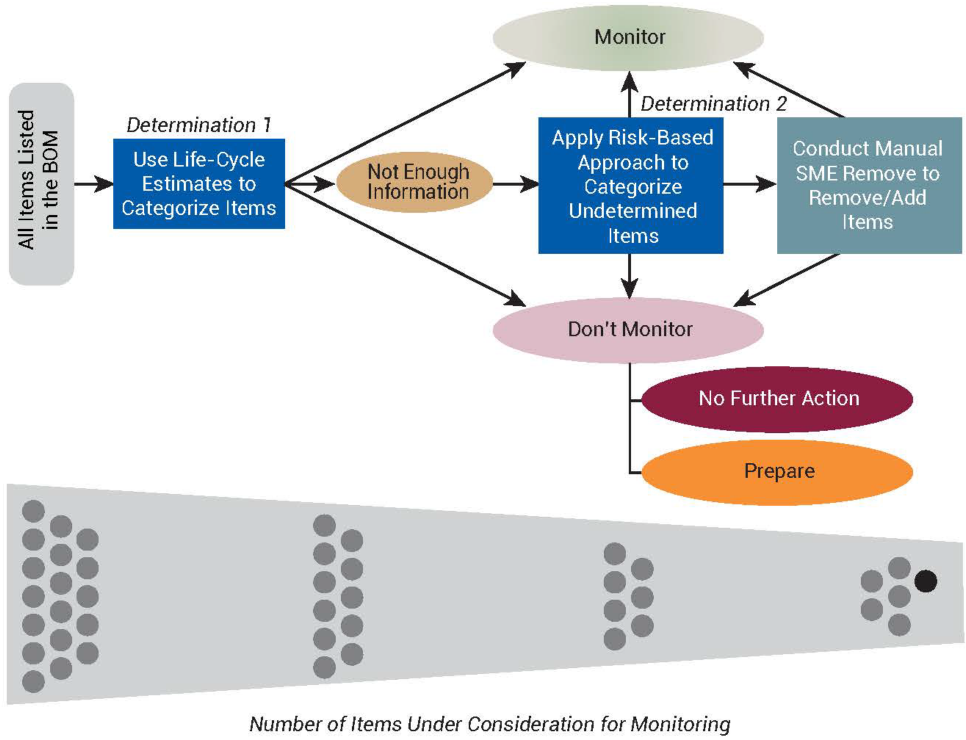
Figure 12. Risk Cube for Determining Where Proactive Monitoring of Previously "Uncategorized" Items Is Important



Regardless of what level of risk analysis is conducted, an SME could adjust the classifications, including the "do not monitor" items. This evaluation will take into account risk cube considerations that could not be adequately measured by automated databases, if applicable. There may also be some known vulnerabilities. For example, the technical members of the DMT may be aware of items that are known to be a problem and items with pending environmental or safety regulations that may limit their availability and use in any area of the world where the system operates. As a bottom line, the DMSMS SME and engineering activity representative should understand the associated risk before choosing not to monitor any such items and should revalidate that decision periodically.

Figure 13 summarizes the entire process described in this section.

Figure 13. Summary Illustration of Risk-Based Approach for Determining Which Items and Materials on the BOM to Monitor



The DMT should have an obsolescence management strategy for every item. The program office should carry forward the “definitely monitor” and “uncategorized” items that have been determined to be high risk across all three risk categories for availability analysis. The strategy for the “not to monitor” items is to find an alternative when they become obsolete, because ample replacements are available commercially, or to make the necessary preparations should a resolution be required down the road.

Once a program office has categorized and prioritized the items on its BOMs, the data for these items can be loaded into predictive tools where appropriate.

4.3.2.2 SOFTWARE

As part of this second layer of prioritization, a program office should also use a risk-based approach to determine where proactive monitoring for software obsolescence makes sense. Knowledgeable software experts should be consulted as needed. Taking a risk-based approach on what to monitor implies higher priority should be given to software that has a critical impact on the ability of the system to perform its missions. Other risk-based monitoring considerations for software include effect on safety, past problems with software, information assurance and cybersecurity, the complexity of interdependence with hardware and other software, and the frequency of updates.

A primary driver of obsolescence is the customization of defense system software for specific COTS operating system, middleware, and application software. Particularly with regard to software, once a decision is made on what to monitor, there should be a risk-based determination of which versions or revisions to track, because further refinements (lower-level revisions) may fix only minor errors and not affect functionality or major vulnerabilities.

4.4 ANALYZE ITEM AVAILABILITY

When all the items are analyzed for obsolescence (as determined via either predictive tool usage or vendor surveys), the magnitude of the program office's immediate and near-term DMSMS issues will begin to surface. Regardless of the method used, engineering analysis and judgment remain key factors in identifying DMSMS issues.

These items' availability status results represent a snapshot in time and, therefore, must be repeated throughout the life of the system, in response to the identification of new obsolescence notices, a vendor survey, or a regularly scheduled update to the predictive tools. If possible, a program office should receive daily DMSMS notifications that pertain to the electronics in its systems. Quarterly or annual alerts or vendor surveys may suffice for COTS items but may be too late for electronic items, especially if a program office has only 30 days to make a LON buy. Update frequency may also differ for different commodity types, based on the availability of information, the rapidity of the technology's evolution, and the risk that the item or material poses to the system and mission.

Analyzing item availability should focus on identifying the items in each of the following three categories for further assessment:

- Items that are no longer available and for which no alternatives are available,[115]
- Items for which discontinuation notices have been issued, but some are still available, and
- Items projected to be out of production in the near future (where the time horizon is specified by the program office).

Sections 4.4.1–4.4.4 describe the four methods—predictive tools, vendor surveys, critical materials analysis, and PDNs—that prompt a refresh of a system's item availability status for hardware—electronic and MaSME items. Section 4.4.5 after that discusses some special considerations for software.

4.4.1 Predictive Tools

Some items (especially electronic items) are more readily analyzed using predictive tools. In contrast, most predictive tools do not cover MaSME items and COTS assemblies. Most program offices will not be in a situation in which they independently evaluate and purchase a license for using a predictive tool. More typically, either a parent organization will have bought a centralized subscription to one or more tools, or the program office will choose a DMSMS management provider (e.g., its prime contractor or independent SME)[116] that has its own set of tools. Tools, however, may be a selection factor for

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[115] The fact that a predictive tool indicates the existence of an alternative item does not guarantee that the item will work successfully in legacy systems. The conversion of original hard-copy drawings to digital drawings for legacy systems may make it difficult to know why a particular source's item was chosen over another source's item that appears to be similar or the same. The hard-copy drawings may have indicated a difference that was not captured digitally. Therefore, the DMT should check with the engineering authority before concluding that an assessment of whether and when to address obsolescence and at what level is not needed.

[116] If a program office decides to have its prime contractor or OEMs perform monitoring and surveillance using DMSMS tools, the government must have access to the outputs of those tools for two key reasons: 1) to allow the government sufficient visibility for effective oversight and 2) to enable it to readily assume DMSMS management responsibilities if DMSMS management roles change. There may be IP issues if the outputs contain data that is proprietary to the prime contractor or a supplier to the prime contractor.

independent SME organizations and the program office may need to obtain a license for its prime contractor or OEMs.

In determining which predictive tools to use, a program office should consider the following desirable attributes:

- Manage accurate configurations,
- Enable real-time assessments of availability for items qualified for the system,
- Identify obsolescence issues and specific quantities per affected assembly,
- Identify after-market sources of supply,
- Create or generate timely alerts on production change notifications and PDNs,
- Enable real-time views of current item availability analysis,
- Provide highly accurate data,
- Provide flexible data input and query options,
- Allow comprehensive reporting options,
- Contain a large number of key items for the prioritized subsystems (or be able to add them),
- Contain information about counterfeits and information assurance and cybersecurity requirements,
- Rapidly develop obsolescence case sheets, providing streamlined and complete status of obsolete item issues when integrated with a DMSMS management system,
- Provide engineers with the data needed to evaluate and implement resolutions,
- Share notes and resolutions across all managed platforms and systems,
- Enhance productivity by minimizing the impact on engineering staffs while rapidly providing critical data needed for decision-making,
- Provide excellent customer service, and
- Provide good value.

A specific tool, alone, will not recognize all items in a BOM. An informal study of two predictive tools found that one of them successfully recognized only 71% of the items being researched by the team,[117] and the other recognized only 72% of the items being researched. When comparing the availability reported by the two predictive tools, the study found that the tools disagreed regarding the obsolescence status of 4% of the items being researched. There are legitimate reasons for these statistics. In particular, different tools use different algorithms and philosophies in identifying and reporting obsolescence. Also, the electronics industry changes rapidly, and new items are added daily. Furthermore, update schedules for the predictive tools vary, sometimes resulting in discrepancies in item availability status between tools. Therefore, if funding allows, and if practicable, the program office should use more than one predictive tool or a tool containing two or more predictive sources.

[117] The study was done approximately ten years ago. It reviewed all the systems (ranging from missiles to aviation and in all phases) monitored by the U.S. Army Aviation and Missile Research Development and Engineering Center. On the basis of that review, the study calculated recognition rates for the two predictive tools used by the center.

If the tools disagree regarding the obsolescence status of an item, then additional manual research is needed to confirm whether or not the item has an immediate or near-term obsolescence issue. If the item does not present an immediate or near-term obsolescence issue, it does not need to be assessed for DMSMS impacts. Even if the predictive tools agree that an obsolescence issue exists with respect to a particular item, a manual check should be done to confirm that finding.

Predictive tools may not provide an obsolescence status for some items. This may be due to an incorrect item number, a lack of identifying information, or the way the tool provider collects data. Also, the item type or the item's manufacturer may not be monitored by the tool. Some items may not be included in a tool's database. Items with unknown availability must not lead to a false sense of security. Additional work is needed to determine their availability; the risk will determine if this additional work is value added. It may be that data errors can simply be corrected to enable the predictive tools to forecast item availability. In other cases, manual research may be necessary. For example, the OCM, if known, should be contacted. Otherwise, inquiries should be made down the supply chain until the OCM can be identified and source control drawings can be accessed. If the item number is correct, another predictive tool may be used. Tool providers allow users to submit requests for items to be added to their library of monitored parts. Certain restrictions apply, but providers usually will add catalog item numbers at a subscriber's request. Subscribers of these tools should take full advantage of this to reduce the amount of manual research required for future BOM monitoring and receipt of EOL notifications.

During start-up, a program office may face a substantial manual research effort to perform an initial cleanup of the data and to confirm the obsolescence-related findings generated by predictive tools. Scoping the types of items to be monitored based upon the application of a second prioritization filter (as described in Section 4.3.2.1) can assist a program office in reducing the level of effort it will need to employ to clean up and manually research such unknowns and verify statuses. Later, once a program office's DMSMS management has entered a steady state, research will need to be conducted only when certain predetermined conditions occur (e.g., item status changes, an item has not been researched in a certain amount of time, changes in sources of alternate items, packaging changes, and periodic revisit of previous "no action required" items).

Predictive tools should be used throughout the life cycle. Early in design, they should be used on notional BOMs or preferred parts lists; both are good sources of items that are likely to be used in production. Early design for new systems is usually based on existing designs being developed by the OEM. The starting point is rarely a predominately blank technical drawing.

4.4.2 Vendor Surveys

Predictive tools may not be able to forecast the availability of some items (such as COTS assemblies and MaSME items). This will also be the case for materials such as alloys, epoxies, glues, tapes, cooling fluids, and adhesives. In these instances, the best way to analyze availability is through vendor surveys, phone calls, emails, and vendor websites. To help make the research process repeatable, it is a best practice to document the steps taken to research items and decisions and agreements made.

It is helpful to develop a vendor survey questionnaire to manually interact with COTS and hardware—electronic and MaSME items manufacturers and knowledgeable material specialists, establish a database to capture and track the survey information, and determine the frequency to make contact for updates (again, prioritized based on criticality). Contacts for these surveys can be made through phone calls or email communication. A program office should be mindful to conduct these surveys in the least burdensome manner possible to increase the likelihood of responses. Developing relationships with vendors often improves response time and willingness to participate. Some data can also be collected by reviewing manufacturers' websites and other web research. This activity is particularly relevant to COTS items; manufacturers will often provide the status for the current item's planned life cycle, especially when a next-generation version is intended.

The following list provides some examples of vendor survey information and questions that a program office can include in its vendor survey questionnaires for electronic items.[118,119,120] The types of vendor survey questions suggested here for electronic items are generally applicable to MaSME items, as well; however, additional questions can be added to determine if someone other than the OEM is a likely candidate for providing future support for those items.

- What is the product name?
- What is the company name?
- What are the CAGE codes?
- What is the part number?
- What is the contact information?
- Is this item currently in production? If no, when did production end? If this product is no longer in production, can the government still purchase it? If yes, how many? When is the last date that the product can be purchased? If currently in production, when do you anticipate end of production?
- If you are not currently planning an end of production date for this product, please provide an estimate, based on similar products, past history, technology/item obsolescence, and so forth. (Keep in mind that this date is used for supply planning purposes only.)
- How long after the end of production will the government be able to have this product repaired? What's the typical cost to repair this item?
- Once production has been discontinued on the product, how much stock (in time) is typically available for sale? Are there considerations regarding shelf life (may be of particular interest for materials) of which the government should be aware?
- When this product is discontinued by your company, will you enter into an agreement with an after-market vendor so that customers can still buy the product? If yes (for this product or for other similar ones), please indicate the name of the vendor and give a point of contact.
- Is there a replacement or a planned upgrade to the product? Is the new item equivalent in terms of form, fit, and function? If so, what is the new product's part number and cost?
- What are your technology update plans? What additional capability will the new technologies provide?

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[118] Although more questions can be asked, the response rate is likely to be higher if the vendor survey is brief. Additional questions specific to different types of software are provided in Section 4.4.5.
[119] The answers to these questions and any follow-up questions should be provided to the appropriate technology road-mapping community in the program office.
[120] ANSI/VITA 53.0-2010, *Commercial Technology Market Surveillance*, is a reference to consider for additional questions to pose to a manufacturer (production start/end dates, end-of-support dates, failure, warranty, distributers, design changes, and so forth).

- What warranty does the product have? What is the warranty length and can the length or start time be adjusted to allow for integration and deployment? What extended warrantees are available, and at what cost?
- What is the list price of the product and its lead time?

A key step in developing an obsolescence management strategy for MaSME- and COTS-based systems is to compile a list of equipment and items in the system and group them by the original manufacturer. With such a list, the DMT can make one phone call to each OCM and OEM to obtain obsolescence information about numerous items. Another helpful hint for a contractor that has been tasked by the government to survey vendors is to obtain a letter of permission to seek this information from the government and share it with the vendor. With this letter, vendors will likely be more cooperative in sharing information. The program office (regardless of whether in-house or contracted out) should decide how often to contact the OCMs and OEMs; the appropriate frequency will depend on the criticality of each system, general life-cycle expectations, and other DMT-determined factors.

It is a best practice to conduct vendor surveys twice per year for electronic items, due to the rapid pace of change characterized by the market. For MaSME items, market changes occur much slower. While this might support the argument that vendor surveys could be conducted less frequently for MaSME items, there are several arguments against such an approach. First, conducting different vendor surveys (potentially for the same vendor) at different frequencies could lead to extra work and unnecessary complications for a program office's DMSMS management effort. Second, the marginal cost of conducting more frequent vendor surveys would likely be small, assuming that there are not a very large number of contacts to be made. Finally, material obsolescence caused by changes to environmental regulations or geo-political disruptions in supply can happen very quickly. For this reason, it could be beneficial to be monitoring MaSME items on a more frequent basis. Ultimately, a program office should make its own determination on the frequency of vendor surveys for non-electronic items, based on obsolescence risk, resources, and the criticality/safety associated with those items.

Performing research on the managed software items is the most time consuming effort within a software obsolescence program. The frequency of researching/refreshing each item must be determined by taking into account the 1) associated risk, 2) personnel, 3) number of items being tracked, and 4) funding. Below is a recommended frequency suggestion depending upon the known risk of the software.

- High Risk: quarterly.
- Moderate Risk: semi-annually.
- Low Risk: minimum of annually.

4.4.3 Critical Materials Analysis

It is important to be aware that under some circumstances, the vendor survey and research approach may not be sufficient. This could be the case if and when the suppliers of the items listed on the BOM are unaware of issues associated with materials within their items' supply chains. It is because of these instances that the importance of the program office's third strategic decision from the foundations of DMSMS management (see Section 3.1) is highlighted. This third determination reflects the program office's determination of whether to investigate critical materials in the supply chain (those not identified in a BOM) or in a manufacturing process.

A critical material could be hazardous, exotic, or otherwise be supply constrained. Such a material can either be embedded within an item that is listed on a BOM or required as part of the manufacturing of an item on a BOM. The incorporation of critical materials into a system will usually be done at a low level in the supply chain—a level that is below an item being surveyed or whose status is being determined by a predictive tool and from a company that may not even know that its product is destined for a DoD system. Potential changes and disruptions at the lower-tier material level may not be immediately apparent and understood when an item's status is being determined (especially for low-demand items) and, consequently, potential DMSMS concerns may not be identified early enough to resolve in a timely or cost-effective manner. For example, a buyout of a key critical material producer may lead to a major impact if there are plans to consolidate production lines. Given examples such as this, knowing whether there are critical materials present in or used in the manufacturing process of a MaSME item in the BOM will improve the analysis of availability of that item or material. The same is true for electronic items analyzed through predictive tools or other vendor surveys.

Program offices often do not know which critical materials are in their supply chains. Only minimal information can be learned about imbedded critical materials from TDPs, material safety data sheets, and an item's technical characteristics. Even if the critical materials in an item's supply chain were known, in nearly all cases, issues with these critical materials will affect multiple program offices and systems. It would therefore be inefficient if every program office independently conducted research to identify obsolescence concerns for critical materials in its own supply chain and then determine how to mitigate any issues that may be discovered from its own perspective. Such efforts are best accomplished on a centralized basis in coordination with all other stakeholders.

Program offices should devote resources to identify material issues in lower-tier suppliers based on their perceived risk. First, a program office can identify the set of lower-tier critical materials with which it is concerned; these would be the critical materials that are anticipated to have the greatest potential impact, if there should be an issue obtaining or being able to use a given material. Second, a program office can strive to better understand the extent to which issues associated with the lower-tier critical materials in the supply chain may impact monitored item availability.

With regard to identifying the lower-tier critical materials with which to be concerned, a program office has two options: 1) create a master list of all critical materials or 2) create a targeted list of critical materials for which the availability of that material can be anticipated to be uncertain because of pending regulatory change or other potential supply disruption. In selecting an approach, a program office should keep in mind that hazardous materials (which often represent a large fraction of all critical materials) may fall into one of three categories: 1) their use is prohibited, 2) their use is restricted, or 3) their use is otherwise tracked.

Regardless of which hazardous material category applies, a predictive tool or a vendor survey will accurately capture the obsolescence risk status of an item on a BOM that uses a hazardous material, as long as there have been no recent changes in the categorization of that hazardous material within that item. For example, if the material is prohibited and has been for a period of time, the impact of that material on the items that it is in will already likely be known and those items will most likely be obsolete. In other words, the status of the item will already reflect the known categorization of its hazardous material. If the material is also known to be restricted or tracked, supply chain availability will be understood; there may or may not be DMSMS concerns. Only when the material's category has recently changed or there is a strong likelihood of a change in the near future would there be a need to conduct further research to ensure that the end item status accurately accounts for these risks.

Consequently, it is sufficient for most program offices to create a list of hazardous materials where the availability of that material can be anticipated to be uncertain, where uncertainty does not imply that the material should not be used. A targeted list of hazardous materials should be based on an understanding of and remaining up-to-date on the latest regarding the following:

- Uncertainties associated with environmental restrictions pertaining to materials. The Chemical and Material Risk Management Program (CMRMP) scans a variety of sources to identify emerging contaminants—chemicals or materials that either lack human health standards or have an evolving science and regulatory status. When a potential emerging contaminant is first discovered, a risk alert is issued. The materials for which emerging risk alerts have been issued can be found at the following link: https://www.denix.osd.mil/cmrmp/ecmr/ecprogrambasics/ or from the CMRMP main webpage (https://www.denix.osd.mil/cmrmp/home/) through the Menu text at the upper right-hand side of the webpage.
- Material vulnerability uncertainties associated with the Department's National Defense Strategy and national emergency planning. DLA's Strategic Materials Office maintains a strategic and critical materials (SCM) "watch list," which focuses on materials of concern. The list is compiled from nominations by DoD Components, other parts of the Executive Branch, Congress, SMEs, and other interested parties. Criteria for nomination include evidence of "weak links" in important material supply chains for defense and/or critical civilian applications. The list is used as the basis for assessments to recommend possible materials for purchase by the National Defense Stockpile. The Strategic Materials Office produces such assessments on an ongoing basis. Assessment results show that not every entry on the "watch list" is a potential shortfall. A shortfall does not imply a peacetime shortage—it only implies a possible shortage associated with DoD reconstituting its losses of that material (or end-items that use that material) during a national emergency. Therefore, from a DMSMS perspective, materials of interest could be limited to new additions to DLA's identified shortfalls, or significant changes in the quantity and value of a previous shortfall material. Context for material shortfalls is provided in the assessments. A careful reading of assessment documents can provide insight into the details associated with each assessment to determine a subset of materials on which DMSMS may choose to focus.

While it will likely be sufficient for most program offices to create a targeted list, based on the sources described above, some program offices may still judge that all critical materials are of concern. In this case, there are several sources of data that can be used to support this effort:

- The 2016 National Aerospace Standard (NAS) 411-1, Hazardous Material Target List (HMTL). The HMTL has been developed to support and enhance the management of risks associated with the use of hazardous materials in products and services consistent with NAS 411, *Hazardous Materials Management Program,* and Military Standard (MIL-STD) 882E, *Department of Defense Standard Practice: System Safety,* in which a Hazardous Materials Management Plan is described as a management task. The HMTL includes prohibited and restricted materials. A consolidated, tracked materials list is under development. NAS 411-1 may be purchased online from the Aerospace Industry Association.
- DLA's SCM List. As described above, DLA's Strategic Materials Office maintains an SCM "watch list" that focuses on materials of concern. This office's website has a page that lists materials of interest (https://www.dla.mil/HQ/Acquisition/StrategicMaterials/Materials/).
- Aerospace and Defence Declarable Substance List (AD-DSL). The International Aerospace Environmental Group (IAEG) develops an AD-DSL to identify chemical substances for which aerospace and defense supply chain supplier reporting is necessary. The AD-DSL addresses substances that are:

– “Restricted in articles,”
– “Restricted in substances and mixtures,”
– “Declarable in articles,” and
– ”Of interest.”[121]

This list can be found at the IAEG website’s “Materials and Substances Declaration for Aerospace and Defence” web page (http://www.iaeg.com/chemicalrpt/addsl/). This web page includes further links to the 2015, 2017, and 2019 AD-DSL in multiple download formats.

- Registration, Evaluation, Authorisation, and Restriction of Chemicals (REACH). The European Union’s REACH regulation controls the use of and imposes reporting requirements for certain hazardous substances in Europe. The following European Commission website contains information on substances for which additional restrictions have been adopted and specific chemicals that require additional legislation: https://ec.europa.eu/growth/sectors/chemicals/reach/restrictions_en and https://ec.europa.eu/growth/sectors/chemicals/specific-chemicals.
- Restriction of Hazardous Substances. European and various other countries have issued RoHS regulations that limit the material content of electronic and electrical equipment. Regulated substances can be found at the following link: http://www.rohsguide.com/.

Regardless of which approach is taken to compile a list of lower-tier critical materials of concern, DMSMS management stakeholders should have an opportunity to contribute. Anyone on the DMT, including material and environmental engineers in the program office, may become aware of a potential material-related supply chain issue. Other potential sources include component organizations with material SMEs and/or organizations that conduct industrial base analyses.

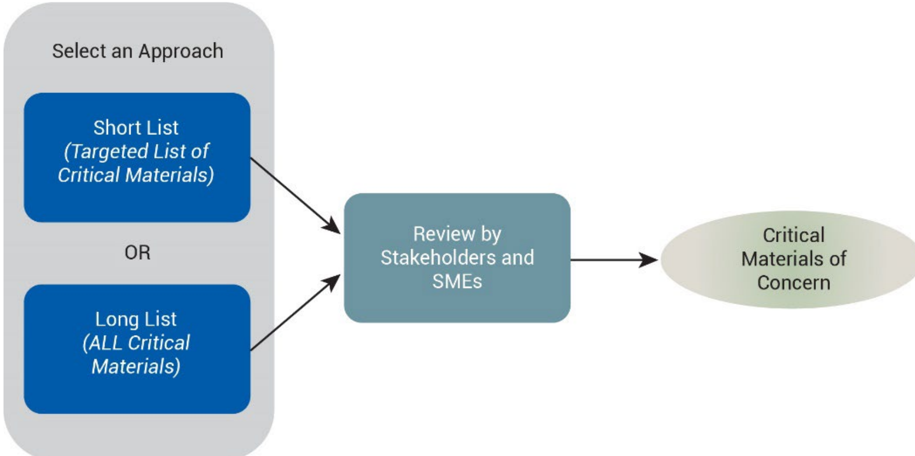
A system’s list of critical materials of concern may be shortened over time as a function of what the DMT learns about whether these critical materials are being used on the system or not. Consequently, there will typically be three classes of materials on a system’s list of critical materials of concern:

- Those materials that are known to be on the system,
- Those suspected to be on the system, and
- Those where their presence on the system remains unknown (this is likely to be the most prevalent class, particularly at the beginning of a program office’s DMSMS management effort).

Figure 14 illustrates the first step of a proactive approach for issue identification for critical materials in the lower tier of the supply chain. This first step focuses on selecting those materials that will serve as the critical materials of concern for the program office.

[121] IAEG, “Aerospace and Defense Declarable Substance List,” Version 5.0, March 19, 2021, p. 1.

Figure 14. Select the Critical Materials of Concern for the Program Office



For items in the BOM, robust DMSMS management seeks to be proactive in problem identification to discover potential issues well before they materialize. This maximizes the time available to implement a resolution and thereby both increases the likelihood of finding an inexpensive resolution and minimizes any ill effects on schedule and readiness. From this perspective, once a program office has identified the critical materials of interest, the next set of activities should follow a risk-based, proactive problem identification path to highlight "the unknown unknowns" of critical materials' impact on item availability.

A typical proactive approach using predictive tools and vendor surveys and research would not normally be used to better understand the extent to which critical materials issues in the supply chain may impact monitored item availability. Such an approach to problem identification is very labor intensive and the data do not indicate that the DMSMS risks and potential impacts are severe enough to justify the investment needed to be proactive in that way.[122] Even if the government DMT were able to identify and contact lower-tier vendors, these contacts may not generate a complete response as the government will be seeking proprietary information that the company is unlikely to share unless it is in the company's best interest to do so (e.g., the company wants government help to solve the problem).

In the absence of any exacerbating circumstances indicating high risk, the most cost-effective DMT approach for risk-based, proactive problem identification for lower-tier critical materials (and materials used in manufacturing processes) is to encourage and engage in communications among key critical material stakeholders to share tacit knowledge on the subject.[123] Considerations regarding how these types of communications can be fostered include the following:

- Establishing an agenda item for critical material supply chain issues for every DMT meeting. This will engage the prime contractor and any OEMs on the DMT. These DMT members may be aware of some critical materials in the supply chain, as well as potential issues with these materials because of any chemical profiling they are performing on their products. Such chemical profiling may be due to regulations or because it has been determined important for them to do this from a business perspective (e.g., sales may otherwise be affected). Furthermore, primes and OEMs have the most detailed engineering understanding of the items on the system. Therefore, they will play an important role in determining a resolution, should that be necessary.

[122] This may change in the future if a greater number of substances become subject to environmental restrictions.
[123] A more proactive approach is to include a provision in contracts to collect data on any material of interest in the supply chain. This is a more costly approach and could be integrated with potential programmatic environment, safety, and occupation health evaluation-related efforts. See Appendix E.

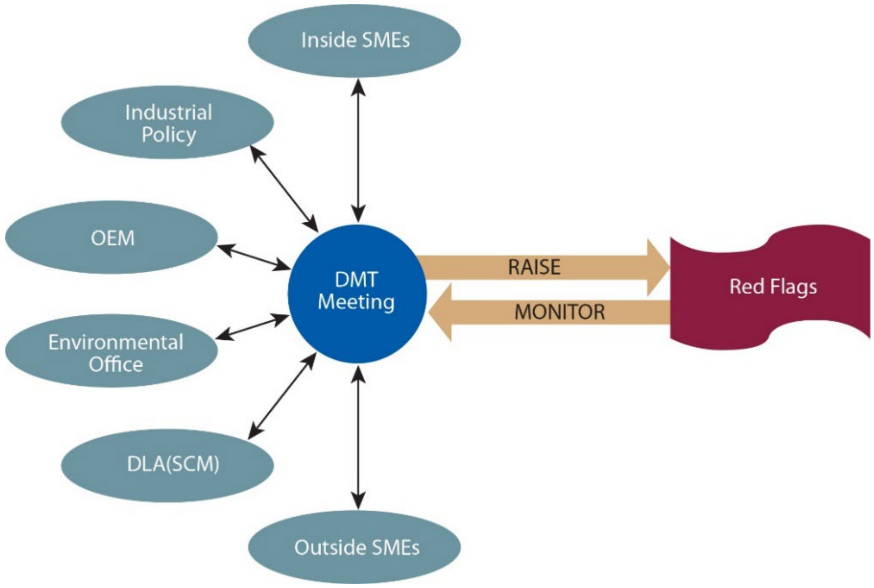
A DMT agenda item will also engage the organic depots involved in sustainment. Although the depots may not normally have a representative on the DMT (Section 3.3.1 lists them as ad-hoc members), someone on the DMT will be in the position to communicate with them. This is an important avenue of communication because there is a supply chain associated with depot activities and, consequently, the depots may be aware of the presence of critical materials in the system and critical materials issues analogous to those known by the primes and OEMs. Depots may even be in a position to query their supply chains about issues.

- Engaging with other stakeholders in preparation for a DMT discussion. Other stakeholders to engage include the following:
  - DLA's Strategic and Critical Materials Office. This office can be contacted using the "Contact Us" link at the bottom right of its website (https://www.dla.mil/HQ/Acquisition/StrategicMaterials.aspx).
  - The Office of the DASA(IP) has three functions that could be pertinent to these discussions. These functions pertain to the Defense Production Act and Title III (https://www.businessdefense.gov/Programs/DPA-Title-III/), Industrial Assessments (https://www.businessdefense.gov/Industrial-Assessments/), and Industrial Base Analysis and Sustainment (https://www.businessdefense.gov/IBAS/).
  - The Manufacturing Technology (ManTech) program anticipates and closes gaps in manufacturing capabilities, and as such represents another potential stakeholder of interest (https://rt.cto.mil/stpe/tmib/).
  - Chemical and Material Risk Management Program. This program produces environmental risk alerts, which are maintained by the DoD Environment, Safety, and Occupational Health Network and Information Exchange. This program can be accessed using the "Menu" link at the top right of the CMRMP webpage (https://www.denix.osd.mil/cmrmp/home/).
  - Major OEMs in the supply chain. This would apply particularly in the case of those OEMs who are not already represented on the DMT but who may be profiling chemicals on their own products.
  - Material engineers in the program office.
  - Environmental engineers in the program office. As part of the program office's programmatic environment, safety, and occupation health evaluation (PESHE) requirements, hazardous materials, waste, and pollutants on the system must be identified.[124] Environmental engineers may also be briefed periodically on regulatory changes that might affect the system.
  - Organizations that conduct materials research or perform industrial base sector analysis, and/or cross-cutting materials SMEs for the components.

Figure 15 illustrates the second step of the proactive approach for issue identification for critical materials in the lower tier of the supply chain, as described above. This step focuses on the DMT assembling materials-related stakeholder knowledge and experience (both internal and external to the program office) to inform DMT meetings. In that way, materials-related red flags can be raised, as necessary, to help mitigate against being caught off guard.

[124] *DAG*, at 4.3.9., "Environment, Safety, and Occupational Health."

Figure 15. Identification of Potential DMSMS Issues Associated with Critical Materials



Identification of issues is associated with engagements among stakeholders. The rationale for these engagements focused on critical materials include the following:

- Encourage all stakeholders to keep their ears open—primes and OEMs may be encouraged to more proactively monitor their supply chains,
- Learn the potential issues others are aware of and what they are concerned about,
- Learn what is being done,
- Learn what conversations are taking place,
- Actively share all information among the stakeholders, and
- Ultimately put the stakeholders in a position to anticipate changes in regulations and other market-driven disruptions to the critical materials supply chain.

Once a potential problem is discovered, these engagements will force a conversation on what to do about the problem. A resolution that develops a drop-in replacement that is compliant and meets performance specifications is highly desirable. One of the stakeholders may be willing to take the lead in researching the issue and recommending a course of action. There may be circumstances where the prime and an OEM agree to resolve the problem because there is a clear business case for that to happen—this is most likely to occur when the material is included via a company-owned specification or drawing.

By engaging high-level organizations, a DoD-wide initiative may be established. Some DMT research may be warranted, but in most cases this would not occur until other options have been pursued. Regardless of who does the research, some potential data sources are as follows:

- Industry associations.
- Organizations that track both recent and pending domestic and international regulation changes. As one example, the National Aeronautics and Space Administration (NASA) has established a Principal Center for Regulatory Risk Analysis and Communication (RRAC) that conducts regulatory reviews

and performs risk analyses that can be accessed via email subscription or through the RRAC website.[125]

- REACH, RoHS, and conflict minerals data associated with items.
- Other technical data, for example, annotations on drawings may lead to educated guesses about tracking or identifying critical material suppliers.
- Full material disclosures published on company websites.
- OEM contractual deliverables indicating potential DMSMS issues and supply issues.
- Just as proactive DMSMS monitoring should begin by the time of the program office's PDR, so should these engagements and chemical profiling activities. They may lead to a design change if substances are included where there is a concern about anticipated regulation. Also, they help establish a baseline of understanding critical material content and issues during sustainment.

4.4.4 Product Discontinuance Notices

The DMSMS management program should receive automated industry obsolescence notices and DMSMS alerts from the selected predictive tools, Government Industry Data Exchange Program (GIDEP), and DLA. Although overlaps will occur, all three sources should be used to maximize completeness and timeliness. Any PDNs received should be validated before any action is taken. In addition, the DMT should query manufacturers' websites, build relationships with OCMs (similar to the vendor survey relationships), and access other federal supply sources such as GIDEP and DLA to identify data and notifications on item availability. The remainder of this section focuses on alerts and external triggers for item availability analysis updates from GIDEP and DLA.

4.4.4.1 GOVERNMENT INDUSTRY DATA EXCHANGE PROGRAM

A DMSMS management program should become a GIDEP member early in its life cycle and a member of the DMT should become trained in its usage. GIDEP is a cooperative activity between government and industry participants seeking to reduce or eliminate expenditures of resources by sharing essential technical information during the research, design, development, production, and operational phases of the life cycle of systems, facilities, and equipment. For complete requirements, and to become a member, see the GIDEP website (www.gidep.org).

GIDEP is a useful tool to support monitoring and surveillance, because it has developed a part batch search routine that permits GIDEP participants to send and compare part lists to the part identifiers in the GIDEP database. Part lists are protected so that only GIDEP operations center personnel have access. Batch processing is available only to registered GIDEP participants. Additionally, GIDEP members can search the GIDEP site for key words such as DMSMS, Stop Shipment or Suspect Counterfeit to identify associated alerts and parts lists to compare to a parts list outside GIDEP.

Also, as a GIDEP member, a program office can get "push mail," which is generated, as a convenience, to provide GIDEP participants with an overview of information without having to access the database. If a part or title in the list is of interest, the corresponding document can be retrieved through direct database access. All GIDEP representatives are automatically eligible to receive push mail. Users may also be granted access with their representative's approval. Representatives can either access the push mail registration online to update their profile or to assign distribution to their users. Once users have been granted access to push mail, they can update and change their own distribution or email online. As part of

[125] NASA, "EMD Principal Centers," last updated June 29, 2020, https://www.nasa.gov/emd/emd-principal-centers.

push mail, members can receive weekly summaries that list documents committed to the database during the week cited. The list includes the document number, date, designator, title, and abstract.

Members can also request parts lists that represent all part identifiers (manufacturer, government, specification, drawing, model, base, and NSNs) either contained within or cross-referenced to all documents entered into the GIDEP database during the week cited. This allows a program office to check its parts against the GIDEP-generated weekly parts list without having to create reports itself. A program office may then enter the database to retrieve only those documents of interest to the program office.

GIDEP can also provide support when developing resolution options for a DMSMS issue. The GIDEP Urgent Data Request (UDR) is a service available to any authorized GIDEP user as well as the public. The service enables the user to enter two types of queries—a source of supply and a request for information:

- A source of supply request is a mechanism for locating hard to find or obsolete items that are no longer available through traditional sources. The item may be an entire assembly or a material used in its manufacture. If multiple sources of supply are found, the user can select the most cost-effective supplier. Significant time savings to resolve an issue are achievable if any source of supply is found. If no source of supply can be found, the query may lead to potential new production sources.
- A request for information may help an activity with resolutions to an obsolescence problem by finding technical or experiential data or other information that apply to the issue. For example, the request for information may ask for test, calibration, design, maintenance, or failure data. Having such data may help determine the viability of a substitute part.

In summary, GIDEP does not have the ability to predict which parts will become obsolete, but it can provide a program office with a no-cost means to find out which NSN parts[126] of interest already have discontinuation notices against them. Program offices can also use GIDEP's batch processing as a way to ensure that the program office will receive discontinuance notices that match system parts and also may provide the ability to assist with identifying unmatched parts.

4.4.4.2 DEFENSE LOGISTICS AGENCY

DLA (www.dla.mil) also provides PDN alerts to subscribers—including military services, government agencies, FMS customers, and industry (with .mil email accounts and common access card capability)—through its shared data warehouse.[127,128] These DLA-generated alerts contain information not available through GIDEP, such as DLA usage and weapon system coding. For DLA-managed items, additional analyses are done to determine resolution options ranging from requesting users to determine quantities for LON buys to examining options to emulate microcircuits using its Generalized Emulation of Microcircuits (GEM) and Advanced Microcircuit Emulation (AME) programs.[129]

Access to DLA's websites allows a program office to search the following:

- Qualified Manufacturers Lists (QMLs)/Qualified Products Lists (QPLs). The data provided in this search are updated as changes occur and may contain information not reflected in the hard-copy version. A program office's search will always return the latest information available at that time. QMLs/QPLs are also available in the Acquisition Streamlining and Standardization Information

[126] Many designs contain parts without NSNs.
[127] The email address to become a subscriber is dmsms@dla.mil.
[128] DLA's Obsolescence Data Repository is a centralized repository for resolution data and information.
[129] SRI International, "AME GEM," accessed April 7, 2020, http://www.gemes.com.

System (ASSIST) Qualified Products Database. DLA updates the lists as necessary and is charged with requalifying vendors every two years.

- Standard microcircuit cross-reference. This search provides a cross-reference of microcircuits covered by standard microcircuit drawings, MIL-M-38510 specifications, and vendor item drawings. If a program office prefers to use the cross-reference data on a local computer, a standard microcircuit lookup table can be downloaded.
- Military specifications (MilSpecs) and drawings. This website provides courtesy copies of documents managed at DLA. If a program office cannot find a document here, it may not be managed at DLA. For a complete list of all DoD MilSpecs, refer to DLA's document automation and production service.
- Standard microcircuit drawings. A list of standard microcircuit drawings is available to download.

4.4.5 Special Considerations for Software

The following software management best practices should be taken into consideration to establish and maintain a robust software obsolescence program:

- A software background/understanding is preferred for personnel who will be researching the software since a lot of the research relies heavily on either contacting the vendors or visiting vendor websites.
- Periodically re-evaluate survey questions to determine which questions are hardest to convey to the vendors. Re-wording/rephrasing/reordering questions can assist in getting a better response from the vendor.
- Ensure research is value added by meeting with the people who use the research to determine if additional questions would be helpful, if answers to current questions are not beneficial and should be removed or if the report format/content requires modification to assist with decision-making.
- Document research process used. If using a website to research software, document the steps performed to re-create the research (for new personnel/refreshing current research).
- Document research agreements/decisions made on what items are to be researched for each system and what items will not be managed.

The following sections provide best practices for conducting research as a function of the type of software item. Similar to hardware, websites may be a valuable source of the information needed. Also, it is a best practice to document the steps taken to research items and decisions and agreements made to help make the research process repeatable.

4.4.5.1 COTS OPERATING SYSTEM, MIDDLEWARE, AND APPLICATION SYSTEM

The use of COTS software is increasing. It is often less expensive and quicker to integrate a COTS software product than to develop a custom product. COTS software may be monitored primarily by keeping track of licenses and support agreements,[130] analyzing technology and product roadmaps and projected new release information, participating in user groups,[131] tracking new interface standards, and conducting vendor surveys of the rapidly changing market to evaluate competitive products as a future replacement option.[132] Just as qualified sources for hardware items should be identified, so should

[130] To achieve economies of scale, organizations should consider having a higher-level organization obtain licenses and support. This is not a DMSMS management activity.
[131] User groups are also a source of information on error and vulnerabilities.
[132] There is a question of whether this function should be done at the program level or enterprise level for COTS software, because the same software may be used by multiple programs. In addition, the need for software vendor surveys may not be as great compared to hardware because much more software update information is available on the web.

qualified sources of support for each element of software. Potential software vendor survey questions are as follows:

- What is the basis for changing version/revision levels? Are they updated regularly, and when?
- How are patches and updates announced? How are they distributed?
- What is the current version/revision of the software?
- When was this product first available for sale?
- Has {your version/revision} been discontinued?
- How long will license agreements for {your version/revision} be obtainable?
- Will license downgrades be available? For how long?
- How long will you support {your version/revision}?
- Will third-party support be available after that? For how long?
- What is the planned product EOL?
- Is there a planned replacement product?
- Is the planned replacement backward-compatible?
- What are the different technical characteristics between the old and new version?
- What operating systems are compatible with the software?
- What are the minimum hardware requirements (if any), for example, processor speed, communications interfaces, or memory?

Another aspect of proactive obsolescence management for COTS software is information assurance. DoD security bulletins may also be monitored.

4.4.5.2 CUSTOM OPERATING SYSTEM, MIDDLEWARE, AND APPLICATION SOFTWARE

Because licenses do not usually apply to custom applications, the key information that can be tracked is viable continuation of support when there are both contractual and in-house elements. Surveys may not be the best mechanisms to obtain information. Program office sustainment personnel may be in a good position to identify potential software obsolescence risks. Key questions for consideration are as follows:

- What is the current version/revision of the software?
- Do you still have the ability to modify the software?
- Is the source code repository maintained?
- Are the development tools maintained?
- Are there any third-party items?
- Are you able to compile those third-party items?
- What is the planned product EOL?
- What is the planned product end of support?
- Will third-party support be available after that? For how long?

- Is there a replacement product?
- Is the planned replacement backward-compatible?
- What development and testing hardware and software infrastructure are needed to maintain the software?

4.4.5.3 OPEN SOURCE OPERATING SYSTEM, MIDDLEWARE, AND APPLICATION SOFTWARE

If open source software is used, the government and/or OEM should assume configuration control for the source code. An analogy can be made to custom software, but there are differences. The expertise for making changes is likely to be found in the open source community, not with the OEM. Consequently, proactive software obsolescence management may consider monitoring changes made to the open source version (often found in the website), because using the newer version of the software may be necessary to support changes to the older code being used by the government. Licensing may not be an issue but the terms and conditions for using the open source software should be reviewed by a legal team because, for example, there may be a requirement to provide any modifications to the entire open source community.

4.4.5.4 GOTS OPERATING SYSTEM, MIDDLEWARE, AND APPLICATION SOFTWARE

Government off-the-shelf (GOTS) software is a subset of COTS software; therefore, the same considerations may apply. Licensing is unlikely to be an issue. The vendor survey would be conducted with the appropriate government entity.

4.4.5.5 COTS FIRMWARE

Product changes that only upgrade COTS firmware may impact the system. When buying items, the program office may not realize that firmware changes have been made and that those changes may not be fully compatible with the rest of the system even though there is no issue with the hardware in which it is embedded. In this situation, the item is a functional group—a combination of hardware and software. The item becomes obsolete when either the hardware or the firmware becomes obsolete in a way that affects the system.

COTS firmware changes may be tracked by monitoring the item itself as a functional group. If the hardware item is tracked through vendor surveys, a question about the firmware version or revision should be included. If the hardware item is monitored with a predictive tool, depending on the risk to the system, it may be important to include that hardware item in a vendor survey. Potential questions include the following:

- What is the current version of the firmware?
- Is it still in production?
- When was the firmware last updated? What was the reason for the update?
- When is the next scheduled update? What is the reason for the update?
- What is the estimated remaining market life?
- How are updates announced and how are they distributed?
- How many years of maintenance will be offered for the older version?

The need to use specific firmware to avoid a critical impact to the system should be documented; for example, the requirement may be identified in an engineering drawing.

4.4.5.6 CUSTOM FIRMWARE

There are no obvious considerations for proactive software obsolescence management because the program office should be aware of changes to the firmware it controls. Therefore, there is no need to monitor such firmware.

4.5 ASSESS PRELIMINARY DESIGNS FOR DMSMS RISK

Selecting obsolete parts and/or hazardous or exotic materials into a system design should be avoided. Assessing preliminary designs, whether for a new design or redesign, for obsolescence risk is a best practice to minimize this occurrence. Assessments evaluate the DMSMS resilience of a design early in a system's life cycle or early in the course of a redesign. Program offices should generate such design assessments based upon the review of the design's preliminary parts list. This can identify the wider potential for obsolescence issues in the overall system design. This type of assessment might be of particular use during early phases of the life cycle and/or during the early stages of DMSMS management for a program office, when the system design may still be in flux and/or a complete parts list or BOM data are not yet available. A more comprehensive system health assessment, as described in Section 5.3.1, may be more suitable once a system design is mature and stable. Regardless, an assessment of a preliminary design might also be useful at other times during the system life cycle to provide a summary assessment of the system's obsolescence risk.

Ideally, an assessment of a preliminary system design should be aligned to coincide with major technical design reviews or design changes. The assessments should be conducted and provided to program office leadership before such design reviews to identify DMSMS issues ahead of time and, ideally, to help prevent the incorporation of an obsolete or near-obsolete item into a design. This could be either an obsolete item itself (e.g., a die) or its packaging. Assessments of preliminary designs should not, however, be restricted to supporting the design reviews. They should be conducted whenever new parts lists are received. Table 10 is a sample template for organizing information for an assessment of a system's preliminary design. Each program office should tailor the information and format of such an assessment to best suit its needs.

Table 10. Sample Template for an Assessment of Preliminary Designs for Obsolescence Risk

Risk Area	Value	Impact (High, Medium, Low)			Red/Yellow/Green
		Cost	Schedule	Performance	
Early preparation					
DMP adequate and appropriately funded (as judged by logistics and reliability) throughout the life cycle	Not applicable				
Technology roadmap available and integrated into DMSMS management process, and vice versa	Not applicable				
Ability to monitor					
Percentage of critical BOMs/parts lists available (i.e., a risk-informed decision has been made to monitor)					

Risk Area	Value	Impact (High, Medium, Low)			Red/Yellow/ Green
		Cost	Schedule	Performance	
Percentage of available critical BOMs/parts lists being monitored					
Item obsolescence					
Percentage/number of items obsolete (or with EOL notice)					
Percentage/number of items at high risk (custom items, ASICs, hybrids, sole source, and so forth)					
Number of obsolescence cases open, closed, and pending (i.e., no assessment has occurred to determine whether to open a case)					

The assessment should highlight risk in terms of its impact on cost, schedule, and performance. The first two rows of Table 10 are especially important early in the life cycle. They indicate the status of two key enablers of robust DMSMS management. The next two rows measure the scope of the DMSMS management efforts underway relative to where it should be from a risk-based perspective. Finally, the last three rows portray a high-level view of the extent of obsolescence in the system.

When high risk items are identified, mitigating actions should be taken. There should be interactions with the parts selection, system engineering, and program office management communities to either replace high risk parts, or establish a risk mitigation plan (e.g., make a LON buy). As a result, there will be:

- Maximum use of parts with most of their life cycle remaining;
- Trades conducted between part life and technology refreshment plans;
- Consideration of trades between standard parts and innovations; and
- System designs more resistant to DMSMS impacts.

4.6 FORECAST FUTURE DMSMS ISSUES

Forecasting DMSMS issues is an important element of the *Identify* step of DMSMS management. The only way to delay DMSMS issues is to address forecasted obsolete items strategically before they become a problem. Strategic plans can be implemented on an item-by-item basis or by more comprehensive modification plans.[133] "Modification" is one term to describe configuration changes to a system. Other terms include (block) upgrades, (preplanned) product improvements, service life extension, modernization, and technology refreshment and insertion (defined later in this section). Plans that address anticipated DMSMS issues prevent operational or production so long as implementation occurs before those items can no longer be purchased or stocks of those items run out.

The processes for the *Identify* step contribute to forecasting future DMSMS issues. The predictive tools for DMSMS management track the obsolescence status of tens of thousands of items. The infrastructure

[133] For items ith a robust commercial capability, plans can entail finding another source in lieu of a redesign.

behind those tools links to suppliers to obtain information on whether items have been discontinued, whether a discontinuation notice has been issued, and the official discontinuation date, if applicable. Furthermore, some predictive tools use the part introduction date, average life of the technology in the item, and other factors to estimate an EOL date. Vendor surveys asking for EOL dates and other parts research information help monitor items not covered by predictive tools. All this information is further supplemented with product roadmaps, market research, and technology roadmaps to develop a picture of when items will no longer be produced.

Developing and maintaining product roadmaps support modification planning (on any scale) and DMSMS issue forecasting. A roadmap is an information organizing framework that brings together diverse issues in a common view.[134] This SD uses the term "product roadmap" to represent the evolution of the product (or system) resulting from an acquisition program, including all funded, as well as planned but not yet funded, modifications. An acquisition program is "a directed, funded effort that provides a new, improved, or continuing materiel, weapon, information system, or service capability in response to an approved need. …"[135] Often, a program office has a portfolio of product roadmaps that can be applied to an individual item (hardware or software), assembly, subsystem, or the entire system.

A product roadmap for the entire system aggregates the lower-level roadmaps that it encompasses. In a DoD program office, such an aggregation occurs in an integrated master schedule (IMS) that captures the tasks, events, and accomplishments necessary to implement the changes in the product roadmap. DAU defines an IMS as follows:

> *An integrated and networked multi-layered schedule of program tasks required to complete the work effort captured in a related Integrated Master Plan (IMP). The IMS should include all IMP events and accomplishments and support each accomplishment closure criteria.*[136]

Whereas, the IMP is

> *An event-driven plan that documents the significant accomplishments necessary to complete the work and ties each accomplishment to a key program event.*[137]

Other types of roadmaps contribute to product roadmaps (see Appendix J for a more detailed description). Product improvement roadmaps apply to changes in capability to address a new threat, safety deficiencies, information assurance, or the introduction of new statutory or regulatory requirements. Supportability roadmaps encompass improvements in the ability to maintain or sustain the product, increase its reliability, or extend service life. Product roadmaps, therefore, contain all planned product and supportability improvements for the system.

Finally, technology roadmaps capture technology changes that enable product improvement and supportability roadmaps. In program offices, the technologies in technology roadmaps are usually selected solely to drive desired product and supportability improvements. The DMSMS community uses technology roadmaps and the technology management efforts underlying them as inputs to forecast and verify issues during the *Identify* step in the DMSMS management process (the output).

- Technology roadmaps. The *Identify* step finds current and near-term DMSMS issues. While some near-term issues are discovered through predictive tool forecasts and vendor surveys, technology

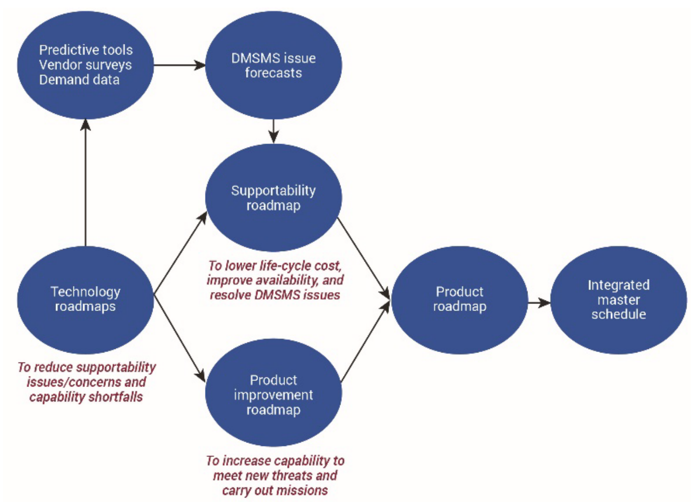
[134] Petrick, Irene J., *Developing and Implementing Roadmaps: A Reference Guide*, Pennsylvania State University, nd.
[135] DAU Glossary, updated July 21, 2020, https://www.dau.edu/glossary/Pages/Glossary.aspx#!both|A|26790.
[136] Ibid.
[137] Ibid.

roadmaps developed from market research and technology development activities may expand coverage and extend the forecast timeline.

- Technology management. Technology management, as one of the most important aspects of supply chain management throughout the life cycle, creates a strategic understanding of the supplier base, enabling an assessment of planned system technology developments and their effects on the competitiveness and viability of essential industrial and technological capabilities. Such an understanding furnishes a picture of the forecasted health of the industrial base and its ability to develop, produce, maintain, and support the system. That picture of forecasted industrial base health serves as an early warning of potential DMSMS issues not only for the system as it is configured today but also as it may be modified in the future.

Figure 16 summarizes the relationships among roadmaps and forecasts of DMSMS issues.

Figure 16. Relationships among Roadmaps and DMSMS Forecasts



Technology roadmaps enable the following:

- Incorporating acquisition and life-cycle sustainment strategies into the product roadmap,
- Minimizing the cost of resolving future obsolescence issues,
- Utilizing state-of-the-art technologies to increase reliability,
- Lowering sustainment costs, and
- Increasing warfighting capability to meet evolving requirements throughout an indefinite service life.

Determining when to upgrade or make modifications requires considering cost tradeoffs. From a single item perspective, the cost of the upgrade at a specified time can be compared to the cost of the upgrade at a later time plus the cost of mitigating the DMSMS issues until that later upgrade date. Such cost comparisons become increasingly complicated when multiple items are involved. Changes in capability affect the decision regarding when to upgrade.

5. Assess: Resolution Need, Timing, and Level

An old logistician's proverb—which begins with "for want of a nail the (horse) shoe was lost" and ends with the kingdom being lost, "all for want of a nail"—illustrates that the lowest-level item in a system's hierarchy can affect the entire system. Consequently, the *Assess* step of the DMSMS management program examines the potential effects that a DMSMS issue, at any level of a system, may have on cost, schedule, availability, and readiness. Most DMSMS issues result in a combination of these effects and, ultimately, all if left unaddressed:

- Cost impacts may be experienced in any stage of the life cycle. The impact is measured as 1) the additional cost that must be paid to resolve the issue, 2) the change in support costs (it will cost the program office less if reliability is improved), and 3) the difference in the cost of items before and after resolution. This third element of cost may be positive or negative, depending on the resolution pursued. If a more expensive alternative item is used, then the cost will be higher.
- Schedule impacts are usually associated with the design or production phases of the life cycle or with modifications during the sustainment phase, because obsolescence may delay design or manufacturing activities.
- Availability and readiness impacts normally occur during sustainment. DMSMS issues may affect the mission capability of a system, or they may prevent the system from being used altogether.

The purpose of the assessment is to answer three questions:

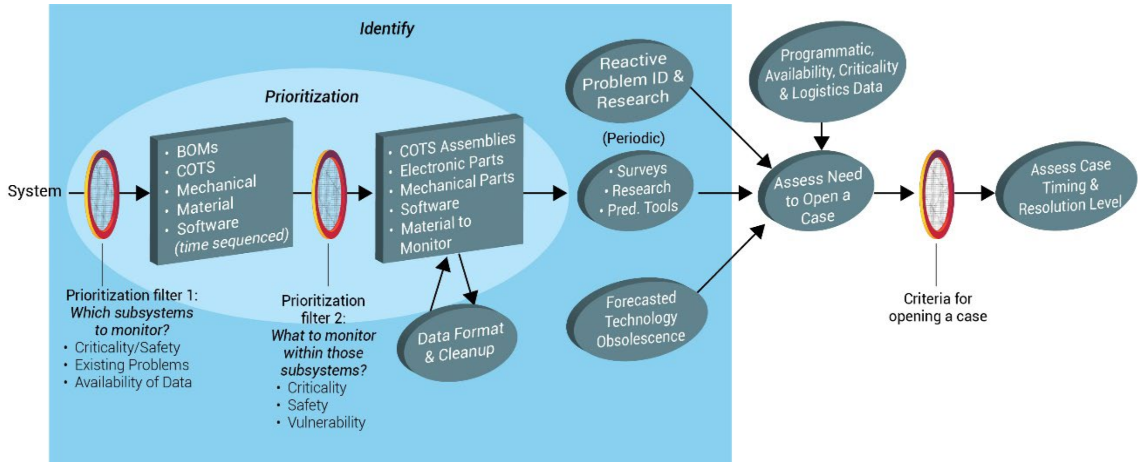
- Should a resolution to the problem be pursued? Or, should a case be opened?
- Which problem should be addressed first? Or, when should the resolution be started?
- At what level of assembly should a resolution be considered?

The DMSMS community does not answer these questions on its own. Data collection and research on the potential resolution level are carried out in conjunction with other DMT members. In particular, the assessment should be done in partnership with program office and prime/OEM logisticians because inventory data and demand data are essential elements for determining when an impact will occur. If the demand data are not based on field experience, then the program office and prime/OEM engineers must be involved to assess reliability. Determining the level at which the resolution should be considered involves several technical engineering considerations about resolution feasibility and complexity as well as DMSMS information about other items in the higher level assemblies.

Figure 17 summarizes the DMSMS management activities leading up to the *Assess* step. As the figure shows, an assessment may be initiated for the following reasons:

- The results of predictive tool analyses or vendor surveys indicate a problem.
- The program office receives a PDN.
- A change occurs in a health assessment because of an increase in demand for obsolete items in inventory.

Figure 17. Initiation of the Assessment Step



The remainder of this section describes the data and assessments needed to help provide answers to the above three questions. As a best practice, as much data as possible should be gathered to increase the rigor of the analysis. However, in many cases, some of the data may not be available. The DMT should do the best job possible with the data it has. When the DMT uses assumptions to compensate for missing data, the results of the analysis will be subject to greater uncertainty.

5.1 OBTAIN DATA NEEDED FOR THE ASSESSMENT

Programmatic, availability, criticality, and logistics data, along with the results of an item's availability analysis, support the DMSMS assessment process and, ultimately, resolution determination. The data should be refreshed regularly (as changes are made to the systems being monitored) to ensure that the most up-to-date data are used for DMSMS assessments and program office decision-making. In some cases, the data may be updated with the receipt of EOL notices for an item or set of system items or with the update of predictive tools or vendor surveys.

The data collection process differs slightly as a function of the acquisition phase. Early in the design phase, item data may be notional and based on a preferred parts list. Programmatic data may have less certainty early in a system's life cycle. Predicted reliability data should be used until better data can be derived from operational use. Actual logistics data will be available only during sustainment.

Logistics and programmatic data may be acquired from the program office, logistics databases, item managers, OEMs, and depots (contractor and organic). Of note, the services and DLA can obtain this type of information from their own logistics tools and databases. Those data enable the DMSMS management program to assess when an item with a DMSMS issue may no longer be available or supported, and which mitigation resolution is most feasible and cost effective.

5.1.1 Programmatic Data

Below are the different types of programmatic data needed for an assessment. It would be useful to have similar data on other systems using the obsolete item.

- Life-cycle phase. If the system is in the design or production phase, the overall life-cycle risk is significant, and emphasis on obsolescence issues at this point will have a significant impact on the total ownership cost of the system. However, an obsolescence issue discovered in the sustainment phase may not be as significant if the system is scheduled for disposal or if the replacement system is ready to be fielded. Industry tends to be interested in collaborating with DoD to solve an obsolescence issue during the design and production phases of acquisition; however, such collaboration can be difficult once the production line has gone cold.

- Planned technology insertions or refreshments for the subject item/assembly/software element and the next higher unit. This information is important for an obsolescence issue at any point in the life cycle, because it presents an opportunity to eliminate the requirement for the problem item. It is important to understand whether the planned technology insertion or refreshment is funded. If no resources are programmed, then technology insertion or refreshment is unlikely to occur. It is also important to understand that DMSMS management is not the main driver of technology insertion or refreshment. DMSMS management simply leverages this information to determine risk and, where appropriate, to recommend a resolution option. However, DMSMS issues can affect the technology refreshment's scope and schedule, both positively and negatively, after they are initially established (see Section 4.6).
- Planned end of system life. EOL data are used for inventory-related calculations. If the system is in design or production, the system EOL may not be known. Even during sustainment, the EOL may be uncertain, because of unplanned service life extensions, which in turn affect inventory requirements and may have potential DMSMS impacts. If the service life is extended, DMSMS situations with no operational impact before the extension may have a significant operational impact because of the extension. Nevertheless, the only approach is to base DMSMS assessments on official plans.
- Number of systems in use over time through the end of system life. This number is used for inventory-related calculations. If the system is in design or production, only near-term numbers may be available.
- Planned average operating hours per system. This number is used to help calculate demand for the item. If the system is in design or production, future average operating hours may not be available. In that case, it may be possible to make estimates based upon historical data for similar systems or on the planned operating tempo for the system.

5.1.2 Availability Data

Availability data are needed at the item, assembly, and unit levels. For software elements, the program office should track licenses, end-of-support dates, and frequency of updates. Availability should be identified at the lowest level possible, with an assessment of the impact at the next higher levels to better understand the risk and to help identify the most efficient cost resolution option. The DMT should differentiate between items that are currently unavailable and items forecasted to be obsolete in the near term (within two or three years). If authorized substitutes are available, there is no immediate obsolescence risk.

5.1.3 Criticality Data

Like availability data, criticality data are needed at the item, assembly, and unit levels. The first process in the *Identify* step (see Section 4) is to prioritize systems according to their mission criticality and safety-related features. Those same criticality factors apply in assessments. Furthermore, item (hardware and software) criticality is often determined by the criticality of its function. Examples of items with critical functions are microprocessors, microcontrollers, memory, ASICs, and field-programmable gate arrays. Finally, the cost of the item is a criticality factor.

5.1.4 Logistics Data

Systems managed and repaired organically may have access to logistics data, assuming the data are captured and archived. Each military service has a logistics management system and item managers who have access to and understand logistics data. The contractor will have the data for program offices that employ contractor logistics support (CLS); the government should arrange to have access to this information via contract requirements and deliverables. The following are examples of logistics data:

- Item cost. This represents what the program office should expect to pay for the purchase of the item.
- Demand for the items, assemblies, and units with DMSMS issues. This applies primarily to items in sustainment, unless the same items are used in the same way on other systems in the inventory.
- Reliability of the items, assemblies, and units with DMSMS issues. This should be the same as the demand data for items in sustainment. When in design or production, when no demand data have been collected, the manufacturer's stated reliability may be used, but it introduces more uncertainty into the assessment.
- Inventory for the items, assemblies, and units with DMSMS issues. Inventory may be found in the service depot (either contractor or organic), production facility, and DLA facilities. The portion of the inventories should be identified for the system in question versus that for other platforms. Data on inventory due in, backlogged orders, and the length of time on back-order are also relevant. If the system is in design or production, inventory is most likely available from contractors.
- Maintenance philosophy for the items, assemblies, and units with DMSMS issues. Some items may be repairable, while other items may be disposed of when they fail. The availability of or the development of a source of repair can reduce the risk that all these elements must be investigated.
- Repair history. This indicates how often the item is repaired based on the number of hours in service. Engaging with vendors on an increasing repair turn-around-time can help identify an impending DMSMS issue before it is fully realized.
- Survival rates. This represents the fraction of time repair is economically feasible.
- Wearout rates. This represents the fraction of time repair should not be made because the item would be expected to fail very quickly after being returned to service.

5.2 DETERMINE WHETHER A RESOLUTION SHOULD BE PURSUED

Just because a predictive tool indicates that a particular item is obsolete, or anticipated to be obsolete by a particular date, does not automatically translate into a DMSMS issue for which a program office should pursue a resolution. A program office will want to first validate the risk by examining when the item will no longer be available, the stocks on hand for the item, and the expected time to implement a resolution. The factoring in of the time to implement a resolution may be of particular importance when addressing a MaSME item. For example, there may be instances where an item, perhaps particularly a MaSME item, is not yet obsolete, but the time to realize a resolution would be very long. Depending on the exact facts of the situation, it may be worthwhile for the program office to either increase its on-hand inventory or take an action that would reduce the time to resolve the issue should it arise.

One way to answer this question is to identify when a resolution should *not* be pursued. Clearly, no resolution is needed if enough items are on hand to meet all future demands. However, because the level of "all future demands" is never certain, the level of risk should be considered, as illustrated in these situations:

- Situation 1. If the system is in sustainment and there have never been demands for the item facing a DMSMS issue, then there is usually a low risk for not pursuing a resolution although the consequences of a DMSMS issue should also be considered.
- Situation 2. If the system is in sustainment and calculations show that enough inventory of the item is on hand to last until the system is retired or until a technology refreshment replaces the

item, then the risk of not pursuing a resolution is low, but it should be evaluated further. For instance, an individual program office should also keep in mind that the item inventory available may not be held for only its own specific needs; therefore, inventory levels should be monitored periodically. Reliability data are an extremely useful input in the assessment of risk at any level in the configuration: the higher the reliability, the greater the availability of the item and, therefore, the lower the risk of an obsolescence impact. For example, if a circuit card assembly (CCA) seldom has to be replaced or repaired (highly reliable), obsolescence issues at the item level will not be as high risk as an obsolescence issue on a card that is continually being repaired or replaced. This information, if available, should be used in the overall assessment. If the EOL date for the item is uncertain and the item is in high demand, a best practice is to keep it on the list of problems to be addressed, but with low priority. Conversely, for items with a known EOL date and low-demand items, the risk of not pursuing a resolution is relatively low.

- Situation 3. The risk of not pursuing a resolution could be considered low if there are reclamation opportunities to recover a sufficient quantity of the item to satisfy the projected demand for that item.
- Situation 4. While a system is in the design or production phase, a constant supply of items is usually required. The rare exception is when there is a high degree of confidence that all items needed for production and sustainment have already been procured. The uncertainty of such an analysis would be enormous.

As illustrated through the situations above, when hardware—electronic and MaSME items become obsolete, there may be stockpiles that last for a while. A resolution may not be needed at all, depending on the days of supply on hand. Loss of a software license will usually have a more immediate impact. Assuming the software is mission or safety critical, a resolution should be pursued. Similarly, an information assurance issue with the software has an immediate impact as the software can no longer be used without a waiver.

Loss of software support is more complex. If obsolete software has never been changed and no errors have been uncovered or no changes are anticipated, then it also may be safe not to pursue a resolution for some period of time. The software may continue to operate correctly until the end of system life as long as the underlying layers can be sustained. Consequently, the cost of changing the software becomes a consideration. Requalification of systems after a software change can be more extensive than after a hardware change due in part to the complex nature of the required testing.

In the case of firmware changes, there is a question of whether there will be an effect if a new functional group is introduced into the system. A resolution should be pursued on the basis of the risk in making changes in the functional group application.

When an issue of environmental compliance is identified with regard to a material, the program office will need to evaluate how long the item in which that material is resident will remain available.

5.3 ASSESS RESOLUTION TIMING AND LEVEL

5.3.1 Conduct a Health Assessment

Health assessments provide insights that support the assess step. After the design becomes mature, health assessments should be conducted regularly throughout the remainder of system development, production, and sustainment.[138] They offer a program office a comprehensive accounting of its current and projected hardware and software obsolescence issues.

5.3.1.1 HARDWARE HEALTH ASSESSMENTS

In its most basic form, a health assessment breaks out individual items, documenting, by year, the starting quantity balance, predicted/actual usage, and ending quantity balance of that item over a certain timeframe, say ten years. This information enables a program office to make a preliminary estimate of when a component will no longer be available to satisfy a demand and therefore when to begin implementing a DMSMS resolution. Table 11 is a simplified example of the type of format that could be used for reporting the results of a health assessment. Program offices should tailor the content and format to best meet their specific needs.

Table 11. Basic Template for a Health Assessment Report

Item No.	Item Type	Sub-system	Status Characteristics	FYx	FYx +1	FYx +2	FYx +3	FYx +4	FYx +5	FYx +6	FYx +7	FYx +8	FYx +9
123	Micro-processor	1	Starting balance	4	3	2	0	−1	−2	−3	−5	−6	−7
			Predicted/actual usage	1	1	2	1	1	1	2	1	1	1
			Ending balance	3	2	0	−1	−2	−3	−5	−6	−7	−8
456	Amplifier	1	Starting balance	135	122	108	92	75	55	33	8	−18	−44
			Predicted/actual usage	13	14	16	17	20	22	25	26	26	26
			Ending balance	122	108	92	75	55	33	8	−18	−44	−70
789	Touch screen	2	Starting balance	16	15	14	13	11	10	9	8	7	5
			Predicted/actual usage	1	1	1	2	1	1	1	1	2	1
			Ending balance	15	14	13	11	10	9	8	7	5	4
211	Motherboard	2	Starting balance	12	10	7	4	2	−1	−4	−7	−9	−12
			Predicted/actual usage	2	3	3	2	3	3	3	2	3	3
			Ending balance	10	7	4	2	−1	−4	−7	−9	−12	−15
222	Graphics CCA	2	Starting balance	11	11	11	11	11	10	10	10	10	10
			Predicted/actual usage	0	0	0	0	1	0	0	0	0	0
			Ending balance	11	11	11	11	10	10	10	10	10	10
233	Ethernet interface	2	Starting balance	18	14	11	7	3	−1	−5	−9	−13	−17
			Predicted/actual usage	4	3	4	4	4	4	4	4	4	4
			Ending balance	14	11	7	3	−1	−5	−9	−13	−17	−21

[138] The DMSMS management community has not established standard terminology for the efforts described as health assessments. Other terms include obsolescence impact assessment, DMSMS impact assessment, tombstone charts, sustainability assessments, supportability analysis, and operational impact assessments.

Item No.	Item Type	Sub-system	Status Characteristics	FYx	FYx +1	FYx +2	FYx +3	FYx +4	FYx +5	FYx +6	FYx +7	FYx +8	FYx +9
244	Serial I/O CCA	2	Starting balance	2	−38	−83	−128	−173	−218	−263	−308	−353	−398
			Predicted/actual usage	40	45	45	45	45	45	45	45	45	45
			Ending balance	−38	−83	−128	−173	−218	−263	−308	−353	−398	−443
255	Notebook computer	2	Starting balance	11	10	9	7	6	5	4	2	1	0
			Predicted/actual usage	1	1	1	1	1	1	2	1	1	1
			Ending balance	10	9	7	6	5	4	2	1	0	−1

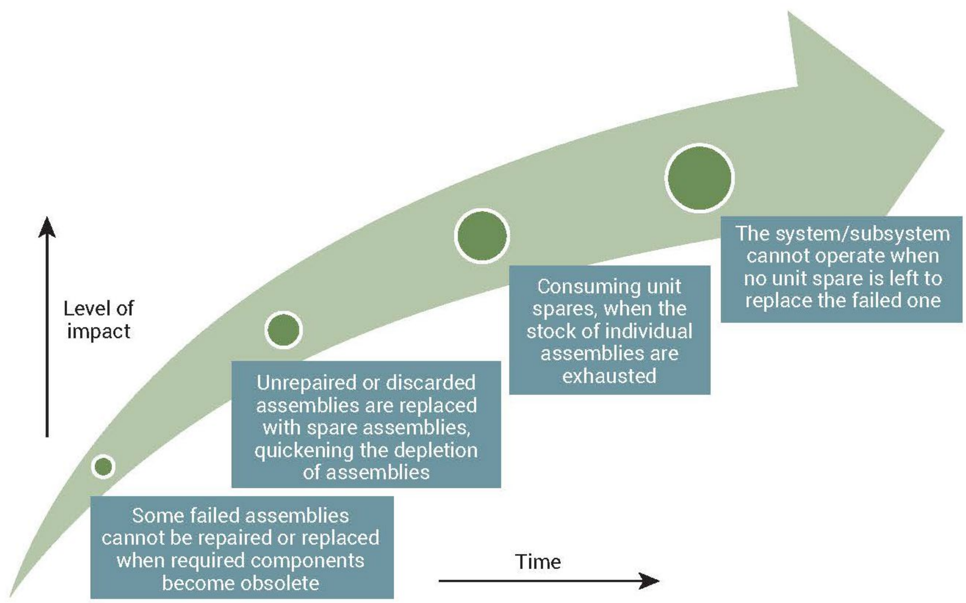
Legend:

(white)	Sufficient assets to support more than 5 years	(green)	Sufficient assets to support next 5 years
(yellow)	Zero quantity reached within 4 years	(red)	Zero quantity reached within 3 years
(gray)	Insufficient assets (0 or negative)		

Appendix K provides a comprehensive description of a health assessment. It is a best practice to have a contractual requirement for the prime contractors/OEMs/sustainment providers to perform the calculations described in the appendix, because DoD may not have visibility of contractor held stocks. For a mature system in sustainment that relies heavily on organic support, the DMT may be the most appropriate source for these calculations.

Employing the Appendix K methodology enables an improved estimate of when a DMSMS issue will affect the system rather than merely the component. This is accomplished by aligning the steps in the health assessment with the supportability impact levels displayed in Figure 18.

Figure 18. Supportability Progression after a Component Can No Longer Be Procured



The sustainment system is designed to keep weapon systems operating. Failed items at any level in a system's hierarchy are replaced by operational ones stocked in the supply system. The failed items are then either discarded or repaired. In the former case, new items are bought for the supply system; in the latter case repaired items are returned to the supply system for issuance when needed. When obsolescence occurs, fewer repairs are feasible and replacements cannot be obtained. Health assessments portray the progression of how failures at the component level affect the availability of assemblies, units, and ultimately systems/subsystems for components that can no longer be procured.[139]

A health assessment assumes that spares are stocked at all levels (i.e., component, assembly). If that is not the case, then a step in the progression disappears and the impact occurs sooner. When a component fails, it will cause the assembly that houses that component to fail. Under normal circumstances, the failed component is replaced and the assembly is ready to be reissued where needed.[140] The DoD supply system will order another component to replace the one used to fix the assembly.[141] If the component is obsolete, then it cannot be replaced in the supply system. Therefore, the next time that a component fails, the only way to maintain operations is to replace the entire assembly with a spare that is in inventory.[142] Once spare assemblies are depleted, spare units must be used to maintain operations. When the spare units are exhausted, the MICAP rate for the system/subsystem begins to decline.

Understanding the overall risk of an obsolescence issue depends on understanding when the issue will affect the system. This can be accomplished only through an understanding of the supply availability of the items within the system. An analysis of the logistics and programmatic data provides a snapshot in time of current inventory levels and usage rates to identify the timeframe available (sometimes referred to as days of supply) to identify and implement a resolution. The ability to develop a resolution—within the timeframe of availability levels and while a replacement item is available—is directly related to the risk of experiencing some negative impact as a result of a DMSMS issue.

To determine the potential for a future shortage of a particular item, the DMT must estimate the future demand for the item and determine whether the existing stocks (including items due in and items on back-order) will meet that demand. Mathematical methods, applied at the component or NHA level and accepted by the logistics community, are available for calculating future demand.[143] Estimating the future demand for items is risky, due primarily to two key assumptions that must be made: projected future operational hours and reliability. The relative risk varies from decision to decision, but it is real and should be expressed to higher level decision makers when proposing resolutions. The risk introduced by assumptions is always higher before a system is deployed, because no reliability data based on actual operations are available. If the subject item will be removed from the system by a planned technology insertion, then the period of requirement ends when the item is replaced. Once the demand is established for the period required, the DMT can simply subtract the demand from the available stock (including due-ins from prior orders and planned procurements of items that are not yet obsolete) to determine if and when the shortage will affect the system.

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[139] This hierarchical terminology is used to explain the different steps in the health assessment. The term “item” is not used because that term is employed throughout this document in the more general sense to apply at any place in the hierarchy.
[140] The use of wearout and survival rates discussed in Section 5.1 is a consideration in the health assessment process.
[141] While inventory models are somewhat more sophisticated than this, the same principle applies. Inventory models usually specify a reorder point and lot size (the number of component to procure) for every item.
[142] In theory, replacement assemblies could be procured, but this is unlikely when at least one component needed for its manufacture is not available.
[143] Many articles are related to this topic; see the material available at https://www.dau.edu/events/Lunch-and-Learn---Demand-Forecasting.

Applying the full Appendix K methodology also provides insight on the level of assembly where the resolution should be applied by including other obsolete and obsolescent[144] items and technology roadmaps and forecasting considerations within the highest level of assembly at which the resolution could be considered. This in turn could have an impact on priority and timing.

The health assessment results should be an input to the modification planning process because those results may have an impact on both the timing and scope of modification plans. For example, if there is a planned modification for an item in year X, but the health assessment indicates an earlier impact in year X-1, consideration should be given to changing the modification timing or implementing a short-term resolution such as a LON buy. Another example is a situation where the marginal cost of incorporating the resolution of an obsolete item into a modification is much smaller than the cost to resolve the issue independent of the modification (see Section 7.2).

5.3.1.2 SOFTWARE HEALTH ASSESSMENTS

There has not been sufficient experience with software health assessment to develop best practices on how to quantify the level of risk to a system due to software obsolescence. Therefore it is up to the program office to define the levels of risk that should be represented in a health assessment.

The concepts of a starting balance, usage, and an ending balance do not apply to software. However, in developing a software analog to the health assessment portrayed in Table 11, those concepts can be replaced by a measure of the risk that obsolescence will have a negative impact on the system. The rows of such a table could correspond to every tracked software item or a set of tables could be developed for tracked software items by subsystem.

Some possible software obsolescence situations are listed below. The health assessment could use all of the elements in this list to characterize risk by year for each software element. Alternatively, the situations described could be combined in a way that is useful to the program office to characterize the risk as low, moderate, and high or some other similar scale. Finally the health assessment could also be presented at a more aggregate level showing, by fiscal year, the number of tracked software items at the different levels of risk or in the different risk situations. Some common risk situations are as follows in order of increasing risk for the specified version of the software item:

- Most current version; supported with updates for security, new capability, and error correction; available for purchase.
- Not the most current version; supported with updates for security and error correction; not available for purchase.
- Not the most current version; supported with error correction only; not available for purchase.
- Not the most current version; supported with error correction only through the period of performance of an existing support agreement; not available for purchase.
- Not the most current version; no support; not available for purchase; no history of needing support for error correction.
- Not the most current version; no support; not available for purchase; with a history of needing support for error correction.

[144] About to become obsolete.

5.3.2 Which Problem Should Be Addressed First?

A step-by-step process can be used to prioritize problems on the basis of their impact on the system. Several ways exist to develop such a prioritized list. The example here is based on knowledge of piece-part electronics, CCAs, and the black boxes the circuit cards populate. A similar approach for assessing risk of mechanical assemblies, materials, and COTS assemblies can be derived from these steps. There is one situation, however, that may make prioritization of the problem unnecessary—an external organization will resolve the issue. This may be the case for a common item that is shared among many platforms. The DMT may become aware of such a situation through its interfaces with DMSMS management activities in other program offices. This may also be the case for subtier materials where a higher level organization is pursuing a DoD-wide resolution. In either situation, the DMT should evaluate whether that external resolution will meet both its schedule and technical requirements.

The steps below are based on assessing the impact of circuit card obsolescence issues given knowledge of the devices (piece parts) on the card. These steps include general statements, such as rank by “x” or adjust the rankings as a function of “y.” There is no set formula for these rankings and adjustments. They are based on the experience of the person making the assessment:

1. The first step considers both an analysis of piece-part availability and the results of the calculation of the timeframe until impact using the logistics data and the programmatic data. The order in which availability and logistics analyses are evaluated is determined by the risk assessor. Initially, the cards could be ranked by some combination of the total number of obsolete parts per card, the number of obsolete mission- or safety-critical parts per card, and the number and distribution of unique parts. The rankings could then be adjusted by the days of supply and the average monthly demand for both the parts and the card if the system is in sustainment. If the system is in design or production, reliability data, if available, could be used for the average monthly demand. Inventory levels would be the contractor’s stock level.
2. The second step is to adjust the rankings based on the near-term obsolescence risk for the parts and the card and on the number of sources or alternatives available for the parts on the card. These data could be generated using predictive tools.
3. A third step is to adjust the rankings based on the maintenance philosophy for the parts and the card. If the circuit card is repairable and the obsolete parts are highly reliable, then the risk of the part causing the card to be unavailable is not as great as if the card is a throw-away and no more cards can be produced, due to an obsolete part (even if it is reliable). For example, a repairable circuit card with critical obsolete items may not rank as high risk if the inventory levels of the circuit card are high and the usage rate is low, whereas a card not considered highly complex may be a greater risk based on low inventory levels and high demand rates. The bottom line is that no matter how simple the card, if a spare is not available, then the unit is out of commission. On the basis of this additional logistics information, the risk priority of the cards in a given unit may change. In design or production, this step might not affect the rankings very much, but the factors addressed are a consideration.
4. A final step is to examine programmatic data concerning product improvement plans or other mitigation efforts already underway. If a modernization plan calls for the replacement of the unit or if a refreshment of any of the circuit cards is planned, the risk priority may change yet again. For example, if a CCA is identified as high risk with low inventory levels, but a replacement unit is scheduled to be fielded, the risk may not be as great. The timeframe for fielding and the ability to

support the card through other means until that time may reduce the risk and therefore the priority of the card. These factors would probably not have much effect for a system in design or production.

If information is available about the electronic piece parts that populate a unit but no structure is available to understand the breakdown from the unit to the card level, then the previous four steps are completely analogous to Situation 1. Only the risk at the part level and this translation to the unit level can be evaluated. The number of obsolete items, the complexity of the function of any obsolete items, and the near-term obsolescence risks, along with logistics information at the unit level and the programmatic data, will identify the risk. For example, assume the list of parts contains 100 unique items. The availability analysis identifies no current obsolescence issues; however, several critical part functions are predicted to be obsolete in less than two years. The unit was just fielded, with production to continue for two more years and no near-term plan to replace it. In this situation, the near-term obsolescence elevates the risk of the unit, but the DMT has some time to plan the resolution options. Evaluating the availability of alternates for the high-risk items and working with the program office and the prime contractor to develop a path ahead will reduce the DMSMS risk of this unit.

The same four steps could be used for assessing a COTS or a mechanical assembly for which part data are unlikely to be available. However, the analysis would be much less granular. Instead of using predictive tools, the DMT would need to derive availability data from vendor surveys. For step 1, the availability data would simply be that the assembly is obsolete and the logistics data would be similar to the above. Step 2 would consider just the near-term obsolescence risk for the assembly, and steps 3 and 4 would be analogous to the above. For example, assume the supplier survey indicates that the box will be available for another year and that a replacement is planned for when the box is discontinued. However, this replacement is not backward compatible; therefore, some non-recurring engineering is required and, possibly, some testing to evaluate the use of the new unit in the system. From the logistics input, the DMT determines that the demand rate is low, with enough inventory to support the item for another 18 months as long as the demand rate does not increase. The risk may be assessed as low, given the availability of a replacement and the current inventory levels.

In another case, only one manufacturer supplies ball bearings for aviation platforms. The Industrial Capability Assessment (ICA) of the manufacturer indicates both financial and workforce well-being. However, the ICA also indicates that the manufacturer has limited capacity to surge and that all aviation platforms across the military services use this one source of ball bearings. If current inventory levels indicate a six-month supply at the current operating tempo, and if DoD plans to increase the operating tempo, the ball bearings could be a high-risk item for availability (material shortage) even though not obsolete. The supplier might have problems meeting delivery schedules if multiple systems also experience an increase in operating tempo. If an additional source for these bearings is being developed, but qualification of the new supplier is still two years out, this manufacturer and this item would be considered medium risk and monitored. Evaluation of the increase in flying hours, along with reliability of the bearings, can identify possible future shortages.

Even though software can function for a long period of time with no support and without any adverse impact if underlying layers are stable, the loss of a software license should be addressed immediately. The same holds true for software no longer meeting information assurance requirements or a firmware change that affects system operation. When determining the priority under a loss-of-support situation, consideration should be given to the number and frequency of updates, the number of different versions currently being used on the system, or the age of the versions in use.[145]

5.3.3 At What Level Should a Resolution Be Applied?

If a system will be affected by a DMSMS issue, the DMT should determine where in the item's hierarchy the resolution should be applied. For example, the subject item may be one of many items within its hierarchy that have DMSMS issues. In such cases, it may be expeditious to replace or redesign the assembly rather than resolve the problems with each individual item. The same factors should be considered in this analysis:

- Number and difficulty of DMSMS problems in the hierarchy,
- Reliability of items in the hierarchy,
- Expense of repair within the hierarchy compared with redesign or replacement,
- Life cycle of other items in the hierarchy, and
- Potential for enhancing mission capabilities by redesigning or replacing items.

Most of these factors can be analyzed by the DMT if sufficient data exist. The importance of integrating item availability data with logistics and life-cycle data cannot be overemphasized when analyzing the impact of a DMSMS issue. The first factor is largely a numbers game. If the cost to implement numerous DMSMS resolutions exceeds the cost to redesign the NHA, then the redesign should be considered.[146] The second and third factors are similar, in that one must compare the cost of continued operation of the existing item to that of implementing and maintaining a new item. This calculation is more involved, but in the end, it is a simple evaluation of which resolution provides the most bang for the buck.

The fourth factor requires a more subjective judgment, because item life cycles are not a strictly objective measure and because educated guesses are required to predict DMSMS problems. One must look at various sources of information and determine if the risk of future obsolescence and its accompanying costs exceed the benefits of resolving known problems now. This analysis is often the basis for planning technology refreshes and may result in a decision to resolve the DMSMS problem for a limited time (LON buy).

The last factor will require the input of other program offices, and potentially higher level, personnel. If future mission demands require new equipment or different capabilities, it may be expeditious to implement those features now rather than to wait.

For software, the assessment is more complicated. A hardware health assessment is relatively linear in that item obsolescence will have an effect on its NHAs. There often are non-linear, secondary and tertiary effects of software obsolescence. Consequently, software dependencies—those elements of the system potentially affected by changes to software—are usually more complex and far reaching than those of hardware. Understanding software (and hardware, for that matter) dependencies is crucial for determining

[145] Software can degrade through configuration incompatibilities. While all the individual software elements may be fine, over time, the combination of these elements can be incompatible and lead to system failure.

[146] A single item may be a constituent component in multiple higher-level assemblies. This may change the cost calculation, because multiple higher-level assemblies may need to be redesigned. The most cost-effective option could be a combination of resolutions at the item level and at higher levels of assembly.

the most cost-effective level of resolution.[147] Because of this, the answer to this question should be determined on a case-by-case basis.

[147] That is why identification of the interdependencies was included in the *Identify* phase of robust DMSMS management.

6. Analyze: DMSMS Resolution Determination

This chapter discusses the *Analyze* step; specifically, it explains how to find the best resolution option. The resolution determination process is iterative; the analysis is updated as new issues are identified and prioritized. Typically, new issues to be resolved are added at every DMT meeting. The following sections address identifying the cost elements associated with estimating implementation costs, identifying and defining resolution options, and determining the preferred resolution option. The resolution determination process is the same whether the DMSMS issue is related to hardware—electronic and MaSME items or software.

6.1 IDENTIFY RESOLUTION COST ELEMENTS

To determine the best resolution, a program office must first understand that resolution's total implementation cost. That cost is the sum of all applicable cost elements associated with that resolution. For example, a resolution may require anything from simple drawing and technical manual updates to full development and testing of new designs to be implemented in a system. If the actual costs for particular cost elements are known, those costs should be used to develop a more accurate account of the costs required to implement a resolution or series of resolutions. Actual costs give a program office the most accurate account of the funding required to mitigate obsolescence and is an important metric.[148] Although using actual costs for resolutions is preferred, actual costs may not be readily available, and obtaining actual costs may be cost-prohibitive. Therefore, each program office should develop average costs for each applicable cost element.

The following cost elements should be considered when determining the total cost for resolving a DMSMS issue:

- Non-recurring engineering. The cost of the design and development and the changes from the old to the new configuration.
- Engineering and engineering data revision. Cost of modifying drawings and other data to reflect the new configuration.
- Purchase of engineering, design, or technical data. Cost of purchasing technical data required for support.
- Qualification of new items. Testing and evaluation cost to choose a new item.
- Revision of test procedures. Cost of updating test procedures to accommodate any new testing requirements of the selected solution.
- Software changes. Cost of updating software because of the selected solution and including software updates to test equipment.
- Start-up costs. Non-recurring engineering costs to develop production or repair capabilities.
- Testing. Cost of testing requirements for the selected resolution to ensure system compatibility.

[148] Over time, this metric can be referenced for projecting budget requirements for implementing solutions (see Section 7).

- Tooling, equipment, test equipment, or software. Cost of repairing and maintaining equipment.
- Computer programs and documentation. Costs of new software and documentation to support the new item.
- Interim support. Contractor cost to maintain a product until a permanent resolution can be implemented.
- Spares. Cost to procure spares for sustainment.
- Supply and provisioning data. Cost to update logistics data to ensure support of selected resolution.
- Support and test equipment. Cost to provide the repair center with any required support or test equipment.
- Technical manuals. Cost to provide any manuals and documentation to repair centers.
- Training and trainers. Cost to develop and maintain training for the new equipment.
- Other. Any other costs as required.

The prevalence of counterfeit parts and the use of Pb-free solder in the electronics industry also affect the costs and risks to resolve a DMSMS issue. When a DMSMS resolution option involves purchasing an electronic item from sources other than authorized suppliers (i.e., OCM, OEM, authorized or franchised distributer, or authorized or approved after-market manufacturers), additional testing must be done to ensure that counterfeit parts do not enter DoD's supply chain. Therefore, the average testing cost must be included. See the following commercial standards and a DoDI for more information on counterfeit prevention.

- AS5553, "Counterfeit Electrical, Electronic, and Electromechanical (EEE) Parts; Avoidance, Detection, Mitigation, and Disposition;"
- AS6081, "Fraudulent/Counterfeit Electronic Parts: Avoidance, Detection, Mitigation, and Disposition—Distributors;"
- AS6171, "Test Methods Standard; General Requirements, Suspect/Counterfeit, Electrical, Electronic, and Electromechanical Parts;"
- AS6174, "Counterfeit Materiel; Assuring Acquisition of Authentic and Conforming Materiel;"
- AS6462, "AS5553C, Counterfeit Electrical, Electronic and Electromechanical (EEE) Parts; Avoidance, Detection, Mitigation, and Disposition Verification Criteria;"
- AS6496, "Fraudulent/Counterfeit Electronic Parts: Avoidance, Detection, Mitigation, and Disposition—Authorized/Franchised Distribution;" and
- DoDI 4140.67, "DoD Counterfeit Prevention Policy."

6.2 IDENTIFY AND DEFINE DMSMS RESOLUTION OPTIONS

Many different types of resolutions exist for resolving an obsolescence issue. These resolutions fall into three broad categories: existing material (logistics), substitutes (engineering), and redesign (engineering). These broad categories indicate the level and amount of research required to implement a resolution. As a program office progresses through the various resolution categories, the amount of research and number of cost elements required to implement a resolution increase. Resolutions under the existing material (logistics) category require actions to secure availability of existing supply. Substitute (engineering) resolutions require engineering involvement to qualify or implement. Redesign resolutions usually require all aspects of engineering and qualification to implement new or highly modified equipment. Table 12 contains the standard definitions and examples of each type of resolution, in order of complexity.

Table 12. DMSMS Resolution Options, Definitions, and Examples

Resolution	Definition	Examples
No solution required	No solution is required, because existing stock contained in government- or contractor-maintained inventories will satisfy future demands for the product or because the existing software may be used indefinitely without any anticipated repercussions. This is often the result of planned technology refreshment, redesign, or system retirement.	It is determined that sufficient stock of an item exists in current government- or contractor-maintained inventories to support the system until its next technology refreshment. It is determined that firmware embedded in obsolete hardware will remain functional until the hardware is replaced and existing hardware stocks are sufficient to meet system requirements through the end of service date. A UDR query identified a vendor that had new items with a government acceptance stamp on them that had previously been sold as excess.
Approved item	The obsolescence issue is resolved by the use of items already approved on the drawing and still in production.	Research indicates that the drawing includes a reference to another approved item that is still available. Supply is directed to procure the other approved item. The media used to store the software is no longer readable (e.g., floppy disks). The software is digitally ported to a compact disc.
LON buy[149]	A sufficient quantity of the item is purchased to sustain the product until its next technology refreshment or the discontinuance of the host assembly. The quantity purchased should consider demands from all users. Because this resolution uses an approved item, no testing or drawing changes are required. The source of supply can be residual stock from the original manufacturer, shelf stock from distributers, sponsor-owned material, and so forth. Costs for packaging, storage, and transportation should be considered in the BCA for selecting resolutions. This is sometimes referred to as a life-of-type buy, bridge buy, or lifetime buy. For software, sufficient licensing and/or support is obtained for the LON, assuming the LON is short enough to ensure that the vendor will remain in business.	On the basis of historical usage rates, it is determined that 165 diodes are required to sustain the system until it is decommissioned. Sufficient inventory of the discontinued item is then purchased from an approved distributor and stored for use as needed. An LON buy can also be made during design or production. Production material and associated spares can be procured when an obsolescence issue occurs early in the life cycle. A license downgrade is negotiated with the software vendor, which enables the users to expand or extend authorized use of an older product by purchasing additional licenses of the latest version and applying those licenses to the older product until it is retired. A particular adhesive used in production of circuit cards went obsolete. A sufficient quantity of adhesive was purchased to meet demand until a new adhesive could be qualified.

[149] When planning a LON buy, a consideration is that the LON quantity may be hard to predict if there are no funded modification plans. When an OEM makes a LON buy, the program office should understand how DLA inventory was or was not considered.

Resolution	Definition	Examples
Repair, refurbishment, or reclamation	The obsolescence issue is resolved by doing one of the following: Instituting a repair or refurbishment program for the existing item or assembly, whether through a depot repair, a repair contract with the original manufacturer, or support from a third party. Instituting a reclamation program to reclaim items from marginal, out-of-service, or surplus materiel. Costs for restoring reclaimed materiel as a result of electrostatic discharge (ESD) damage, handling damage, and heat damage from unsoldering should be considered.[150] Obtaining access to the software source code, development tools, and the human resource skills necessary to change it to ensure continued support.	A program office has sufficient items or assemblies to support the system, if they are refurbished. A private company is identified that has this capability, and a contract is awarded to repair these assets for the system's remaining service life. Hybrids are salvaged from an earlier configuration of the NHA, repaired, and used for future repairs on higher assemblies. Because of scrap steel shortage, it was difficult to maintain a source for high explosive munitions bodies. A process was developed to decontaminate and mill surplus munitions projectiles. The original vendor allows the customer to purchase the source code and the development tools to maintain it and will provide software engineering support for a fee.
Extension of production or support	The supplier is incentivized to continue providing the obsolete items. This may involve long-term agreements to procure specific quantities of items. One-time costs may be associated with setting up this resolution. Those costs should be included in any cost and cost avoidance by being proactive calculations. For software, long-term licensing and/or support agreements are obtained.	The DMT works with the manufacturer to resolve any obsolescence problems with a COTS assembly's piece-parts or raw materials, so the original COTS assembly can still be manufactured. The government obtains the COTS assembly BOM from the OEM, resolves piece-part obsolescence, and then provides the needed parts to the OEM as government-furnished material to facilitate continued manufacture and repair. The DMT works with the manufacturer or software vendor to extend the warranty or support period, thus extending the useful life of the product. A third party is contracted to continue support on a software application. A vendor creates a custom item number that freezes hardware and firmware at a specific version/revision level to ensure that future supply meets the original requirements.

[150] The salvage or reclamation process for used authentic items may impact the item's internal integrity. Many plastic-encapsulated electronic items absorb moisture over time. If excess heat is applied before the moisture can be baked out, the items are easily damaged by the expanding gas as it exits the device. The damage takes the form of microcracks and internal voids that, if they do not cause immediate failure, can allow contaminants to seep in (e.g., during a cleaning process that exposes the item to unfiltered water) and dramatically reduce the item's life. Of lesser risk, but still important, is the potential for component microcracks caused by mechanical flexure stress imparted onto the soldered items when the populated printed circuit board is bent, twisted, or flexed during the salvage operation. As with thermally induced micro-cracks, the component's life may be reduced. The storage and shipping of salvaged or reclaimed items may also introduce risk into the reliability of the item. One such risk pertains to the fact that the items have been previously used. If the item has a set life, it may be unknown how much of that life was consumed by its original application. This could result in an item needing to be replaced within a shorter period of time than anticipated. Handling of the items in a non-electrostatic discharge safe environment raises the distinct possibility of electrical damage to the item. This type of damage is often latent, reducing the reliability of the device.

Resolution	Definition	Examples
Simple substitute	The item is replaced with an existing item that meets all requirements without modification to either the item or its NHA and requires only minimal qualification. Typically, this implies use of a commercial item or NDI that is an F3 substitute. Associated costs are largely administrative. This is sometimes referred to as an alternate.	The original item number from a company is purchased from a source not identified in control drawings; in other words, the item was purchased from a different vendor. The original oil specified in the drawings is no longer available. Another company makes oil with similar characteristics and was approved as a substitute with minimal evaluation. The TDP of an intrinsically suitable, but different, item (e.g., a more reliable version or an existing item) is evaluated. A rebadged COTS product is discontinued by its vendor, but the source item is still available from its OEM under a different part number. The deployed version of an operating system is no longer supported. The support version is installed as an upgrade and meets all the current requirements. A previously emulated device (e.g., from DLA's GEM program[151]) is substituted for the original item. Currently, software is rehosted to operate correctly with new application hardware or software.
Complex substitute	A replacement item that has different specifications but requires no modification of the source product or the NHA, is researched and validated. The substitute may be the result of a redefined military requirement.	An optical coupler approved in the source control drawing is no longer made. An engineering search finds four couplers with similar characteristics. After qualification, two are approved for the application. The suggested sources table in the source control drawing is changed to authorize the new items. The current operating system is obsolete. The replacement operating system does not meet all the specifications of the current version and must be thoroughly tested. A military requirement was restated or revised to allow for the use of a substitute item from a commercial source. Another software product is used to replace the obsolete software. A magnetic tape with an obsolete fire-resistant coating was replaced with a tape with a similar fire-resistant coating that had to be fully tested and qualified before use.
Development of a new source	A new manufacturing or production source for the item is established using technical data without affecting the NHA. If the government has not already obtained access to the technical data, the necessary technical data must be purchased or obtained by the government and provided to the new source. First-article testing is required along with any necessary testing to ensure that the new item functionally meets all requirements when installed in the system.	A virtual machine environment card is discontinued by its original manufacturer. Another manufacturer is contracted to purchase drawing packages, manufacturing equipment, and production rights to continue production of the card. A manufacturer is approached to purchase specifications and production rights to resume production of a mechanical item (e.g., a diesel engine) discontinued by the original manufacturer.

[151] GEM technology provides F3 emulation at the digital component level (e.g., logic devices, application specific-integrated circuits, field programmable gate arrays, static memory devices, hybrids, microprocessors, and microcontrollers). http://www.gemes.com.

Resolution	Definition	Examples
Design refreshment	The original item is replaced with a new item developed using existing technical data and without affecting the NHA. The government already possesses the bulk of the technical data for the unrefreshed item or the data is generally available at no cost or can be purchased. First-article testing is required along with any necessary testing to ensure that the new item functionally meets all requirements when installed in the system. The manufacturing source for the new item may be the original manufacturer or a new source.	A special fabrication project in an organic facility is initiated to develop and produce an item. The firmware for a circuit card is no longer available and must be rewritten using different tools. The function of an obsolete application-specific integrated circuit (using original design data) is retargeted into a field-programmable gate array. Board re-layout is required to accommodate the new solution and accompanying support components. A lower-voltage static random-access memory (SRAM) is found to replace an obsolete SRAM. An interposer and voltage regulator are added to maintain the initial design without requalification.
Redesign–NHA	The affected item's NHA must be modified. Only the NHA is affected, and the new design will not affect anything at a higher level in the system.	An obsolete component for which a viable F3 replacement cannot be found requires a redesign of the circuit card on which the component is found. The operating system of a single board computer is obsolete and no longer supported by the manufacturer. Policy dictates that it can no longer be used on DoD systems. The new version of the software will not run on the existing hardware. A replacement board that runs the new version of the operating system is available and will not require changes to other equipment. Some of the associated software must be modified to accommodate the new operating system. A refrigeration system that used a banned Freon refrigerant had to be redesigned to use an approved refrigerant.
Redevelop the item	The original item is replaced with a new item developed without the benefit of existing technical data and without affecting the NHA. The new item may be developed by emulating, reverse engineering, designing a replacement based on the original manufacturing designs and processes, or designing a different item based on the original or new requirements. The manufacturing source for the new item may be the original manufacturer or a new source.	DLA's GEM program creates a device that emulates the original device or a new way to additively manufacture the item is developed. The software application is redeveloped because of an obsolete compiler or obsolete modeling tools. A newer technology replacement is designed for an existing obsolete circuit card assembly board.
Redesign–complex/ system replacement	A major assembly redesign affects assemblies beyond the obsolete item's NHA and may require that higher level assemblies, software, and interfaces be changed.	Aircraft radar was replaced to use a different operating frequency. Many obsolescence issues were eliminated in the new design. The operating system of a server must be replaced due to policy changes. The new operating system will require hardware changes to multiple hardware and software configurations. A vehicle's diesel engine became obsolete, requiring the replacement of the entire drive train for the vehicle, because the old transmission was not compatible with the new engine.

Table 13 identifies the cost elements that apply to each resolution. "X" indicates a cost element that is likely to be part of the listed resolution and may need to be considered when evaluating costs. There may be some differences in the applicability of the DMSMS cost elements to the resolution options when software is an issue. Because the cost element terminology is very broad, the differences are small. However, no data exist to support whether an average cost estimate for a software resolution will be the same or different than the cost of a hardware resolution.

Table 13. Cost Elements as Applied to DMSMS Resolution Options

Cost Element	Existing Material (Logistics)				Substitute (Engineering)			Redesign (Engineering)			
	Approved Item	LON Buy	Repair, Refurbishment, Reclamation	Extension of Production or Support	Simple Substitute	Complex Substitute	Development of a New Source	Design Refreshment	Redevelop the Item	Redesign–NHA	Redesign–Complex/ System Replacemen
Non-recurring engineering			X			X	X	X	X	X	X
Engineering, engineering data revision					X	X	X	X	X	X	X
Purchase of engineering, design, or technical data			X			X	X	X	X	X	X
Qualification of new items					X	X	X	X	X	X	X
Revision of test procedures			X			X	X	X	X	X	X
Software changes						X	X	X	X	X	X
Start-up costs (after-market, and so forth)			X	X			X	X	X	X	X
Testing			X		X	X	X	X	X	X	X
Tooling, equipment, test equipment, or software			X			X	X	X	X	X	X
Computer programs/documentation			X		X	X	X	X	X	X	X
Interim support								X	X	X	X
Supply/provisioning data					X	X		X	X	X	X
Support/test equipment			X			X	X	X	X	X	X
Technical manuals			X		X	X		X	X	X	X
Training/trainers			X			X		X	X	X	X
Spares (optional)			X				X	X	X	X	X
Other (as required)	X	X[152]	X[153]	X	X	X	X	X	X	X	X

6.3 DETERMINE THE PREFERRED DMSMS RESOLUTION

6.3.1 Overall Process

The resolution determination process uses various outputs from monitoring and surveillance and health assessments that determine if and when an issue will affect the operational availability of the system. Figure 19 illustrates the major activities and tasks of the resolution determination process. One important, initial activity in this process is to determine whether there is an external organization that is pursuing a resolution to a DMSMS issue in a manner that meets the program office's schedule and technical requirements. As long as the external resolution process meets all the system's requirements, then the program office only needs to monitor that the resolution process is on track. Otherwise, the program office should continue with the other major activities of the resolution process.

The resolution process should also consider the requirements to transition from one system life-cycle phase or contract to another. For example, resolutions in the design phase may include short-term actions until a longer-term option can be implemented in the production phase. This complicates the

[152] Optionally includes the one-time cost of the items themselves since it is a programming and budgeting consideration.
[153] Optionally includes the cost of the item's repair, refurbishment, or reclamation itself.

process because the analysis may need to be conducted over multiple time increments (e.g., between now and the end of production and between the end of production and a planned technology insertion).

If the health assessment indicates that a resolution is needed, one or more of the resolutions listed in Table 12 can be applied regardless of whether the DMSMS problem is mechanical, material, software, or electronic in nature.[154] While all these resolution types apply to different item types, the frequency of use of a particular DMSMS resolution may differ depending on commodity type. Table 14 illustrates the distribution of resolution types by part commodity—electrical, electronics, and mechanical—the table summarizes data collected through a 2014 Department of Commerce DMSMS Cost Survey.[155] Although implementation[156] may vary drastically for different types of issues, the overall resolution determination process is the same. Not all resolutions can be applied to a given DMSMS problem. Only those that can be applied are considered viable.[157] For instance, most of the resolution options are not viable for a forged impeller body that has become obsolete; the only viable resolutions may be the identification of a new source or redesign. However, the process to determine the viable resolutions (often the most cost effective) is the same, whether the problem is a CCA or a specific chemical used in the manufacturing process that has become obsolete because of environmental restrictions.

Table 14. Distribution of DMSMS Resolutions by Part Commodity

DMSMS Resolution	Electrical	Electronics	Mechanical	Total
Approved items	987	316	236	1,539
LON buy	27	633	6	666
Simple substitute	190	1,233	77	1,500
Complex substitute	34	331	45	410
Extension of production or support	27	68	3	98
Repair, refurbishment, or reclamation	1	38	1	40
Development of a new source, design refreshment, and redevelop the item[158]	14	103	10	127
Redesign—NHA	2	132	4	138
Redesign—complex/system replacement	12	31	1	44
Total	1,294	2,885	383	4,562
Percentage of share	28.4%	63.2%	8.4%	100%

Source: DSPO, *Diminishing Manufacturing Sources and Material Shortages: Cost Metrics* (Fort Belvoir, VA: DSPO, February 2015), p. 12.

[154] The National Defense Stockpile should be a consideration for a DMSMS issue relating to raw materials. The raw materials may already be stockpiled, or they may be added to the stockpile in the future. For more information, see the Strategic and Critical Materials Stockpiling Act (50 U.S.C. § 98 et seq.) and *Strategic and Critical Materials 2015 Report on Stockpile Requirements*, issued by the Under Secretary of Defense for Acquisition, Technology and Logistics, January 2015.

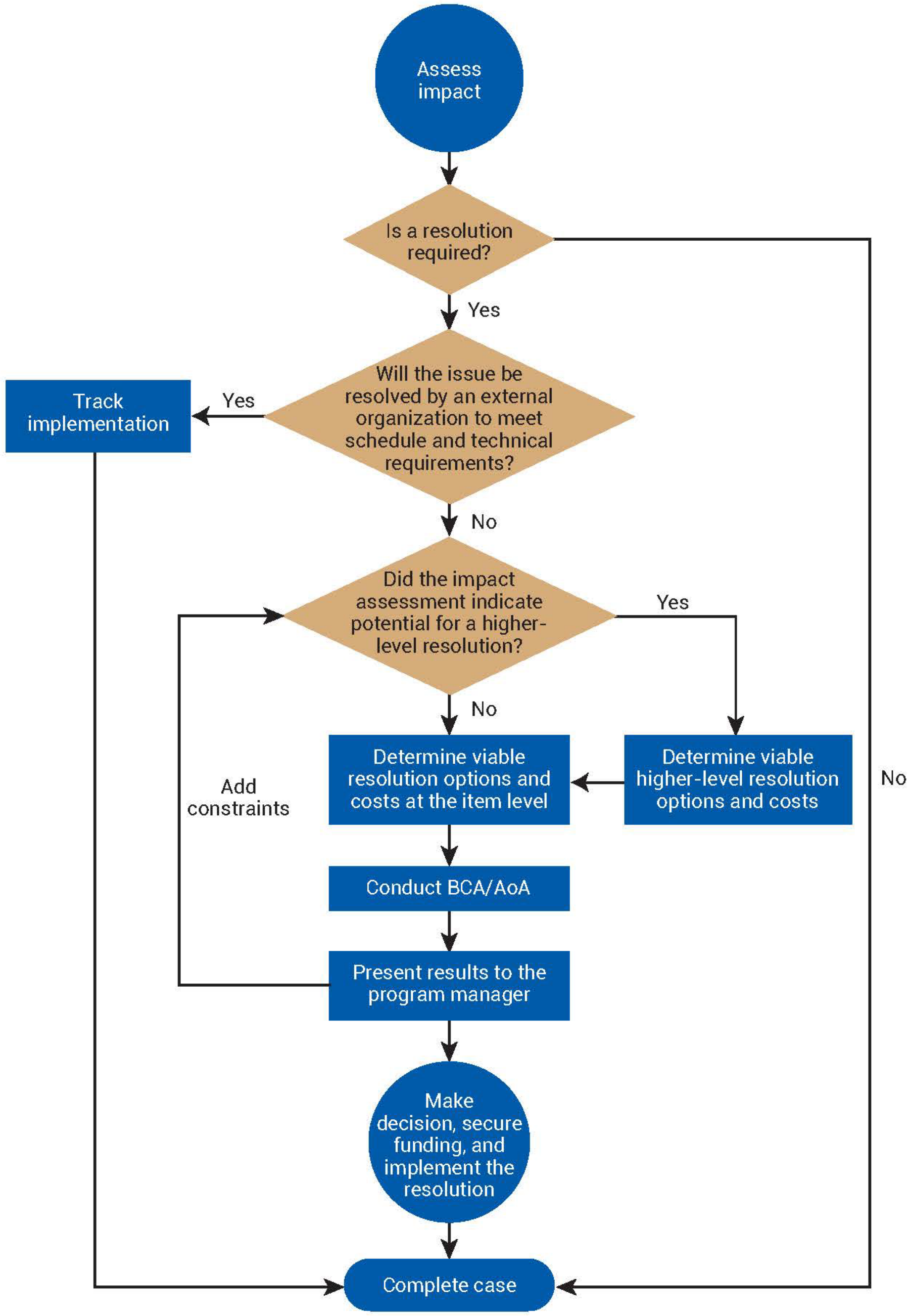
[155] Appendix L contains more detailed survey data.

[156] Technology and product roadmaps can provide information that influences options for implementing different resolutions.

[157] All requirements (performance, safety, security, and so forth) must be met for a resolution to be viable. A viable resolution must also address all second-order derivative effects.

[158] The Department of Commerce survey asked for data in a single resolution type: development of a new item or source.

Figure 19. DMSMS Resolution Determination Process



As resolutions become more complex, their implementation becomes more costly.[159] The list of viable resolutions is built by going through Table 12 from top to bottom and determining the feasibility of each

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[159] An LON buy may appear to be the least costly and simplest option to implement. However, before this resolution may be used, a number of obstacles must be addressed. Limitations may be imposed on the size of a LON buy (see Section 7.3). Also, contractors cannot typically be obligated to procure stock beyond the life of their contract, so the government would need to procure and maintain a stock of the needed item. Also, because reliability and end of system life are estimates, accurately determining the quantity of an item to buy is nearly impossible. These obstacles may result in the determination that a LON buy is not an option unless it would be used as an interim resolution until another alternative is implemented.

option. Many of the factors (e.g., near-term cost, total life-cycle cost, level in the system, mission factors, planned technology refreshes or upgrades, results of health assessments, and terms and conditions of contract) used to analyze the operational impact should be used to help determine which resolutions are viable. The overall resolution determination process should consider all viable resolutions at the lowest level of indenture possible and, if the health assessment indicates that a resolution at a higher level of assembly may be preferable, at higher level assemblies. In some cases, a resolution at a higher level will have a higher ROI, because it may resolve numerous issues at once or improve reliability significantly.

6.3.2 Role of Design Considerations

Design considerations also impact the feasibility of resolutions. For example:

- Real-time software. Many times, defense products use software that performs a real-time function. Often this is software for signal processing or signal analysis that has a specific time available to accomplish a specific task. This means that the failure to complete the signal processing in the available time means that information is lost, or worse, the system will crash. DMSMS issues can often have a profound impact on the portability of real-time software. Even when the real-time properties of various software modules are well documented, and latencies of interrupted service requirements are documented, the need to use a new and different processor or components with different memory speed due to obsolescence of an earlier or different processor component can result in considerable impact to real-time performance. Furthermore, real-time performance validation can be extremely difficult, particularly when real-time failures only occur under rare combinations of interrupt conditions. Whether a new processor performs slower or faster, the interaction with external interfaces is certain to be different, and it is occasionally difficult for drivers to fully compensate for speed changes. It is essential that the design, development, and maintenance of software systems that have real-time components maintain very accurate analysis and models of system timing so that as processors and technology evolve, the real-time performance can be easily validated, and software can be ported. There are also important implications with respect to maintaining an understanding of execution time statistics of each software module, and the corresponding understanding of selected compiler optimizations and coding style, to maintain real-time performance when DMSMS issues cause design updates.
- Validation and production testing. Product testing advances today include many sophisticated capabilities to assess analog and digital subsystem performance. When a DMSMS issue occurs, the resolution may impact the means for testing. Today's digital subsystems are tested with Joint Test Action Group and other interface validation. If a design or redesign causes interface changes, or timing changes, there are likely to be impacts to both validation tests and production line tests. It is essential to assure that testability of validation and production line tests remain resilient to these changes. This is especially important so that counterfeit components and marginal designs are quickly detected, identified, and corrected as part of a DMSMS redesign. To assure this, the testing process must retain documentation of traceability between what functions are being tested and how the tests relate to requirements, so that system behavior changes after a DMSMS redesign can be properly understood and validated. When the test equipment itself is affected by a DMSMS issue, validation considerations go beyond testing the function of the equipment. To deal with the potential for malware being introduced into the test equipment, validation should ensure that the equipment is performing all the tests in the way that they should be performed. This is beyond the scope of typical validation testing.

6.3.3 The Role of Roadmaps

6.3.3.1 DIRECT EFFECT ON FORMULATING RESOLUTIONS

Product roadmaps offer information on the following:

- How long an item will be in the system (i.e., the length of need) and
- When planned modifications to the system will be made and the extent of those changes.

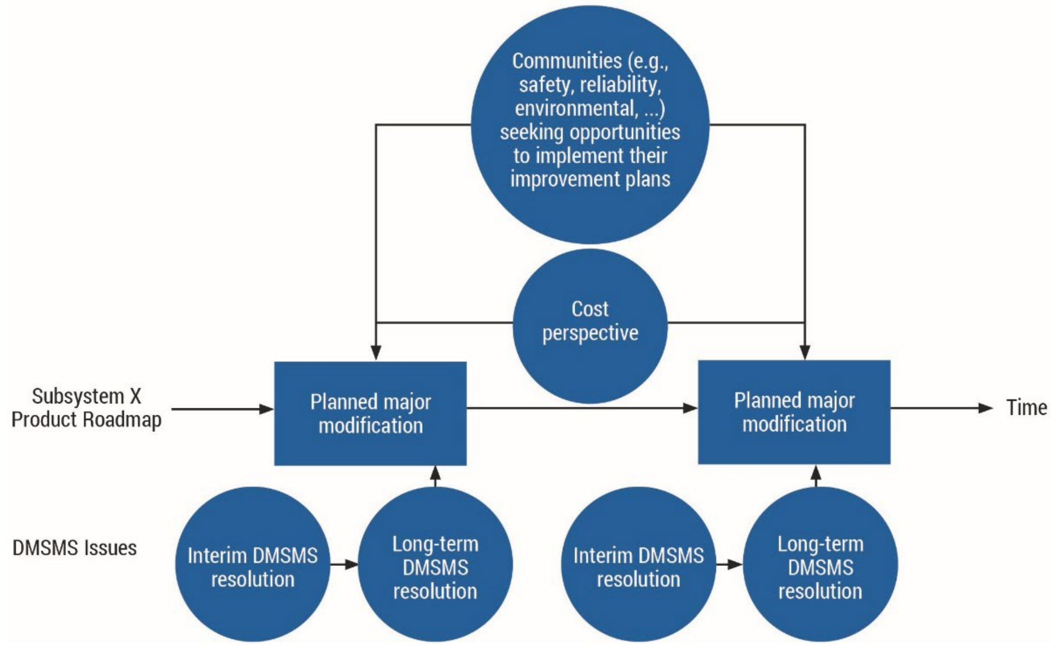
While some of this information is in product improvement and product supportability roadmaps, all the information should be integrated in the overall product roadmap and the IMS. If this is the case, the DMSMS community does not need to use product improvement or product supportability roadmaps; the product roadmap suffice.

The DMSMS community uses product roadmaps for the following purposes:

- Sizing LON buys. In some situations, the selected resolution is a LON buy. To calculate the quantity to purchase, information is required on how long the item must be supported. If the item will be removed from the system because of a planned future modification, then the LON would decrease to the point at which the modification is completed (or nearly completed). If the purchase were sized without the product roadmap, too many would be procured and money would be wasted. (See Section 7.3 for more information on sizing LON buys.)
- Evaluating competing resolutions. Product roadmaps assist evaluating competing resolutions. For example, if a LON buy and a substitute part were both viable, the product roadmap could be instrumental in making a final decision.
- Planning a multi-phase resolution that delays or postpones a redesign. This planning represents a situation where the DMSMS issue is associated with an item that is or could be affected by the planned modification in the product roadmap (e.g., the resolution chosen without knowledge of the product roadmap might be a redesign of the item). If such an item were changed or eliminated by the modification, then performing a redesign earlier may be avoidable. A substitute (or a LON buy or reclamation) may be feasible and sufficient to offer an interim resolution before the modification occurs. Even if the item were not affected in the planned modification, waiting until the modification to begin the redesign can reduce costs by performing the redesign in conjunction with the other work. Furthermore, when the modification and redesign are combined, a redesign at a different level of assembly may be more cost effective. The same set of interim resolutions may apply (see Section 6.3.4 for more information on formulating a cost-effective resolution).

Figure 20 illustrates how short- and long-term DMSMS resolutions can be the most cost-effective approach to supportability because they enable synchronization with planned roadmap events by knowing what the events encompass, their timing, and their magnitude. Figure 20 shows how this synchronization concept applies to other program office support functions, such as reliability, safety, and environmental concerns. Strategically, those functions attempt to meld their perspectives into the larger product improvement standpoint. Cost influences the ability to include all desired changes.

Figure 20. Interactions with Supportability and Product Improvement



The DMSMS community uses product roadmaps to evaluate the type, scope, and timing of resolutions. Therefore, these roadmaps affect the programming and budgeting of the resources necessary to implement resolutions—not only the amount of resources but also the responsibility for securing them. If the DMSMS resolution is implemented by itself, then the DMSMS community is responsible. However, in situations where the DMSMS resolution is implemented in conjunction with a larger change to the product, then the IPT responsible for the modifications may be responsible for programming and budgeting for the modification and the DMSMS resolution.[160] Just as DMSMS may affect programming and budgeting by the responsible IPT (see Section 7.2 for more information on integrating DMSMS resolution and modification funding), it may affect the scope and timing of the change as described in the next section.

6.3.3.2 INTERFACES WITH MODIFICATION PLANNING IN FORMULATING RESOLUTIONS

Modification plans to improve supportability (including the resolution of DMSMS issues) are often characterized as technology refreshment needs. Technology refreshment is described as "the periodic replacement of COTS items … to assure continued supportability of that system through an indefinite service life. Technology refreshments can be strategically applied to prevent the occurrence of DMSMS issues preemptively or to minimize them significantly."[161] In DoD, the limitation to apply technology refreshment only to COTS items is not applicable. It can apply to custom electronics as well.

Modification planning includes technology insertion to improve capability. Figure 21 illustrates the interactions between modification planning, roadmapping, and DMSMS management activities. It includes material from 6.3.3.3. The tan portions are associated with modification planning processes while the blue portions pertain to DMSMS management-related activities. The yellow portion represents general processes taking both into account.

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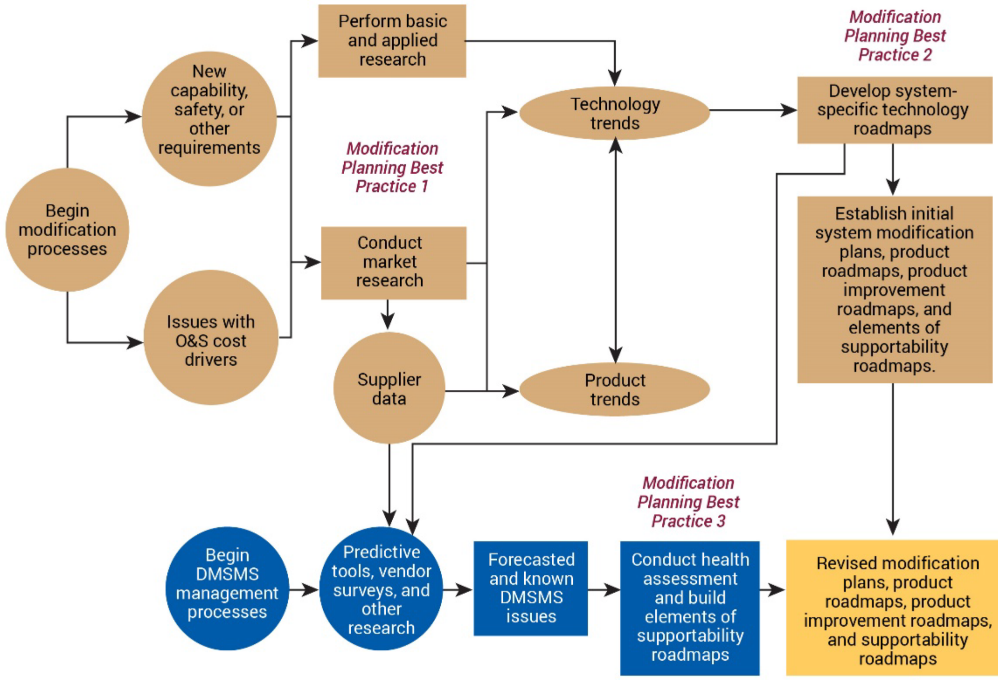
[160] It is unusual for two organizations be responsible for obtaining the funding for a single body of work.
[161] Pete Pizzutillo, "Technology Refreshment—A Management/Acquisition Perspective," July 2001.

Figure 21. Interactions among DMSMS Management, Roadmapping, and Modification Planning



The left side of the figure (where the reader should start) deals with technology management and O&S cost drivers. The upper right side depicts the formulation of technology roadmaps and modification plans. The bottom shows interactions with DMSMS management that refine modification plans. The following bullets discuss various elements of this figure through a set of enabling best practices (shown on the figure) for DMSMS management and modification planning. The first two of these enabling best practices indicate ways a program office's DMSMS management community should leverage its modification planning. The third best practice, which includes significantly more explanatory material, discusses how DMSMS management may influence modification planning.

- Modification Planning Best Practice 1. Utilize market research to minimize near-term DMSMS issues. Market research identifies areas where new technologies and products will be introduced. Modification planning should strongly consider incorporating these new technologies and products in the system. Doing so enables an AS and a life-cycle sustainment strategy that minimizes the cost of resolving future obsolescence issues while incorporating state-of-the-art technologies to increase reliability, lower sustainment requirement costs, and increase warfighting capability to meet evolving requirements throughout an indefinite service life.
- Modification Planning Best Practice 2. Utilize technology roadmaps to guide modification planning. Technology roadmaps (often developed external to the program office) and system modification are closely linked. Technology roadmaps show when technologies are mature enough for application on a system, implying the potential for future DMSMS issues and the approximate timing for technology insertion or refreshment. Thorough technology roadmaps, therefore, should form an initial basis for modification plans to avoid some obsolescence issues before they materialize and resolve other issues while achieving other product improvement and supportability benefits.
- Modification Planning Best Practice 3. Use DMSMS health assessments to refine modification plans. Health assessments are discussed in Section 5.3.1 and Appendix K. DMSMS health assessments should be made for LRUs, boxes, COTS, or other levels of assembly that contain items vulnerable to obsolescence. The health assessments portray when individual items are

expected to become obsolete and when that obsolescence may affect the assembly based on analysis of PDNs, OEM surveys, the results generated by predictive tool algorithms, knowledge of typical commercial technology life cycles, and technology and product roadmaps. Given this forecast of when and what in the system will be affected by obsolescence, the DMT can recommend DMSMS resolutions to eliminate the problem or defer impact. The modifications (developed jointly by the PSM and the DMSMS community) necessary to prevent the ill effects forecasted in these heath assessments are ultimately translated into the supportability roadmaps once funded and scheduled.

Figure 22 represents the notional results of a health assessment of a subsystem with five primary parts. The red, yellow, and green coloring scheme in the figure connotes the size of the inventory of the parts in the supply system. Green implies adequate, yellow notes a concern, and red means unfulfilled demands. The line in Figure 22 denotes the optimal time for a technology refresh because all the parts inventories are adequate or of concern and some are soon to be unfilled. As a function of risk, the optimal time could be earlier because the effect of the shortfalls would not be acceptable or later if the effect of the shortfalls would be minimal.

Figure 22. Notional Results of a Health Assessment

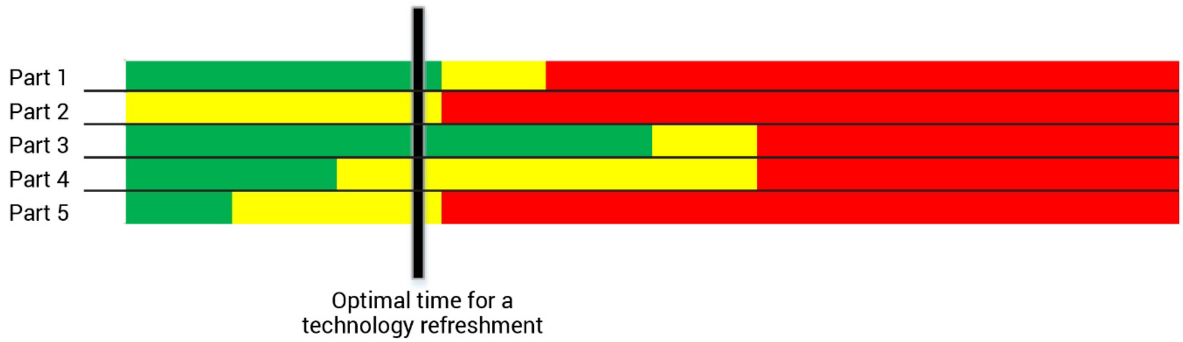


Figure 34 in Appendix J and Figure 22 are linked.[162] Assume that configuration 5 in Figure 34 is a technology refreshment. In theory, the optimal time would coincide with the start of the configuration 5 oval. But, in practice, this may not necessarily be the case. The DMSMS management community is not responsible for managing the content and schedule for a program office's technology refreshments. The DMT may recommend interim DMSMS resolutions to delay the technology refreshment initiation for a limited time. The optimal technology refreshment date is that point when the sum of the cost of individual resolutions is greater than the cost to redesign.

From a general availability and cost perspective, combining technology refreshment with technology insertion is often convenient. The DMSMS community can suggest changing the schedule for planned technology insertion if supportability to the planned insertion start date cannot be extended.

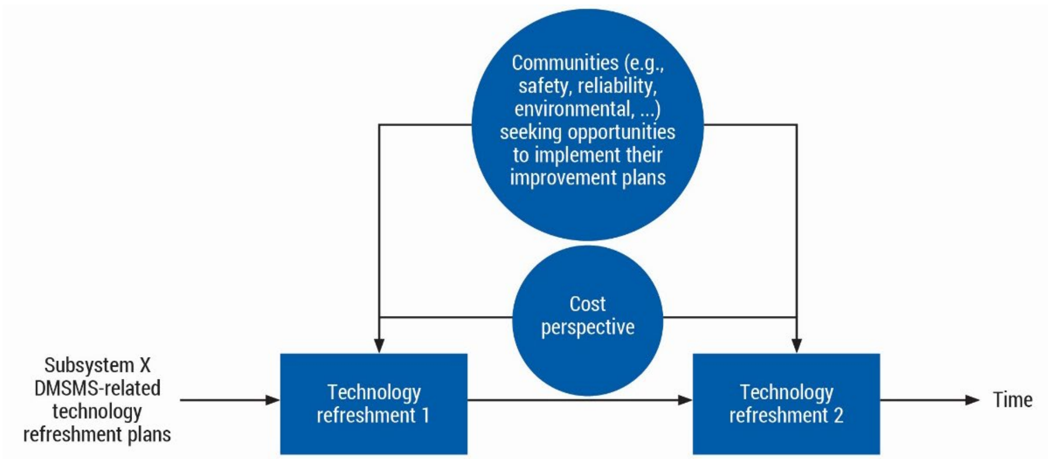
It is helpful if the engineering and product support members of the DMT, who contributed to the health assessment and interface with their counterparts, contribute to modifications plans. A program office can avoid significant DMSMS-related resolution costs in its POMs and budgets by selecting optimum system modification dates. For example, a modification plan to upgrade a product should simultaneously seek to

[162] The relationship between the date of impact estimated by the DMSMS management community and comparable points from a technology roadmap is not predictable in advance. The underlying data used by the DMSMS management community is different. Furthermore, the impact date may be a multiple-year range with additional uncertainty about whether obsolescence will occur in the timeframe.

eliminate obsolete or near obsolete items (as identified via a health assessment), because of the cost effectiveness of resolving a DMSMS issue simultaneously with other changes to the system design rather than as a standalone, out-of-cycle redesign for removing obsolescence only.

Figure 23, based on Figure 20, illustrates this point. These interactions are more likely during sustainment when capability enhancements are less likely and instances of insupportability are more frequent.

Figure 23. Necessary Technology Refreshment May Enable Capability Improvements



Robust DMSMS management will lower the costs associated with obsolescence issues. However, even in the best program offices, individual DMSMS resolutions are often suboptimal. LON procurements are problematic because of limited contractual horizons and uncertainties in estimating the total requirement over the remainder of the system life cycle. Finding or qualifying alternative items may work for a time, but such approaches rarely use new technologies and capabilities. Unplanned redesigns are costly. Therefore, refining the scope and timing of modification plans based on DMSMS health assessments is a best practice to further reduce DMSMS-specific programming, budgeting, and readiness effects throughout the life cycle.

6.3.3.3 REPEATING THE PROCESS

The activities in this section recur, although some may not do so as frequently as the activities for analyzing item availability. Circumstances for *using* roadmaps include integrating programming and budgeting for technology refreshment and insertion, formulating phased resolutions, forecasting DMSMS issues, and sizing LON buys.[163] The DMSMS community always uses the latest version of roadmaps whenever the circumstances create the need to do so. However, in some instances, a roadmap can change in a way that affects a prior DMSMS management decision.

Once executed, changing a LON buy decision may not be possible. If a roadmap change indicates that a LON was too large, then eventually excess inventory will occur. If a roadmap change indicates that the LON buy was too small, then inventories should be watched closely and a supplemental resolution should be considered. Whenever any roadmap changes, the DMSMS community should review future resolutions and their associated funding to update them as required. If budget updates are not feasible,

[163] See Sections 7.2 and 7.3.

reallocating resources in existing budgets should begin immediately. Forecasts of future DMSMS issues should be reevaluated to account for supportability roadmap changes.

Product improvement roadmaps are updated on an as needed basis, typically when the funding profile changes or unanticipated capability needs materialize. Product roadmaps may also be revised if the roadmap for the requisite technologies changes. For example, a technological breakthrough could enable an unplanned, but desirable, capability. Similarly, the timing of technology and manufacturing maturity could accelerate or extend the product improvement schedule.

Supportability considerations (and, therefore, supportability roadmaps) could change at a frequency different from product improvement roadmaps. If supportability roadmaps are combined with the product improvement roadmaps, the pace of change would be a combination of the two.

The element of the supportability roadmap dealing with cost drivers most often changes because of funding availability. Return on investment is usually a primary consideration in funding any such effort. However, an upfront investment (paid back over time) is typically necessary. Obtaining sufficient funding for these upfront investments is difficult and, on occasion, when upfront funding is attained, it is diverted to other higher priority items.

The element of the supportability roadmaps dealing with the inability to supply support may be affected whenever the analysis of item availability changes or technology roadmaps change (if utilized). For example, supportability issues can occur when demand for the item changes. Similarly, an unanticipated discontinuation notice may be released because of the introduction of an updated version of the item or insufficient sales to make a viable business case for maintaining production.

Technological breakthroughs or setbacks affect technology roadmaps. Changes in market conditions influence the timing of new market offerings. Cognizant IPTs should have their technology roadmaps updated periodically to reevaluate their product improvement and supportability roadmaps. These updates require an external relook at DoD technology development progress and updated market research efforts.

6.3.4 Finalizing the Preferred Alternative

Before any analysis of resolutions to identify the most cost-effective approach, the engineering representative on the DMT must ensure that those resolutions satisfy all technical requirements.

All viable options (including the status quo) are then analyzed further using either an AoA or a BCA to determine which resolution or set of resolutions gains the best ROI. A BCA is a formal, structured approach for examining the costs, benefits, and risks of different alternatives. It requires background research and data collection and management. It also requires a thorough understanding of the quality and completeness of the data and of any assumptions made.

The standard criterion for comparing alternatives on an economic basis is net present value (NPV), the discounted monetized value of expected net benefits (benefits minus costs). NPV is computed by assigning monetary values to benefits and costs, discounting future benefits and costs using an appropriate discount rate, and subtracting the sum total of discounted costs from the sum total of discounted benefits. For DMSMS resolution alternatives, the one with the highest NPV (e.g., lowest life-cycle cost) is preferred, because the benefit of mitigating the DMSMS condition—that is, avoiding negative impacts on system operational readiness—is the same for each alternative.

An AoA is a simplified version of a BCA. An AoA does not require the amount of detailed analysis of a BCA to determine the most viable resolution. Typically, an AoA is used in place of a BCA when a low cost and risk of the resolution can be estimated accurately up front without an in-depth analysis.

A program office must be able to calculate resolution costs at an acceptable level of fidelity to perform an AoA or BCA. To make a decision on which resolution to pursue, the cost calculations do not necessarily need to be exact; they just have to be consistent enough to establish an ordinal ranking. To ensure that the funding is sufficient to support the implementation of the selected resolution, a program office will need better fidelity. Table 15 shows average costs associated with implementing each of the DMSMS resolution options. These data were primarily compiled from submissions to a 2014 Department of Commerce survey of government and commercial DMSMS management programs.[164] While it is preferable for a program office to estimate specific costs for resolutions, the costs cited in the table can be used to make preliminary cost estimates when a program office is gathering more detailed information. Other uses of Table 15 include an initial judgement of the validity of resolution cost estimates and cost avoidance calculations when no better information is available.

Table 15. Average Cost Associated with Implementing Each DMSMS Resolution Option

Resolution Option	Average[165]
Approved item	$1,179
LON buy	$5,999
Simple substitute	$14,418
Complex substitute	$29,126
Extension of production or support	$29,197
Repair, refurbishment, or reclamation	$74,524
Development of a new source[166]	$301,967
Design refreshment[166]	$879,821
Redesign—NHA	$1,252,706
Redevelop the item[166]	$1,915,676
Redesign—complex/system replacement	$11,792,758

[164] DSPO, Diminishing Manufacturing Sources and Material Shortages: Cost Metrics (Fort Belvoir, VA: DSPO, February 2015).
[165] Resolution costs adjusted for inflation using a factor of 1.8% per "National Defense Budget Estimates for FY 2016—Office of the Under Secretary for Defense (Comptroller)," Table 5-2: Pay and Inflation Rate Assumptions—Outlays, 54 and then adjusted using the 2022 DoD Greenbook, Column: Total DoD Excluding Defense Health Program, Table 5-4: Department of Defense Deflators—Total Obligation Authority by Public Law Title (Base Year = 2022).
[166] The data to develop these average costs is limited. It includes information collected from companies, examples collected from the government, data from the original Department of Commerce survey, and professional engineering judgement. The numbers derived from these sources are consistent with other data in the table, sensible from an engineering perspective, and sufficient for the uses for which the table is intended. The method to convert to FY22 dollars is as described in note 165.

Calculating averages from the original Department of Commerce data for redesigning NHA and developing a new item or source[167] is problematic.

- Development of a new item or source represented distinct situations with different resolution costs.
- Depending on the level of assembly of the obsolete item, data used to develop the average cost for redesigning NHA could represent simpler and, therefore, less expensive redesigns than those in the data for calculating the average cost for development of a new item or source.

Corrections have been included to compensate for the former bullet but not the latter because no additional information is available to clarify that situation.

Appendix L can be used, with caution, to modify these averages based on more specific circumstances. The appendix is a three-part table that contains the complete results from the Department of Commerce survey. The rows of the table show the resolution options subdivided by environment (aviation, ground, shipboard, space, and undersea). The columns show the commodity type (electrical, mechanical, and electronics) subdivided by item type (assembly, component, raw material, and software). Entries in the table are average cost in FY22 dollars and sample size. Little confidence should be placed in entries with a low sample size.

Both an AoA and a BCA should account for life-cycle costs for each applicable time increment.[168] When possible, multiple resolutions sequenced over time for implementation through the end of need should be considered. This allows a program office time to implement the resolution with the best ROI if barriers exist at the time of notification. For example, if a CCA with an ASIC is obsolete, and the impact on operational availability is projected to occur within six months (based on stock, demand, and reliability information), the DMT may determine that the resolution with the best ROI is to develop a new source of supply. However, if developing a new source will take at least one year after qualification, the DMT will need another resolution to cover the development time; for example, if stock is still available, then a LON buy could be implemented.

Section 3.4.5 introduced the concept of a watch list wherein inventory levels are monitored to determine, in part, how well demand assumptions made during resolution determination are holding. This concept is especially important in determining the preferred resolution to a DMSMS issue, especially when the resolution may be a LON buy or reverse engineering or redesign of the item followed by a LON buy.

The fixed non-recurring engineering cost required to establish a production line for an obsolete item can be more than two orders of magnitude greater than the variable cost to manufacture the item. If the LON buy quantity purchased before a last order date is too small, it may be necessary to make such a large non-recurring investment to support the system in the future. This compares to the relatively small cost of making a larger LON buy before the item is discontinued and possibly having excess inventory when the need for the item disappears. Such a long-term comparison should be a consideration in the AoA or BCA; they should not be limited to examining only the difference between different types of resolutions.

Similarly, when the resolution is reverse engineering or redesign of the item, some quantity of the new item must also be purchased. The fixed non-recurring engineering costs will be amortized over whatever that quantity is. As part of the resolution, actions should be taken to reduce the risk of incurring similar fixed costs in the future. It may be necessary to purchase a larger quantity of the item, similar to a LON

[167] This resolution type has been replaced with development of a new source, design refreshment, and redevelop the item.
[168] For a LON buy, the DMT should consider whether it must purchase a minimum quantity. If that quantity is greater than the expected need, the program should try to identify other potential users as partners.

buy. The unit cost will decrease substantially because the fixed costs are being amortized over a larger number of items. Also, by obtaining the TDP for the item, it should be possible to lower re-order costs in the future. Again, such long-term approach considerations should be part of the AoA or BCA in determining the resolution.

The cost avoidance from being proactive is also a factor in both an AoA and a BCA. The validity of the previous methodology used for calculating DMSMS cost avoidance has been questioned[169] and consequently this document establishes a new best practice for calculating cost avoidance. The cost avoidance by being proactive as it relates to DMSMS resolutions should be the difference between the cost of the reactive resolution avoided and the actual proactive resolution cost. For example, if the proactive resolution was a simple substitute and the reactive resolution would have been a redesign, the cost avoidance from being proactive would be the difference in the cost between a redesign and a simple substitute. There would however be no cost avoidance if the resolution is a redesign because the reactive resolution would be the same. Similarly, there is no cost avoidance if the issue were identified reactively. (See Appendix H.3.2 for a more detailed explanation.)

Once the program office has identified the implementation cost for the viable resolutions, the program office can calculate the breakeven points and ROI to determine which resolution is the most cost effective. That resolution, however, may not be the best option when risk is taken into account. All identified risks associated with the resolutions should be captured and a proper weighting factor should be associated with each risk. Some risks will require a higher weighting factor than others. The following are among the risks to consider:

- Technical. Risk associated with the ability to develop or implement a resolution while still maintaining performance within the specification.
- Supply chain. Risk associated with the financial viability of the resolution provider that will be maintaining the capability.
- Financial. Risk associated with the availability of funding required to implement a resolution within a specified time period.
- Schedule. Risk associated with implementing a resolution before operational availability is affected.

Application of these risks in the decision-making process is subjective. In some instances, a high-cost resolution with low risk is preferable to a low-cost resolution with high risk. For example, testing and qualifying an alternate item that uses technology similar to that in the obsolete item may not be the best choice, because there may soon be a shortage of that alternate. Instead, it may be better to develop a substitute item using more current technology.

When the DMT has determined the best resolution, the PM must decide whether it is acceptable and determine whether the funds and resources are available for implementing that resolution (Section 7.1 and Appendix M address estimating resolution costs to inform programming and budgeting). In some cases, feedback from the PM may require the DMT to repeat the resolution determination process. For

[169] Problems with the previous methodology are threefold. First, there was no prohibition for including solutions for problems that were found reactively. Second, there was no reason to believe that the next viable resolution would have happened or for that matter would have been feasible had the issue been discovered reactively. Finally, the process for determining the cost of the avoided resolution was not clearly defined which could result in very large cost avoidance figures and also discrepancies in the cost avoidance for the same or similar resolutions between different systems.

example, the PM may impose new resources or time constraints or may even bring up the possibility of a new product improvement effort.

7. Implement: Implementation of DMSMS Resolutions

The DMT's role does not end when a PM decides which resolution option to pursue. The final step of the DMSMS management process is implementation. In the *Implement* step, the DMT should be involved in three final processes: programming and budgeting for implementing the preferred resolution, integrating DMSMS resolution and modification funding, and implementing the preferred resolution.

In some cases, contracts with the prime contractor (during design and production) or a logistics provider (during sustainment) may include a requirement for the contractor to fund DMSMS resolutions. (Appendix E contains more information on contracting.) This situation is complex:

- The definition of "end-of-life" can differ depending on one's perspective. If the contract requires the contractor to buy additional items to resolve a DMSMS issue, the contractor will normally be concerned only with demands up to the end of the contract period of performance, whereas the government will likely be interested in addressing an issue through the "end-of-need." Unless the government specifically defines this, it can remain open to interpretation. The government should not expect the contractor to buy enough items to last until the end of need without additional funding.
- If the current contract requires the contractor to resolve DMSMS issues, the contractor may not fund the most cost-effective resolution from the program office's perspective. The contractor will determine the resolution based on its own business case calculations. However, depending on its relationship with the government, the contractor may factor the government's long-term needs into the calculation, assuming the contractor is made aware of those needs. If the program office included, in its request for proposal (RFP) for that current contract, a requirement for the contractor to fund the most cost-effective resolution from a program office perspective, the contractor may bid a much higher price to compensate for uncertainty, unless the parties were able to create a contractual incentive to minimize the contractor's financial risk. Consequently, the program office should be prepared to negotiate with the contractor on which resolution option to implement and should be prepared to provide additional funding if it is not included in the contract. These negotiations are enhanced by a strong government-industry relationship and full government awareness of the DMSMS services provided by the contractor.

7.1 PROGRAM AND BUDGET FOR DMSMS RESOLUTIONS

The focus of the programming and budgeting information that follows is for the implementation of resolutions for known and forecasted DMSMS issues[170] for every item in the system whether it is monitored or not. When resolutions are implemented in phases (e.g., a LON buy in conjunction with a longer term resolution), programming and budgeting should take both into account. The DMT can assist program office leadership in developing its programming and budgeting submissions to be able to fund DMSMS resolutions where necessary as well as to ensure that obsolescence is incorporated in the program office's modification plans.

[170] Separate resource requirements for performing DMSMS management operations were discussed in Section 3.4.1 for the "Prepare" step.

Although a program office may not know the specific DMSMS problems that it will encounter in a given year in the future, experience has proven that DMSMS issues are inevitable and thus a program office will face multiple DMSMS problems annually. Therefore, reliance on obtaining funding in the execution year is not a best practice. Without advance planning for these funds, the necessary resources may not be available and failure to mitigate DMSMS issues can lead to unacceptable performance, degradation of system reliability and availability, schedule slippage, and increased costs.

Appendix M contains detailed information pertaining to the following programming and budgeting for DMSMS resolutions topics:

- Best practices,
- Considerations for funding DMSMS resolutions in the year of execution,
- Leveraging WCFs to fund DMSMS resolutions, and
- Other resources that may be available to finance DMSMS resolutions.

Programming and budgeting for DMSMS resolution funding is only necessary when a resolution is implemented on its own or DMSMS is the principal purpose of a larger work effort that also includes non-DMSMS related activities. According to interviews with the Comptroller Offices, DMSMS resolutions are often implemented in conjunction with other efforts (e.g., capability enhancement, technology insertion, technology refreshment, planned maintenance, life extension, planned modifications, and so forth). This occurs because it is convenient to combine efforts from the perspective of system availability. Also, it is often less costly to combine work efforts on the same subsystem. When the work efforts are combined, and DMSMS is not the driving purpose for the work efforts, then some of the programming and budgeting best practices suggested in this document may not be applicable.

7.2 INTEGRATE DMSMS RESOLUTION AND MODIFICATION FUNDING

Modifications create opportunities to resolve DMSMS issues as notionally shown in Figure 24. The figure represents before and after modification tombstone charts. Normally, entries in the chart would depict the number of items remaining with green representing a safe number, yellow implying a near-term concern, and red indicating not enough items available (i.e., a negative number). To illustrate notionally how a modification could reduce DMSMS issues, only color scheme changes are portrayed in the figure.

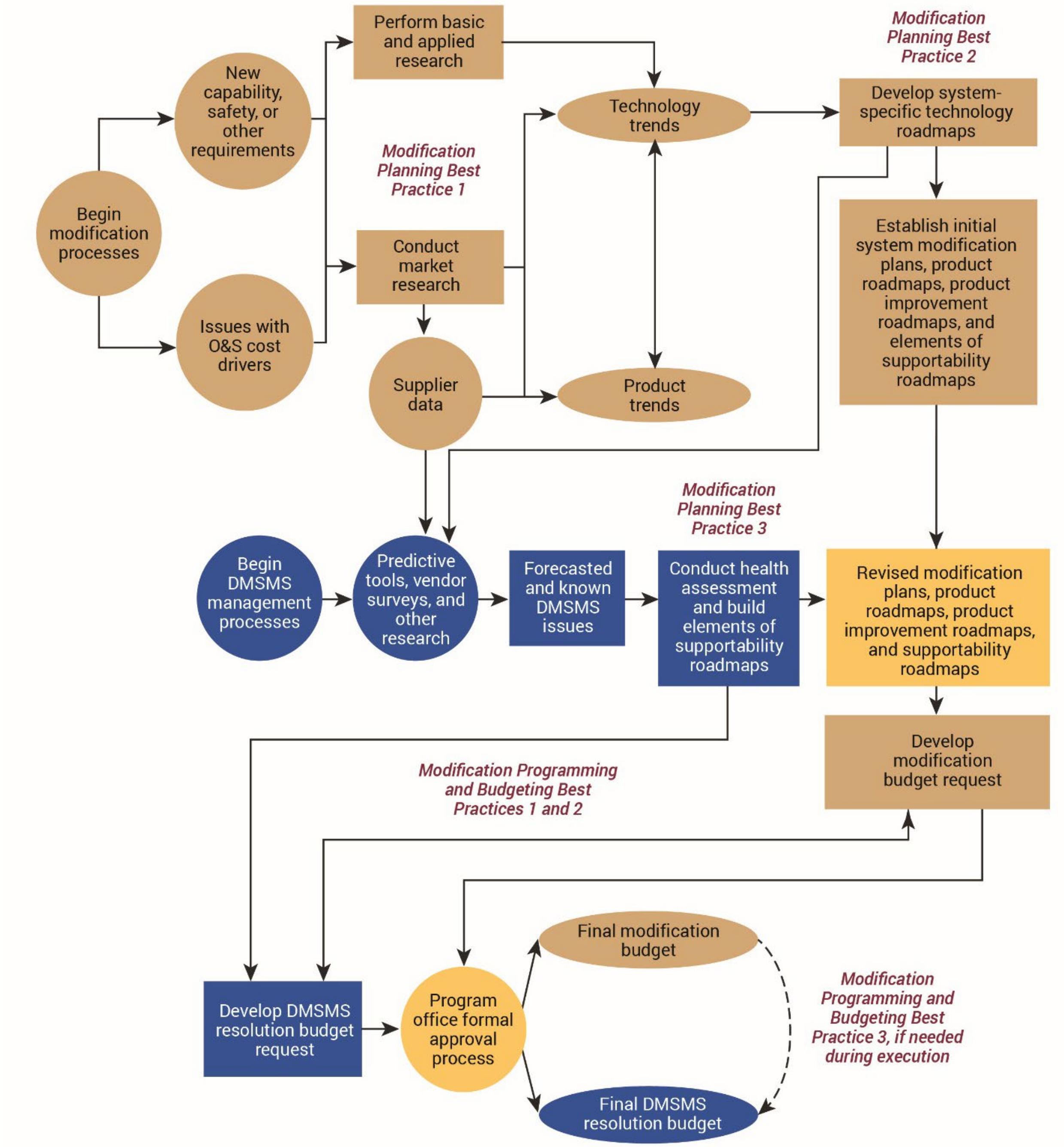
When considering resolution funding needs in conjunction with modification efforts, typically programming and budgeting is the responsibility of the modification planners. This section describes best practices for DMSMS resolution programming and budgeting in connection with modification planning.

Figure 24. Notional Change in Obsolescence Status after Modification

Figure 25 is an extension of Figure 21 in Section 6.3.3.2. The top of Figure 25 concerns the interactions among DMSMS management, roadmaps, and *modification* planning. The bottom section adds *programming and budgeting* considerations and illustrates the interactions between modification planning and DMSMS management activities that yield modification plans and DMSMS resolution programs and budgets. The gray-shaded portions of this figure are associated with modification while the blue shaded portions pertain to DMSMS management. The tan portions represent general programming and budgeting processes that impact modification and DMSMS management.

The upper left of the figure (where the reader should start) deals with technology and supply chain management. Then upper right depicts the formulation of modification plans. The formulation of DMSMS resolution POMs and budgets is represented in the lower left, and their consideration or integration into modification POMs and budgets is illustrated on the lower right. Modification planning (and the funding of those plans) has a significant influence on programming and budgeting for DMSMS resolutions.

Figure 25. Interactions of DMSMS-Related and Modification-Related Programming and Budgeting



The following discusses new elements of this figure through the introduction of a set of additional modification programming and budgeting best practices. These best practices are shown on the figure to indicate ways in which a program office's DMSMS management community should leverage modification POMs and budgets for DMSMS resolutions.

- Modification Programming and Budgeting Best Practice 1. Consider approved modification POMs and budgets when calculating the size of LON buys.

  Funded modification plans may identify a timeframe for phased DMSMS resolutions for obsolete items no longer needed once the modification has been implemented. If any such items impact the system before the modification, then an interim resolution must be put in place. If that interim resolution is anything other than a LON buy, there normally are no programming and budgeting implications related to the modification. For a LON buy, the period of need is defined by when the DMSMS issue will impact the system and when the modification effort will be implemented. The period bounded by these two dates has implications on the quantity of the item to be purchased.

  Except for costs associated with holding inventory, the resolution cost over time for a LON buy is very small, assuming the items will eventually be used. However, LON buys create programming and budgeting implications for the year the buy is executed, especially if the item has a high cost (see Appendix M.2.) Consequently, the best practice from a programming and budgeting perspective is to take funded modification plans into account when sizing LON quantities. However, there may be uncertainty with modification plans. Funding may not be in place because of the uncertainty of start dates or lack of agreement about the scope of the effort. Some situations have a high probability (but not certainty) of funding. These factors should be considered when programming and budgeting for a safety level in the size of a LON buy as discussed in Section 7.3.

- Modification Programming and Budgeting Best Practice 2. Consider funded modification plans when formulating DMSMS resolution-specific POMs and budgets to avoid duplication.

  The DMSMS management community should be able to articulate how much is being spent on resolutions for DMSMS issues. Questions can be raised about the extent to which resolutions are funded through modification. Modification plans may resolve a DMSMS issue if the obsolete item is removed solely as a result of the desired system improvement. Modification plans can also be augmented to resolve a DMSMS issue at a cost substantially less than the cost to resolve the same issue in the absence of the modification effort.

  It is a best practice for the DMSMS management community to know about the former to avoid unnecessary effort in determining resolution options. It is also a best practice for the DMSMS management community to propose the latter as part of normal operating processes in the program office. Following these best practices should avoid duplication among DMSMS management and modification programming and budgeting activities.

- Modification Programming and Budgeting Best Practice 3. Consider adjusting modification efforts to initiate DMSMS resolutions to avoid an immediate impact on the system when emergency and unpredicted, execution year obsolescence occurs.

  While many DMSMS issues are discovered well in advance, DMSMS issues also routinely occur unexpectedly during budget execution. Some of these issues may require significant near-term resources to resolve them before there is an impact to the system. As discussed in Appendix M.2 one potential source of resources is a funded modification effort. In many cases, there would have been formal programming and budgeting for the modification effort; however, other (sponsors) sources of funds may be applicable if that avenue for programming and budgeting is unsuccessful.

  The DMSMS management community should be knowledgeable of both the technical (engineering) authority for the modification effort and the key financial decision makers in the program office. The technical authority may be in a position to identify how the scope of the modification can be adjusted to resolve the new issue or how the modification effort can be slowed to free some funding that can be temporarily applied to a pressing DMSMS issue. The financial points of contact would have to approve funding for either of these technical alternatives.

7.3 IMPLEMENT DMSMS RESOLUTIONS

Upon acceptance and funding, the case enters the implementation phase. This phase should follow the program office's standard process for updating configurations and engineering modifications. Some changes may be largely clerical and not require a specified process for updates, while other changes will require a formal change process. For instance, most updates that affect major configuration changes or engineering modifications flow through the appropriate level of the engineering change proposal (ECP) process. The standard ECP process ensures that all changes and qualifications satisfy the system's requirements.

It is usually a mistake for the DMT to assume that the program office's standard processes will be problem free. As a best practice, the DMT should be involved in the following ways during implementation:

- Ensure that all stakeholders understand their roles and responsibilities for implementation. These roles and responsibilities should have been established when the DMT was formed.
- Ensure that the implementation steps are defined.
- Verify that appropriate technical actions (e.g., qualification of the new item or procurement of the item) were successfully carried out.
- Monitor the process.
- Obtain feedback on the project status to ensure maintenance of full operational availability during implementation. If the project is behind schedule, the DMT may be required to determine supplemental mitigation actions.
- Update BOMs being monitored to reflect the configuration changes once the project is completed.

In some cases, the DMT may have difficulty performing these functions. A champion in the program office is critical to implementation success. The champion should be at a high enough level to assure the appropriate level of attention and be knowledgeable about the importance of an obsolescence program to take ownership of it and justify it to program office leaders. The champion is often the catalyst that brings all the functional disciplines together toward the common goal of managing the availability of the system and is the person to resolve difficulties faced by the DMT in carrying out its DMSMS management responsibilities.

In some cases, the DMT is asked for advice on procedures to deal with issues that arise during implementation. Below are examples of some issues, along with some considerations about ways to resolve them:

- Improving the priority of DMSMS management with the contracting officer. The DMT should invite the contracting officer to its meetings and explain his or her roles and responsibilities. The DMT should ensure that the contracting officer understands what is needed and the associated urgency.
- Buying in advance of need. 31 U.S.C. §1502 (a), Balances available, establishes a limitation on the funds that can be expended on a LON buy and consequently may limit the quantity that can be procured. The statute's wording is as follows:

  (a) The balance of an appropriation or fund limited for obligation to a definite period is available only for payment of expenses properly incurred during the period of availability or

to complete contracts properly made within that period of availability and obligated consistent with section 1501 of this title. However, the appropriation or fund is not available for expenditure for a period beyond the period otherwise authorized by law.

To obtain an exception to this limitation, generally, a "bona fide need" statement must be documented for the General Counsel's office. That statement should explain the DMSMS issue and its impact if not resolved and describe how and why the resolution option was determined. In the absence of any specific organizational guidance, a best practice is to include the following in the statement:

– Statement of the problem,

– Analyses showing the inability to find an alternate part or a resolution that does not require a significant CM change,

– Analyses that show why a LON buy is the most cost effective resolution,

– Description of the expected impacts if a LON buy is not executed,

– Forecast of the quantities of the item needed to support production and sustainment along with an explanation of any assumptions made,

– Documentation of the discontinuation date and the date that impact begins, and

– Identification of the funds to be used for the procurement action.

Procuring more than two years of supply in a stock fund.[171] 10 U.S.C. § 2213, Limitation on the Acquisition of Excess Supplies, may also be an issue in sizing a sufficiently large LON buy for an obsolete item that is managed by a stock fund. The statute reads as follows:

(a) Two-Year Supply.—The Secretary of Defense may not incur any obligation against a stock fund of the Department of Defense for the acquisition of any item of supply if that acquisition is likely to result in an on-hand inventory (excluding war reserves) of that item of supply in excess of two years of operating stocks.

(b) Exceptions.—The head of a procuring activity may authorize the acquisition of an item of supply in excess of the limitation contained in subsection (a) if that activity head determines in writing—

(1) that the acquisition is necessary to achieve an economical order quantity and will not result in an on-hand inventory (excluding war reserves) in excess of three years of operating stocks and that the need for the item is unlikely to decline during the period for which the acquisition is made; or

(2) that the acquisition is necessary for purposes of maintaining the industrial base or for other reasons of national security.

For DLA managed items, the exceptions section in the statute is automatically initiated as part of the process described in Appendix M.3 as long as the following information is available:

– Justification for future demand projections,

– Limitation on the ability to purchase (e.g., the discontinuation notice), and

– Requisite approvals (or statements of need) from buyer leadership.

[171] 31 U.S.C. § 1502(a) does not apply since the stock fund corpus is not subject to the obligation limitations expressed in the statute.

For Service-managed items in the DoD supply system, LON buys are much more unusual since the Services manage typically expensive depot level reparables.

- Calculating sufficient stock to end of need. If all demands for the item are well understood, determining the amount of stock required through the end-of-need is a straightforward calculation involving the use of a statistical distribution[172] with the appropriate confidence limits, operating tempo, number of units in service, and failure rates (either actual or predicted). Of course the end-of-need date for the item must be understood. It could be the retirement date of the system. It could be the point at which a funded modification will remove the obsolete item from the system. Sometimes, the end of need could be the implementation of a longer term resolution.

  The greatest ambiguity is whether that end-of-need date will be changed at some later point in time because plans for the system's life or modifications have altered leading to an overestimation or an underestimation of the quantity needed. If there is underestimation, there could be a need to implement a second interim resolution which may be expensive since options are likely limited. With overestimation, then there will be excess inventory.

  Another issue with the calculation is the uncertainty in the input. Calculation of the LON quantity may not take into account all relevant data and thereby, the quantity may be underestimated. For example:

  – If an organization that manages a WCF is making the purchase, it just considers its own customer demand experience in sizing a LON buy. Some programs however may have bought the item in the past outside of WCF processes (e.g., through logistics support contractors or direct commercial purchases) so there may not be a record of the demand. Being very concerned about avoiding excess inventory, an organization that manages a WCF may not adequately consider past purchases made outside of its WCF. Similarly, there may be instances where a provisioning error does not record a system as a user of an item being considered for a LON buy. Demand from such a system may not be fully reflected in sizing a LON buy. Furthermore, there may also be demands from production lines.

  – The LON buy quantity may be reduced if there is a shelf life limitation for the item.

  – FMS demand, where applicable, may not be easily determined.

  Program offices should take as many of these considerations as possible into account when calculating a LON requirement. Generally, it is better to make conservative assumptions and consider the inclusion of a safety level of items since the cost of underestimating the quantity needed is almost always significantly higher than the cost of buying some excess inventory.

- Determining the appropriate contract vehicle. A contract must be in place with the organization that will implement the resolution (e.g., the organization performing the non-recurring engineering or the organization that will sell the items). Restrictions exist on the use of all appropriations. In some cases, additional procurement funds are necessary; in others, research, development, test, and evaluation funding is required for redesign, material substitution, or qualification of a new source. The contracting office can provide advice on this subject.

- Managing inventory. Some issues may be associated with receiving, inspecting, and storing items. Programs should consider these concerns early in the process; if these problems cannot be solved, a LON buy resolution option may not be viable. Options for storage locations include suppliers, prime contractors, and DoD component storage facilities.[173] There have been situations where program offices have used their own funding to contract commercially for storage.

[172] Normally, the Poisson distribution is used.

[173] For example, White Sands Missile Range in New Mexico has established a facility and processes for storage.

Another related concern is if the item has low demand, a WCF-funded storage location could dispose of the item if it concludes that there is excess inventory. A program office may have to take action to prevent that. In addition, for items that are controlled by an organization that manages a WCF, but used in various systems, a program office may not be able to protect assets it needs from being procured by another program office.

Appendix A. Obsolescence and Its Relationship to DMSMS

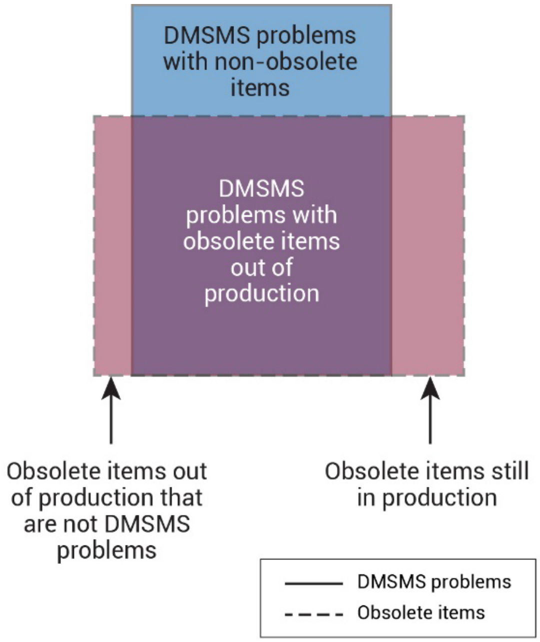
Despite no difference between DMSMS management and obsolescence management from a *process* perspective, obsolescence is not synonymous with DMSMS from a *dictionary* perspective. Obsolescence is less definitive and is situationally dependent in that an item can be obsolete from one perspective, but not from another. In the context of DMSMS management, an item is obsolete if it is out-of-date and superseded by something new. Below are key underlying causes of an item being out-of-date:

- Technology. A technology is obsolete when the use of a newer technology becomes broadly preferred over the old, even if the old technology still functions and can be produced and purchased for certain unique situations. For example, videocassette recorders and players became technologically obsolete, when DVD recorders and players superseded them.
- Function. An item is obsolete functionally if it no longer functions as intended because of hardware, software, or requirements changes to the item. Such an item may still be available commercially. For example, a videocassette tape (especially one in beta format) could be considered to be obsolete functionally, because players are no longer available for purchase to extract the tape's content.
- Regulation. Regulations that ban the use of items or substances lead to their obsolescence. For example, Freon use has been banned because of its ozone-depleting characteristics. Similarly, the purchase of rare-earth elements such as neodymium or ytterbium from China has been banned.
- Supportability. An item may be obsolete if it is no longer supportable. An example is commercial software, which continually needs product support to correct errors, to defend against vulnerabilities, and, in some cases, to maintain licenses. Unsupportable software is obsolete. Beyond software, if the necessary item test capability is no longer available, then the item may no longer function properly and, therefore, could be considered obsolete.
- Market demand. A product becomes obsolete when there is no longer a demand for it, because, for example, it is no longer desirable even though it may still be available for purchase. Leisure suits are an example. Another example is a product that is no longer profitable to produce because of low demand.

Obsolescence may be planned or unplanned. An example of planned obsolescence is a relatively new home computer printer that is technologically equivalent to the latest ones on the market but requires proprietary ink cartridges that are different from the ones used in the most recent model of the printer. The manufacturer may deliberately stop manufacturing those cartridges (thereby making the printer functionally obsolete) to force people to purchase the most recent printer model.

A high degree of overlap exists between obsolete items and DMSMS problems. Figure 26 notionally depicts their relationship.

Figure 26. Notional Relationship between DMSMS and Obsolescence



An item may be obsolete, but if it is still in production, there is no DMSMS issue as long as the production capability or capacity can meet the demand. For example, hand pumps for water are still made for places where power is not available for an electric pump. Another example is a situation of an obsolete computer that is out of production, but it is not a DMSMS issue because there is sufficient stock in inventory to meet all future demands. In the first example, no DMSMS case would be opened because the item is still in production. In the second example, a DMSMS case would be opened, but no resolution would be needed. Changing the circumstances of the second example can create a situation in which a DMSMS problem will evolve over time. If there were not sufficient inventory to meet future demands, DoD might be able to repair the computer instead of replacing it. If that were the case, there would be no DMSMS problem. However, a DMSMS issue would occur if the repair parts were also obsolete, if the know-how (e.g., skills) to make the repair was lacking, or if the ability to test the system (e.g., the test equipment) after the repair was unavailable.

Finally, a non-obsolete item may have a DMSMS issue. For example, market factors may drive a supplier out of a particular line of business, a supplier may declare bankruptcy, a natural disaster may affect production, or a buyout of a sole-source provider may lead to temporary or permanent termination of production of a particular product. Some temporary DMSMS issues may be due to allocation of a scarce item. In this situation, some systems may be faced with a DMSMS issue, while others may not.

Not all obsolescence results in DMSMS issues, and not all DMSMS issues result from obsolescence. However, most DMSMS issues result from some form of obsolescence.

Appendix B. DMSMS Management Questions for SETRs

This appendix contains DMSMS management questions intended for use by DMSMS management practitioners to prepare for six of the SETRs of primary importance:

- ASR,
- SRR,
- SFR,
- PDR,
- CDR, and
- PRR.

The questions are designed for the program office, but many also apply to prime contractors and subcontractors. The questions are presented in five tables. Table 16–Table 20 contain questions pertinent to the five DMSMS management steps: Prepare, Identify, Assess, Analyze, and Implement. They are further broken down by DMSMS management operations processes.

Table 16. DMSMS Management Questions for SETRs: Prepare

Process	ASR	SRR	SFR	PDR	CDR	PRR
Establish the foundations for DMSMS management		Has program office leadership identified expectations for DMSMS management operations and deliverables?	Has program office leadership updated expectations for DMSMS management operations and deliverables?	Has program office leadership updated expectations for DMSMS management operations and deliverables?	Has program office leadership updated expectations for DMSMS management operations and deliverables?	Has program office leadership updated expectations for DMSMS management operations and deliverables?
		Has program office leadership defined the roles and relative relationships among DMT members?	Has program office leadership updated the roles and relative relationships among DMT members?	Has program office leadership updated the roles and relative relationships among DMT members?	Has program office leadership updated the roles and relative relationships among DMT members?	Has program office leadership updated the roles and relative relationships among DMT members?

Process	ASR	SRR	SFR	PDR	CDR	PRR
Establish the foundations for DMSMS management *(continued)*		Has program office leadership determined a risk-based perspective to DMSMS management by identifying criteria for which systems to monitor and which items to monitor within those systems?	Has program office leadership updated the risk-based perspective to DMSMS management by updating criteria for which systems to monitor and which items to monitor within those systems?	Has program office leadership updated the risk-based perspective to DMSMS management by updating criteria for which systems to monitor and which items to monitor within those systems?	Has program office leadership updated the risk-based perspective to DMSMS management by updating criteria for which systems to monitor and which items to monitor within those systems?	Has program office leadership updated the risk-based perspective to DMSMS management by updating criteria for which systems to monitor and which items to monitor within those systems?
Develop a DMP		Has the program office started to develop its plan for addressing and managing the impact of DMSMS issues?	Has the program office established a robust DMSMS management program that identifies obsolescence due to DMSMS issues before critical items are unavailable?	Has a government DMP been formally approved by program office leadership?	Is the government DMP being implemented and updated, as necessary?	Is the government DMP being implemented and updated, as necessary?
		Does the draft DMP identify the roles and responsibilities of the prime/ subcontractor and third-party vendors?	Does the draft government DMP identify the roles and responsibilities of the prime/ subcontractor and third-party vendors?	Does the approved government DMP identify the roles and responsibilities of the prime/ subcontractor and third-party vendors?		
		Have the roles and responsibilities of the government, prime/ subcontractor, and third-party vendors been established?	Have the roles and responsibilities of the government, prime/ subcontractor, and third-party vendors been established?	Have the roles and responsibilities of the government, prime/ subcontractor, and third-party vendors been established?	Are the roles and responsibilities of the government, prime/ subcontractor, and third-party vendors being executed?	Are the roles and responsibilities of the government, prime/ subcontractor, and third-party vendors being executed?

Process	ASR	SRR	SFR	PDR	CDR	PRR
Develop a DMP *(continued)*		Is the government conducting sufficient oversight when contractors are responsible for executing DMSMS operational processes?	Is the government conducting sufficient oversight when contractors are responsible for executing DMSMS operational processes?	Is the government conducting sufficient oversight when contractors are responsible for executing DMSMS operational processes?	Is the government conducting sufficient oversight when contractors are responsible for executing DMSMS operational processes?	Is the government conducting sufficient oversight when contractors are responsible for executing DMSMS operational processes?
Form a DMT			Has a partial DMT been formed?	Has a partial DMT been formed?	Has the full DMT been formed?	Has the full DMT been formed?
			Do all identified DMT members understand their roles and responsibilities and have adequate training to fulfill their roles and responsibilities?	Do all identified DMT members understand their roles and responsibilities and have adequate training to fulfill their roles and responsibilities?	Do all identified DMT members understand their roles and responsibilities and have adequate training to fulfill their roles and responsibilities?	Do all identified DMT members understand their roles and responsibilities and have adequate training to fulfill their roles and responsibilities?
Establish DMSMS operational processes			Is the process of defining and documenting all DMSMS operational processes in the government DMP underway?	Have all DMSMS operational processes been defined and documented in the government DMP?		
			Are DMSMS considerations incorporated into pertinent program office documentation?	Are DMSMS considerations incorporated into pertinent program office documentation?	Are DMSMS considerations incorporated into pertinent program office documentation?	Are DMSMS considerations incorporated into pertinent program office documentation?
Secure resources for DMSMS management operations			Have current and out-year DMSMS management operations budgets been estimated and identified?	Have current and out-year DMSMS management operations budgets been established, approved, and funded?	Have current and out-year DMSMS management operations budgets been established, approved, and funded?	Have current and out-year DMSMS management operations budgets been established, approved, and funded?

Process	ASR	SRR	SFR	PDR	CDR	PRR
Establish interfaces to advocate for DMSMS-resilient designs	Are DMSMS impacts a consideration when analyzing alternative systems to help ensure that the preferred system is cost effective, affordable, operationally effective, and suitable and can be developed to provide a timely solution to a need at an acceptable level of risk?	Have interfaces been established with design engineering for the consideration of DMSMS resilience characteristics?	Have interfaces been established with design engineering for the consideration of DMSMS resilience characteristics?	Have the design engineering interfaces been successful in employing DMSMS resilience principles in the designs?	Have the design engineering interfaces been successful in employing DMSMS resilience principles in the designs?	Have the design engineering interfaces been successful in employing DMSMS resilience principles in the designs?
	Are DMSMS impacts a consideration when analyzing alternative systems to help ensure that the preferred system is cost effective, affordable, operationally effective, and suitable and can be developed to provide a timely solution to a need at an acceptable level of risk?	Have interfaces been established with the parts management community for parts selection to enhance DMSMS resilience?	Have interfaces been established with the parts management community for parts selection to enhance DMSMS resilience?	Have the parts management interfaces been successful in selecting items for the designs that will enhance DMSMS resilience?	Have the parts management interfaces been successful in selecting items for the designs that will enhance DMSMS resilience?	Have the parts management interfaces been successful in selecting items for the designs that will enhance DMSMS resilience?

Process	ASR	SRR	SFR	PDR	CDR	PRR
Establish interfaces to advocate for DMSMS-resilient designs *(continued)*				Is DMSMS management a consideration when the system design approach is being determined to minimize the impact on supportability and sustainability?	Is DMSMS management a consideration when the system design approach is being determined to minimize the impact on supportability and sustainability?	Is DMSMS management a consideration when the system design approach is being determined to minimize the impact on supportability and sustainability?
			Are the following addressed: • Order of precedence for parts selection (e.g., use of QML parts, particularly for applications requiring extended temperature ranges) • Selection of parts relatively early in their life cycle • Minimized use of custom parts Requirement for a preferred parts list and parts control before detailed design to minimize obsolescence issues?	Are the following addressed: • Order of precedence for parts selection (e.g., use of QML parts, particularly for applications requiring extended temperature ranges) • Selection of parts relatively early in their life cycle • Minimized use of custom parts Requirement for a preferred parts list and parts control before detailed design to minimize obsolescence issues?	Are the following addressed: • Order of precedence for parts selection (e.g., use of QML parts, particularly for applications requiring extended temperature ranges) • Selection of parts relatively early in their life cycle • Minimized use of custom parts Requirement for a preferred parts list and parts control before detailed design to minimize obsolescence issues?	
Establish a DMSMS management evaluation process			Has planning begun for reporting DMSMS metrics?	Has the plan been established and approved?	Are metrics being reported to program office leadership and other higher level commands?	Are metrics being reported to program office leadership and other higher level commands?

Process	ASR	SRR	SFR	PDR	CDR	PRR
				Are DMSMS metrics being used for programming and budgeting, improving process efficiency, and determining ROI and other benefits?	Are DMSMS metrics being used for programming and budgeting, improving process efficiency, and determining ROI and other benefits?	Are DMSMS metrics being used for programming and budgeting, improving process efficiency, and determining ROI and other benefits?
Establish a QMS			Has a quality plan been established and approved?	Is the quality plan being executed to drive continuous improvement?	Is the quality plan being executed to drive continuous improvement?	Is the quality plan being executed to drive continuous improvement?
Establish a case monitoring and tracking process			Has the program office defined the record keeping framework to 1) track information about the resolution implementation process and status and 2) provide information about DMSMS cost and management operations efficiency?			
				Has the program office identified how it will capture and track information about the resolution implementation process and status?	Is the program office management tracking and monitoring resolution implementation?	Is the program office management tracking and monitoring resolution implementation?
Establish a case monitoring and tracking process *(continued)*				Has the program office developed or obtained a DMSMS case tracking and program record keeping database?		

Process	ASR	SRR	SFR	PDR	CDR	PRR
Establish supporting contracts		Are prime contractors flowing down DMSMS management requirements to their subcontractors and are those subcontractors flowing down requirements to their supply chains in a similar way?	Are prime contractors flowing down DMSMS management requirements to their subcontractors and are those subcontractors flowing down requirements to their supply chains in a similar way?	Are prime contractors flowing down DMSMS management requirements to their subcontractors and are those subcontractors flowing down requirements to their supply chains in a similar way? Is a CDRL included for the delivery of the prime contractor's DMP?	Are prime contractors flowing down DMSMS management requirements to their subcontractors and are those subcontractors flowing down requirements to their supply chains in a similar way?	Are prime contractors flowing down DMSMS management requirements to their subcontractors and are those subcontractors flowing down requirements to their supply chains in a similar way?
		Are there exit strategies in the contracts that require all sustainment providers to ensure no item EOL issues are unresolved at the completion of the period of performance?	Are there exit strategies in the contracts that require all sustainment providers to ensure no item EOL issues are unresolved at the completion of the period of performance?	Are there exit strategies in the contracts that require all sustainment providers to ensure no item EOL issues are unresolved at the completion of the period of performance?	Are there exit strategies in the contracts that require all sustainment providers to ensure no item EOL issues are unresolved at the completion of the period of performance?	Are there exit strategies in the contracts that require all sustainment providers to ensure no item EOL issues are unresolved at the completion of the period of performance?
Establish supporting contracts *(continued)*		Have the roles and responsibilities of the government, prime/ subcontractor, and third-party vendors been established as contractual requirements?	Have the roles and responsibilities of the government, prime/ subcontractor, and third-party vendors been established as contractual requirements?	Have the roles and responsibilities of the government, prime/ subcontractor, and third-party vendors been established as contractual requirements?		

Process	ASR	SRR	SFR	PDR	CDR	PRR
				Have DMSMS management operations contracts been put in place with the prime contractor, independent SMEs, and appropriate OEMs and OCMs?	Have DMSMS management operations contracts been put in place with the prime contractor, independent SMEs, and appropriate OEMs and OCMs?	Have DMSMS management operations contracts been put in place with the prime contractor, independent SMEs, and appropriate OEMs and OCMs?
				Have contractual provisions been put in place to obtain the data and IP rights necessary for effective DMSMS management?	Have contractual provisions been put in place to obtain the data and IP rights necessary for effective DMSMS management?	Have contractual provisions been put in place to obtain the data and IP rights necessary for effective DMSMS management?

Table 17. DMSMS Management Questions for SETRs: Identify

Process	ASR	SRR	SFR	PDR	CDR	PRR
Prioritize systems			Are mission criticality, operational safety, and DMSMS-related costs being considered to identify and prioritize the systems and subsystems to be monitored?	Are mission criticality, operational safety, and DMSMS-related costs being used to identify and prioritize the systems and subsystems to be monitored?	Are mission criticality, operational safety, and DMSMS-related costs being used to identify and prioritize the systems and subsystems to be monitored?	Are mission criticality, operational safety, and DMSMS-related costs being used to identify and prioritize the systems and subsystems to be monitored?

Process	ASR	SRR	SFR	PDR	CDR	PRR
Identify and procure monitoring and surveillance tools			Have DMSMS forecasting and associated data collection and management tools or service providers been researched?	Have DMSMS forecasting and associated data collection and management tools or service providers been researched and selected?	Have DMSMS forecasting and associated data collection and management tools been reviewed to determine their continued suitability for sustainment? Have tool selections been made to supplement, as necessary?	Have DMSMS forecasting and associated data collection and management tools been reviewed to determine their continued suitability for sustainment? Have tool selections been made to supplement, as necessary?
Collect and prepare item data				Have the items associated with critical system functions been identified? Is a CDRL included for the delivery of the system BOM?	Have the items associated with critical system functions been updated?	Have the items associated with critical system functions been updated?
				Have notional BOMs for the system been acquired in accordance with DI-MGMT-82274?	Have indentured BOMs for the system been acquired in accordance with DI-MGMT-82274?	Have indentured BOMs for the system been acquired in accordance with DI-MGMT-82274?
				Are critical materials of concern within the supply chain being considered?	Are critical materials of concern within the supply chain being considered?	Are critical materials of concern within the supply chain being considered?

Process	ASR	SRR	SFR	PDR	CDR	PRR
Collect and prepare item data *(continued)*				Does the program office have a strategy for obtaining the following: • Design disclosed items, including subtier hardware indenture levels • F3/ proprietary design items, including subtier hardware indenture levels Items that are single source and those for which the government cannot obtain data rights and the associated corrective action plans are identified?	Has the program office obtained the following: • Design disclosed items, including subtier hardware indenture levels • F3/ proprietar y design items, including subtier hardware indenture levels Items that are single source and those for which the government cannot obtain data rights and the associated corrective action plans are identified?	Has the program office obtained the following: • Design disclosed items, including subtier hardware indenture levels • F3/ proprietar y design items, including subtier hardware indenture levels Items that are single source and those for which the government cannot obtain data rights and the associated corrective action plans are identified?
				Has the notional BOM been loaded into the selected forecasting/ management tool and/or service to perform an initial DMSMS items availability assessment?	Has the build baseline/final design BOM been loaded into the selected forecasting/ management tool and/or service to perform a DMSMS items availability assessment?	Has the BOM been regularly updated and reloaded into a DMSMS forecasting/ management tool and/or service to perform periodic DMSMS items availability assessments?
Collect and prepare item data *(continued)*				Have preliminary lists of items, software, and materials to monitor been prepared?	Have lists of items, software, and materials to monitor been updated?	Have lists of items, software, and materials to monitor been updated?

Process	ASR	SRR	SFR	PDR	CDR	PRR
Analyze item availability				Are the results of selected forecasting/ management tool or manual research being used to identify immediate and near-term obsolescence issues associated with the notional BOM? For any DMSMS issues identified, are they addressed and mitigated before establishment of the build baseline/final design BOM?	Have the results of selected forecasting/ management tool or manual research been used to identify immediate and near-term obsolescence issues associated with the build baseline/final design BOM? For any DMSMS issues identified, are they addressed and mitigated before acceptance and approval of the build baseline/ final design BOM?	Are the results of selected forecasting/ management tool or manual research being used to identify immediate and near-term obsolescence issues associated with the BOM?
					Is the program office receiving obsolescence forecasts on a scheduled basis?	Is the program office receiving obsolescence forecasts on a scheduled basis?
					Are PDNs being received regularly?	Are PDNs being received regularly?
				Are vendor surveys being conducted on a regular basis?	Are vendor surveys being conducted on a regular basis?	Are vendor surveys being conducted on a regular basis?

Process	ASR	SRR	SFR	PDR	CDR	PRR
Assess preliminary designs for DMSMS risk				Are "quick look" health assessments being conducted to evaluate the DMSMS resilience of designs early in a system's life cycle?	Are "quick look" health assessments being conducted to evaluate the DMSMS resilience of designs early in a system's life cycle?	
				Are design changes being made to mitigate the risks identified in the "quick look" health assessments?	Are design changes being made to mitigate the risks identified in the "quick look" health assessments?	
Forecast technology obsolescence			Is a formal technology roadmap and insertion/ refreshment strategy being developed for all, or portions of, the system?	Has a formal technology roadmap and approved insertion/ refreshment strategy been developed?	Has a formal technology roadmap and approved insertion/ refreshment strategy been developed and funded?	Has a formal technology roadmap and approved insertion/ refreshment strategy been reviewed for potential updates and adjustments?
			Does the technology roadmap and insertion/ refreshment strategy focus on and address the identification of critical items, materials, and technologies, as well as emerging technologies?	Does the roadmap and insertion/ refreshment strategy identify critical items, materials, and technologies, as well as emerging technologies?	Does the technology roadmap and insertion/ refreshment strategy identify critical items, materials, and technologies, as well as emerging technologies?	Does the technology insertion/ refreshment plan identify critical items, materials, and technologies, as well as emerging technologies?

Process	ASR	SRR	SFR	PDR	CDR	PRR
Forecast technology obsolescence *(continued)*			Is the technology insertion/ refreshment plan being used to determine the timeframe for potential DMSMS operational impacts?	Is the technology insertion/ refreshment plan being used to determine the timeframe for potential DMSMS operational impacts?	Is the technology insertion/ refreshment plan being used to determine the timeframe for potential DMSMS operational impacts?	Is the technology insertion/ refreshment plan being used to determine the timeframe for potential DMSMS operational impacts?

Table 18. DMSMS Management Questions for SETRs: Assess

Process	ASR	SRR	SFR	PDR	CDR	PRR
Obtain data needed for the assessment			Have programmatic, logistics, availability, and criticality data needs for health assessments been identified?	Have programmatic, logistics, availability, and criticality data needs for health assessments been updated?	Have programmatic, logistics, availability, and criticality data needs for health assessments been updated and collected?	Have programmatic, logistics, availability, and criticality data needs for health assessments been updated and collected?
Determine whether a resolution should be pursued			Are formal analyses being conducted to determine whether a resolution should be pursued?	Are formal analyses being conducted to determine whether a resolution should be pursued?	Are formal analyses being conducted to determine whether a resolution should be pursued?	Are formal analyses being conducted to determine whether a resolution should be pursued?
Assess resolution timing and level			Are formal analyses being conducted to determine when a resolution should be pursued?	Are formal analyses being conducted to determine when a resolution should be pursued?	Are formal analyses being conducted to determine when a resolution should be pursued?	Are formal analyses being conducted to determine when a resolution should be pursued?
			Are DMSMS operational risks being identified and prioritized at various levels of assembly?	Are DMSMS operational risks being identified and resolved at various levels of assembly?	Are DMSMS operational risks being identified and resolved at various levels of assembly?	Are DMSMS operational risks being identified and resolved at various levels of assembly?

Process	ASR	SRR	SFR	PDR	CDR	PRR
Assess resolution timing and level *(continued)*			Is the monitoring of usage and anticipated demand for items and materials being considered in health assessments?	Is the monitoring of usage and anticipated demand for items and materials being considered in health assessments?	Is the monitoring of usage and anticipated demand for items and materials being considered in health assessments?	Is the monitoring of usage and anticipated demand for items and materials being considered in health assessments?

Table 19. DMSMS Management Questions for SETRs: Analyze

Process	ASR	SRR	SFR	PDR	CDR	PRR
Determine the preferred DMSMS resolution				Are DMSMS issues being identified and addressed during the initial item availability analysis before acceptance and approval of the notional BOM?	Are resolutions to DMSMS issues being identified and addressed during the item availability analysis before acceptance and approval of the build baseline/ final design BOM?	Are resolutions to DMSMS issues being identified and addressed before low rate production?
				Is a BCA or AoA being performed (including ROI calculations) as part of resolution determination?	Is a BCA or AoA being performed (including ROI calculations) as part of resolution determination?	Is a BCA or AoA being performed (including ROI calculations) as part of resolution determination?
				Have all costs associated with a resolution been considered?	Have all costs associated with a resolution been considered?	Have all costs associated with a resolution been considered?
				Do mitigation strategies clearly address the entire system life cycle (not just the contract period)?	Do mitigation strategies clearly address the entire system life cycle (not just the contract period)?	Do mitigation strategies clearly address the entire system life cycle (not just the contract period)?

Process	ASR	SRR	SFR	PDR	CDR	PRR
Determine the preferred DMSMS resolution *(continued)*				Has resolution determination taken into account that the most cost-effective resolution may be found at a higher level of assembly?	Has resolution determination taken into account that the most cost-effective resolution may be found at a higher level of assembly?	Has resolution determination taken into account that the most cost-effective resolution may be found at a higher level of assembly?

Table 20. DMSMS Management Questions for SETRs: Implement

Process	ASR	SRR	SFR	PDR	CDR	PRR
Program and budget for DMSMS resolutions			Are DMSMS record keeping data elements being used to generate metrics in support of funding requests?	Are DMSMS record keeping data elements being used to generate metrics in support of funding requests?	Are DMSMS record keeping data elements being used to generate metrics in support of funding requests?	Are DMSMS record keeping data elements being used to generate metrics in support of funding requests?
			Are projected current and out-year DMSMS resolution budgets being developed using a sound analytical basis that is persuasive enough to obtain necessary funding?	Have projected current and out-year DMSMS resolution budgets been established using a sound analytical basis that is persuasive enough to obtain necessary funding?	Have projected current and out-year DMSMS resolution budgets been established using a sound analytical basis that is persuasive enough to obtain necessary funding?	Have projected current and out-year DMSMS resolution budgets been established using a sound analytical basis that is persuasive enough to obtain necessary funding?
			Is funding being sought on the basis of projected resolution budgets?	Have the resolution budgets been approved and funded?	Have the resolution budgets been approved and funded?	Have the resolution budgets been approved and funded?

Process	ASR	SRR	SFR	PDR	CDR	PRR
Integrate DMSMS resolution and modification funding			Is DMSMS resolution programming and budgeting done in coordination with modification planning (technology insertion/ refreshment)?	Is DMSMS resolution programming and budgeting done in coordination with modification planning (technology insertion/ refreshment)?	Is DMSMS resolution programming and budgeting done in coordination with modification planning (technology insertion/ refreshment)?	Is DMSMS resolution programming and budgeting done in coordination with modification planning (technology insertion/ refreshment)?
			Are DMSMS health assessments being considered as a basis for adjusting the scope or schedule of modification planning (technology insertion/ refreshment)?	Are DMSMS health assessments being considered as a basis for adjusting the scope or schedule of modification planning (technology insertion/ refreshment)?	Are DMSMS health assessments being considered as a basis for adjusting the scope or schedule of modification planning (technology insertion/ refreshment)?	Are DMSMS health assessments being considered as a basis for adjusting the scope or schedule of modification planning (technology insertion/ refreshment)?
Implement DMSMS resolutions				Are the DMSMS impacts on the notional BOM, identified during the item availability analysis resolved?	Are the DMSMS impacts on the build-baseline/ final design BOM, identified during the item availability analysis resolved?	Are funded DMSMS resolutions being implemented on a timely basis?

Appendix C. DMSMS-Related Questions for ILAs

This appendix contains DMSMS-related questions intended for use by DMSMS management practitioners to prepare for ILAs before-fielding and during-operations. The questions are presented in five tables.

Table 21–Table 25 contain questions pertinent to the five DMSMS management steps: Prepare, Identify, Assess, Analyze, and Implement.

Table 21. DMSMS Management Questions for ILAs: Prepare

Process	Before-Fielding	During-Operations
Establish the foundations for DMSMS management	Has program office leadership identified required operations and deliverables, defined DMT member roles and responsibilities, and developed a risk-based approach to DMSMS management?	Has program office leadership updated required operations and deliverables, defined DMT member roles and responsibilities, and developed a risk-based approach to DMSMS management?
Develop a DMP	Has the program office established a robust DMSMS management program that identifies obsolescence due to DMSMS before items are unavailable?	Is the DMSMS management program being executed per the formal approved DMP?
	Has a formal DMP been approved and signed by leadership?	Is the government DMP being updated, as necessary?
	Does the government DMP identify the roles and responsibilities of the prime/ subcontractor and third-party vendors?	Has the government DMP been updated to identify the roles and responsibilities of the prime/subcontractors and third-party vendors as necessary?
	Have these roles and responsibilities for the prime/subcontractor and third-party vendors been established?	Have these roles and responsibilities for the prime/subcontractor and third-party vendors been established?
	Is the government conducting sufficient oversight when contractors are performing DMSMS operational processes?	Is the government conducting sufficient oversight when contractors are performing DMSMS operational processes?
Form a DMT	Has the DMT been formed?	Has the DMT been formed?
Establish DMSMS operational processes	Have all DMSMS operational processes been defined and documented in the government DMP?	Have all DMSMS operational processes been defined and documented in the government DMP?
	Are DMSMS management considerations incorporated into pertinent program office documentation?	Are DMSMS management considerations incorporated into updates of pertinent program office documentation?
Secure resources for DMSMS management operations	Have current and out-year DMSMS management operating budgets been established, approved, and funded?	Have current and out-year DMSMS management operating budgets been established, approved, and funded?

Process	Before-Fielding	During-Operations
Establish interfaces to advocate for DMSMS-resilient designs	Have the design engineering interfaces been successful in employing DMSMS resilience principles in the designs?	
	Have the parts management interfaces been successful in selecting items for the designs that will enhance DMSMS resilience?	
	Is DMSMS management a consideration when the system design approach is being determined to minimize the impact on supportability and sustainability?	Is DMSMS management a consideration when the system modification approach is being determined to minimize the impact on supportability and sustainability?
	Are the following addressed? • Open system architecture, • Order of precedence for parts selection (use of QML parts, particularly for applications requiring extended temperature ranges), • Selection of parts relatively new in their life cycle, • Minimized use of custom parts, • Requirement for a preferred parts list and parts control before detailed design to minimize obsolescence issues, • Identification of shelf and operating life requirements, and • Identification of technology life expectancies.	Are the following addressed? • Open system architecture, • Order of precedence for parts selection (use of QML parts, particularly for applications requiring extended temperature ranges), • Selection of parts relatively new in their life cycle, • Minimized use of custom parts, • Requirement for a preferred parts list and parts control before detailed design to minimize obsolescence issues, • Identification of shelf and operating life requirements, and • Identification of technology life expectancies.
Establish a DMSMS management evaluation process	Are metrics being reported to program office leadership and other higher level commands?	Are metrics being reported to program office leadership and other higher level commands?
	Are DMSMS metrics being used for programming and budgeting, improving process efficiency, and determining ROI and other benefits?	Are DMSMS metrics being used for programming and budgeting, improving process efficiency, and determining ROI and other benefits?
Establish a QMS	Is the quality plan being executed to drive continuous improvement?	Is the quality plan being executed to drive continuous improvement?
Establish a case monitoring and tracking process	Has the program office defined the record keeping framework to 1) track information about the resolution implementation process and status and 2) provide information about DMSMS cost and management operations efficiency?	Has the program office defined the record keeping framework to 1) track information about the resolution implementation process and status and 2) provide information about DMSMS cost and management operations efficiency?
	Has the program office developed or identified a DMSMS case tracking database?	Has the program office developed or identified a DMSMS case tracking database?
	Is the program office using DMSMS metrics to track resolution implementation?	Is the program office using DMSMS metrics to track resolution implementation?

Process	Before-Fielding	During-Operations
Establish supporting contracts	Have the roles and responsibilities for the prime/subcontractor and third-party vendors been established as contractual requirements where applicable?	Have the roles and responsibilities for the prime/subcontractor and third-party vendors been established as contractual requirements where applicable?
	Where applicable, are there exit strategies in the contracts that require all sustainment providers to ensure no item EOL issues are unresolved at the completion of the period of performance?	Where applicable, are there exit strategies in the contracts that require all sustainment providers to ensure no item EOL issues are unresolved at the completion of the period of performance?
	Is a CDRL included for the delivery of the prime contractor's DMP?	

Table 22. DMSMS Management Questions for ILAs: Identify

Process	Before-Fielding	During-Operations
Prioritize systems	Are mission criticality, operational safety, and DMSMS-related costs being used to identify and prioritize the systems and subsystems to be monitored?	Are mission criticality, operational safety, and DMSMS-related costs being used to identify and prioritize the systems and subsystems to be monitored?
Identify and procure monitoring and surveillance tools	Have DMSMS forecasting and associated data collection and management tools or service providers been researched and selected?	Have DMSMS forecasting and associated data collection and management tools or service been reviewed to determine their continued suitability for sustainment? Have tool selections been made to supplement, as necessary?
Collect and prepare item data	Have the items associated with critical functions been identified?	Have the items associated with critical functions been updated?
	Is a CDRL included for the delivery of the system BOM?	
	Have indentured BOMs for the systems been acquired in accordance with DI-MGMT-82274?	
	Has the program office obtained the following? • Design disclosed items, including subtier hardware indenture levels and • F3/proprietary design items, including subtier hardware indenture levels Items that are single source and those for which the government cannot obtain data rights and the associated corrective action plans are identified?	
	Has each indentured BOM been loaded into the DMSMS forecasting/management tool?	Has the BOM been regularly updated and reloaded into a DMSMS forecasting/ management tool or service?
	Have items, materials, and software been identified for monitoring?	Have items, materials, and software been identified for monitoring?

Process	Before-Fielding	During-Operations
Analyze item availability	Are the results of the selected forecasting/ management tool or manual research being used to identify immediate and near-term obsolescence issues associated with the BOM?	Are the results of the selected forecasting/ management tool or manual research being used to identify immediate and near-term obsolescence issues associated with the BOM?
	Is the program office receiving obsolescence forecasts on a scheduled basis?	Is the program office receiving obsolescence forecasts on a scheduled basis?
	Are vendor surveys being conducted?	Are vendor surveys being conducted?
	Are PDNs being received regularly?	Are PDNs being received regularly?
Assess preliminary designs for DMSMS risk	Are "quick look" health assessments being conducted to evaluate the DMSMS resilience of a design early in a system's life cycle? Is the designed changed to accommodate the results?	Are "quick look" health assessments being conducted to evaluate the DMSMS resilience of a design early in a system's life cycle? Is the designed changed to accommodate the results?
Forecast technology obsolescence	Has a formal technology roadmap and approved insertion/refreshment plan been developed and funded?	Has a formal technology roadmap and approved insertion/refreshment plan been reviewed for potential updates and adjustments?
	Does the technology roadmap and insertion/ refreshment strategy focus on and address the identification of critical items, materials, and technologies, as well as emerging technologies?	Does the technology roadmap and insertion/ refreshment strategy identify critical items, materials, and technologies, as well as emerging technologies?
	Is the technology insertion/refreshment plan being used to determine the timeframe for potential DMSMS operational impacts?	Is the technology insertion/refreshment plan being used to determine the timeframe for potential DMSMS operational impacts?

Table 23. DMSMS Management Questions for ILAs: Assess

Process	Before-Fielding	During-Operations
Obtain data needed for the assessment	Have programmatic, logistics, availability, and criticality data needs for impact assessment been identified or updated and collected?	Have programmatic, logistics, availability, and criticality data for impact assessment been updated and collected?
Determine whether a resolution should be pursued	Are formal analyses being conducted to determine whether a resolution should be pursued?	Are formal analyses being conducted to determine whether a resolution should be pursued?
Assess resolution timing and level	Are formal analyses being conducted to determine when a resolution should be pursued?	Are formal analyses being conducted to determine when a resolution should be pursued?
	Are DMSMS operational risks being identified and resolved at various levels of assembly?	Are DMSMS operational risks being identified and resolved at various levels of assembly?
	Is the monitoring of usage and anticipated demand for items and materials being considered in a health assessment?	Is the monitoring of usage and anticipated demand for items and materials being considered in a health assessment?

Table 24. DMSMS Management Questions for ILAs: Analyze

Process	Before-Fielding	During-Operations
Determine the preferred DMSMS resolution	Are resolutions to DMSMS impacts being identified?	Are resolutions to DMSMS impacts being identified?
	Is a BCA or AoA being performed (including ROI calculations) as part of the resolution determination?	Is a BCA or AoA being performed (including ROI calculations) as part of the resolution determination?
	Have all costs associated with a resolution been considered?	Have all costs associated with a resolution been considered?
	Do mitigation strategies clearly address the entire system life cycle (not just the contract period)?	Do mitigation strategies clearly address the entire system life cycle (not just the contract period)?
	Has resolution determination taken into account that the most cost-effective resolution may be found at a higher level of assembly?	Has resolution determination taken into account that the most cost-effective resolution may be found at a higher level of assembly?

Table 25. DMSMS Management Questions for ILAs: Implement

Process	Before-Fielding	During-Operations
Program and budget for DMSMS resolutions	Is funding to mitigate DMSMS risk being identified and obtained?	Is funding to mitigate DMSMS risk being identified and obtained?
	Have projected current and out-year DMSMS resolution budgets been established using a sound analytical basis that is persuasive enough to obtain necessary funding?	Have projected current and out-year DMSMS resolution budgets been established using a sound analytical basis that is persuasive enough to obtain necessary funding?
	Have these projected resolution budgets been approved?	Have these projected resolution budgets been approved?
	Have these resolution budgets been approved and funded?	Have these resolution budgets been approved and funded?
Integrate DMSMS resolution and modification funding	Is DMSMS resolution programming and budgeting done in coordination with modification planning (technology insertion/ refreshment)?	Is DMSMS resolution programming and budgeting done in coordination with modification planning (technology insertion/ refreshment)?
	Are DMSMS health assessments being considered as a basis for adjusting the scope or schedule of modification planning (technology insertion/refreshment)?	Are DMSMS health assessments being considered as a basis for adjusting the scope or schedule of modification planning (technology insertion/refreshment)?
Implement DMSMS resolutions	Are funded DMSMS resolutions being implemented on a timely basis?	Are funded DMSMS resolutions being implemented on a timely basis?

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Appendix D. DMSMS Program Capability Levels

The DMP should include plans for achieving a target DMSMS capability level. This appendix contains information to help guide a decision on the appropriate level for a program office. Table 26 identifies the program capability levels for each DMSMS management step and management operational processes. The levels are defined as follows:

- Level 1 represents minimal DMSMS management capability. Practices are largely reactive.
- Level 2 represents a DMSMS management capability greater than Level 1. Practices are somewhat proactive in situations where proactive practices are needed.
- Level 3 represents a DMSMS management capability greater than Level 2. Proactive and some strategic practices are used when needed.
- Level 4 represents a robust DMSMS management capability. Strategic efforts are being applied throughout all steps of the process.

A program office should use the table as the basis for determining the current state of its DMSMS management practices. This is done by examining each row of the table and identifying what is being done. If the program office does not have a DMP, then it is effectively below capability Level 1. The DMP should provide a basis for systematically progressing through the capability levels to achieve the program office's target. Several factors should be considered when determining the appropriate target capability level for a program office:

- A lower capability level could be sufficient near the end of a system's life cycle.
- A higher capability level might be needed for more complex systems, because such program offices are likely to encounter additional DMSMS issues. However, smaller program offices may be seriously affected, depending on the technologies used.
- A higher capability level cannot be achieved without significant DMSMS management subject matter expertise and DMSMS management training for the entire DMT.
- Not every DMSMS management process must be at the same capability level.
- A program office cannot immediately move from a low capability level to a high capability level; the transition should be gradual.
- Resource constraints may exist, either for a single program office or for a group of program offices.

Table 26. DMSMS Program Capability Levels

Step	Process	Level 1	Level 2	Level 3	Level 4
Prepare	Establish the foundations for DMSMS management	Foundations for DMSMS management not established	Program office leadership sets foundations for DMSMS management	Program office leadership sets foundations for DMSMS management	Program office leadership sets foundations for DMSMS management

Step	Process	Level 1	Level 2	Level 3	Level 4
Prepare *(continued)*	Develop a DMP	DMP developed	DMP approved and signed by program office leadership	DMP approved and signed by program office leadership and updated periodically	DMP approved and signed by program office leadership and updated periodically
		DMP calls for no or minimal government oversight of contractor activities	DMP calls for limited government oversight of contractor activities	DMP calls for extensive government oversight of contractor activities	DMP calls for extensive government oversight of contractor activities
	Form a DMT	DMSMS point of contact established (but retains other duties)	DMSMS point of contact established (but retains other duties)	Full DMT formed including all stakeholders. Stakeholders understand their roles and responsibilities	Full DMT formed including all stakeholders. Stakeholders understand their roles and responsibilities
		No independent DMSMS management SME	Limited funding for the use of an independent DMSMS management SME	Independent DMSMS management SME funded to assist the government with overseeing the prime contractor, give an independent perspective on issues and resolutions, and provide general DMSMS management advice	Independent DMSMS management SME funded to assist the government with overseeing the prime contractor, give an independent perspective on issues and resolutions, and provide general DMSMS management advice
		DMSMS point of contact has limited training	DMSMS point of contact trained	DMT trained	DMT members have advanced DMSMS training
	Establish DMSMS operational processes	DMSMS management operational processes entirely ad hoc and reactive; DMSMS management considerations occasionally incorporated in program office documents	DMSMS management operational processes defined, but not documented; DMSMS management considerations incorporated in program office documents	DMSMS management operational processes defined and documented, and processes are proactive when needed; DMSMS management considerations incorporated in program office documents	DMSMS management operational processes defined and documented, and processes are proactive when needed; DMSMS management considerations incorporated in program office documents

Step	Process	Level 1	Level 2	Level 3	Level 4
Prepare *(continued)*	Secure resources for DMSMS management operations	No DMSMS management operations-earmarked funding	Funded to operate at Level 2	Funded to operate at Level 3 Funding shortfall and impact identified and reported to decision makers	Funded to operate at Level 4 Funding shortfall and impact identified and reported to decision makers
	Establish interfaces to advocate for DMSMS-resilient designs	DMSMS design characteristics and parts selection criteria not being raised to design engineering	DMSMS design characteristics and parts selection criteria being considered by design engineering	DMSMS design trades being made and parts selection criteria being consistently applied	DMSMS design trades being made and parts selection criteria being consistently applied
		DMSMS resilience not a design consideration	DMSMS resilience not a design consideration	DMSMS resilience occasionally considered in design trades	DMSMS resilience fully considered in design trades
		DMSMS resilience not considered in parts selection	DMSMS resilience not considered in parts selection	DMSMS resilience occasionally considered in parts selection	DMSMS resilience always considered in parts selection
	Establish a DMSMS management evaluation process	No record keeping	Limited record keeping, limited attempt to evaluate program office	Detailed records kept. Metrics aggregated and analyzed to improve program office performance, to calculate ROI, and to support programming and budgeting	Metrics widely accepted and used by program office management and higher-level organizations
	Establish a QMS	No quality plan	Quality plan established, limited attempt to improve process	Robust quality plan established; corrective actions and continuous process improvement occurring	Quality assurance metrics established; corrective actions and continuous process improvement occurring
	Establish a case monitoring and tracking process	No record keeping or resolutions not being tracked	Ad-hoc record keeping and some resolutions being tracked	Record keeping formalized and resolutions being tracked	Record keeping formalized and resolutions being tracked

Step	Process	Level 1	Level 2	Level 3	Level 4
Prepare *(continued)*	Establish supporting contracts	Marginal contract requirements covering some aspects of DMSMS management	Contract requirements established for all significant and applicable aspects of DMSMS management	Contract requirements, to include exit clauses, established for all significant and applicable aspects of DMSMS management and flowed down the supply chain	Contract requirements, to include exit clauses and incentives, established for all significant and applicable aspects of DMSMS management and flowed down the supply chain
Identify	Prioritize systems	No prioritization of subsystems	Subsystems and items prioritized for DMSMS management execution	Materials and software explicitly considered	Materials and software explicitly considered
		No prioritization of items	Items evaluated to the lowest level to determine a risk-based approach to DMSMS management	Materials and software explicitly considered	Materials and software explicitly considered
	Identify and procure monitoring and surveillance tools	Predictive tools and data management tools only partially in place	Predictive tools and data management tools in place	Comprehensive DMSMS management tools in place	Comprehensive DMSMS management tools in place
	Collect and prepare item data	Only miscellaneous item data collected; everything driven by PDNs or the inability to procure the item	BOM data collected, but may not be indentured	Indentured BOM data collected (including software and materials); vendors surveyed for assemblies, mechanical parts, software, and materials	Indentured BOM data collected (including software interface specifications and materials); vendors surveyed for assemblies, mechanical parts, software, and materials
		BOM data errors not fully corrected	BOM data errors corrected	Items and materials prioritized and determination made regarding what to exclude from proactive monitoring	All items and materials prioritized and determination made regarding what to exclude from proactive monitoring

Step	Process	Level 1	Level 2	Level 3	Level 4
Identify *(continued)*	Analyze item availability	Predictive tools used occasionally	Results of predictive analyses for electronic items examined continually	Results of at least two predictive tools examined continually for electronic items Vendors surveyed periodically for MaSME items and software	Results of at least two predictive tools examined continually for electronic items Vendors surveyed periodically for MaSME items and software
	Assess preliminary designs for DMSMS/ obsolescence risk	No assessments of preliminary designs	Some assessments of preliminary designs	Assessments of most preliminary designs	Assessments of preliminary designs always conducted
	Forecast technology obsolescence	No technology roadmaps developed	Technology roadmaps created	Technology insertion and refreshment plans being developed	Technology roadmaps used to develop technology insertion and refreshment plans
Assess	Obtain data needed for the assessment	No programmatic, logistics, availability, and criticality data collected	Little programmatic, logistics, availability, and criticality data collected	Some programmatic, logistics, availability, and criticality data collected for impact assessment	Comprehensive programmatic, logistics, availability, and criticality data collected for impact assessment
	Determine whether a resolution should be pursued	Ad hoc determination made with no analysis	Resolution pursued in all cases	Some logistics and programmatic data and vendor surveys being used to determine when an operational impact will occur	Extensive logistics and programmatic data and vendor surveys (including software and materials) being used to determine when an operational impact will occur
	Assess resolution timing and level	Ad hoc; only when PDN received	Only parts availability considered	Some logistics and programmatic data and vendor surveys being used to determine when an operational impact will occur	Extensive logistics and programmatic data and vendor surveys (including software and materials) being used to determine when an operational impact will occur

Step	Process	Level 1	Level 2	Level 3	Level 4
Assess *(continued)*		No priorities	No priorities	Rough priorities being assigned	Specific priorities being assigned; next higher levels of assembly being examined for operational impact
Analyze	Determine the preferred DMSMS resolution	Ad hoc; limited cost data used	AoA conducted using unrefined cost factors	BCA conducted using refined cost factors, tailored to the specific problem	Resolution options determined at item level and for higher levels of assembly BCA used where necessary
Implement	Program and budget for DMSMS resolutions	No resolution budgets; funding sought on case-by-case basis	No resolution budgets; funding sought on case-by-case basis	Resolution budgets funded based on projections of issues; out-year budgets unfunded	Active engagement in obtaining other sources of funding; out-year budgets programmed
	Integrate DMSMS resolution and modification funding	No health assessments conducted	DMSMS resolution programming and budgeting uses health assessments to establish resolution timing	DMSMS resolution programming and budgeting done in conjunction with modification planning	DMSMS resolution programming and budgeting done in conjunction with modification planning; health assessments used to adjust modification plans
	Implement DMSMS resolutions	No follow-up	Minimal oversight of execution	Comprehensive oversight of execution	Comprehensive oversight of execution

Appendix E. Contracting

DMSMS management can be performed 1) by a program office using government personnel (and contractor technical support), 2) by the prime contractor and its subcontractors,[174] or 3) by independent DMSMS management SME organizations.[175] The entity managing DMSMS issues for a program office has no bearing on the robustness of that effort.

Regardless of who performs DMSMS management, the government remains responsible for ensuring that DMSMS risk is managed effectively. The government must remain in a position to carefully oversee what the prime contractor and its subcontractors do with regard to DMSMS management, including the identification and resolution of current and near-term obsolescence issues. Simply receiving an item obsolescence report at a design review is not sufficient oversight; the government should have a thorough understanding of and maintain visibility into the DMSMS management processes being used by the prime contractor and its subcontractors.

Effective management is established by the DMP, which emphasizes how a robust DMSMS management effort will reduce future obsolescence-related costs and minimize detrimental impacts on materiel readiness, operational mission capability, and safety of personnel. The DMP identifies all the program office's DMSMS management planning objectives, the approach to be pursued, and the entities that will perform the functions necessary to pursue the approach (see Section 3.2). If contractors perform the work, the DMP should describe the nature and extent of government oversight.

The DMSMS management responsibilities of contractors can vary greatly. Under certain circumstances, nearly all DMSMS management activities (other than program office oversight) will be performed by contractors. This is often the case when dealing with complex systems prior to sustainment. In other situations, the government may perform most DMSMS management functions. This generally applies to commercial items or to systems maintained organically. Contract language must be tailored to these two extremes and everything in between.

When a program office decides to use a prime contractor (and its subcontractors) or an independent SME organization for DMSMS management, contracts containing DMSMS management-related requirements (including government access to sufficient DMSMS management-related information), combined with government oversight, provide the basis for ensuring that DMSMS management is effective. This appendix provides a broad overview of the factors a program office should consider incorporating into contracts with a prime contractor (and its subcontractors) or an independent contractor provider of DMSMS management. It also discusses considerations for making a decision about whether to contract for DMSMS management.

The SD-26 provides much more detailed guidance. Its purpose is to assist DoD program offices in preparing DMSMS management provisions in contracts by providing representative contract language for

[174] The OEM should be responsible for flowing down DMSMS management-related contractual requirements to its suppliers and to require those suppliers to flow down DMSMS management-related requirements through their supply chains in a similar way. This appendix assumes that is the case whenever the OEM is discussed as a potential provider of DMSMS management functions.

[175] An independent SME organization could be part of a government DMSMS management SME team, as discussed in Section 3.3.1.

various aspects of DMSMS management. The tables in the SD-26 contain illustrative contract language, and related information keyed to specific DMSMS management tasks, for use in preparing a consolidated performance work statement or SOW for contract DMSMS management activities. The following is a list of the tables included in Appendix A of the SD-26 which suggests ways to fill out the CDRLs for different scenarios:

- Table 1. Illustrative Contract Language for Areas of Potential DMSMS Requirements;
- Table 2. Clause Applicability during Each Acquisition Phase;
- Table 3. Clause Applicability Based on Government Involvement in DMSMS Management;
- Table 4. Notional Decision Drivers for Table 3;
- Table 5. DMSMS Topics for Non-DMSMS Contract Sections;
- Table 6. DMSMS CDRLs and DIDs; and
- Table 7. Non-DMSMS CDRLs and DIDs that could or should exist in the contract.

The SD-26 can be used when relevant or tailored for the specific approach to DMSMS management the program office has taken. The wording should be tailored to the specific program office to blend with its acquisition strategy, product support concepts, competition strategy, technical data strategy, and IP acquisition strategy (all likely contained in the program office's acquisition strategy).

It is useful to read this appendix before reading the SD-26.

E.1 DETERMINING WHETHER TO CONTRACT FOR DMSMS MANAGEMENT

E.1.1 General Factors to Consider

Early in a system's life cycle, a decision should be made regarding who will have primary responsibility to perform DMSMS management in support of the program office. This section includes a number of factors a program office should consider in determining whether to keep DMSMS management solely within the government or to contract with a prime contractor (and its subcontractors) or an independent SME organization.

E.1.1.1 AVAILABILITY OF RESOURCES

Using a contractor (whether a prime contractor and its subcontractors or an independent SME organization) for DMSMS management requires funding. In some instances, the program office may already have funding available associated with a design, production, or sustainment contract. In those cases, such contracts and funding could be used to support a prime contractor and its subcontractors as the DMSMS management provider for the program office. Using an independent SME organization for DMSMS management normally requires a separate contract. If funding available for such contracts is limited, internal program office staff should be used to provide DMSMS management functions.

E.1.1.2 DMSMS Management Capability

The capability of the organizations being considered to perform DMSMS management should be a key consideration. Two basic capability questions that apply to all organizations are as follows:

- What kind of capability and access does the organization have regarding the receipt of PDNs or the ability to manually research items?
- Have other program offices used this organization? How have these other program offices evaluated the organization's performance?

From a prime contractor's perspective, if there is a robust DMSMS management capability in place, then the program office might want to leverage that existing capability, rather than establish an entirely duplicative government-run DMSMS management program. In this case, the government might want the prime contractor to manage and mitigate DMSMS issues for the program office, while the program office establishes a surveillance strategy for the government to oversee the prime contractor's DMSMS management efforts. However, if a prime contractor's internal DMSMS management program does not appear to be sufficiently effective, then the government may need to establish its other more robust DMSMS management program before a contract requirement is created.

If a program office is considering the use of an independent SME organization, it should take into account the additional capabilities such an independent SME organization might offer, as compared to other DMSMS management providers. Below are some questions that a program office should consider:

- Is the independent SME organization offering DMSMS management capability that is not available through the prime contractor or the program office itself? If so, what additional capability is being offered?
- Is an independent SME organization needed if the prime contractor and its subcontractors have an existing, robust DMSMS management capability?

E.1.1.3 LIFE-CYCLE PHASE

During the design and production phases of a system's life cycle, the program office already has a prime contractor under contract to develop and manufacture the system. DMSMS management and mitigation should inherently be a part of those efforts; therefore, the prime contractor and its subcontractors are in a natural position to perform these activities. In such a case, the government should ensure that a contractual requirement exists for the prime contractor to develop and deliver a DMP establishing its DMSMS management objectives and approach for the program office in alignment with the DMP for the program office. There is, however, the potential for conflicting forces to be at work, if DMSMS management responsibility is assigned to the prime contractor. The business objectives of any for-profit company include lowering costs and increasing revenue, whereas implementing DMSMS management practices requires expending time and resources. The contractor's leadership must understand that DMSMS management is a good business practice, because it makes products more attractive to buyers through the reduction of total ownership cost. Consequently, the contractor's products will have a competitive advantage.

Effective DMSMS management in the design phase is critical. If obsolescence is "designed in," then the program office will face large costs to mitigate these problems later in the life cycle. The prime contractor and its subcontractors, operating under comprehensive government oversight, are in a good position to manage DMSMS issues during design, because of their familiarity with the current configuration of the design (including the potential for rapidly changing items).

Although the system's parts lists and BOMs should be stable by the time the system has entered the production phase, the government will still have limited experience with the system. Consequently, the prime contractor may continue to play a key role in DMSMS management. One of the areas that the government should include in its oversight is laying the appropriate groundwork to transition DMSMS management to the entity most appropriate to perform that role during sustainment.

Typically, the government uses a combination of three different sustainment strategies:

- In-house support through a service depot or supply system or through DLA,
- Non-PBL contractor support services, and
- PBL contracts.

In the first case, the government will typically not use the prime contractor and its subcontractors for DMSMS management. The government will either use its own in-house capability or combine its in-house capability with an independent SME organization. The latter two cases do not preclude the use of organic service providers through public-private partnerships, especially for PBL contracts where such partnerships are commonly formed.

The use of non-PBL contract support depends on the scope of work. For example, a contractor operating a repair depot on either a cost-reimbursable or fixed-price basis could be asked to perform DMSMS management. If the work is more limited (e.g., interim or emergency support), then DMSMS management could be out of scope for that contract.

PBL is a sustainment strategy that places primary emphasis on optimizing system support to meet the needs of the warfighter. PBL specifies outcome performance goals of systems, ensures that responsibilities are assigned, provides incentives for attaining those goals, and facilitates the overall life-cycle management of system reliability, supportability, and total ownership costs. It is an integrated acquisition and logistics process for buying system capability. Generally, PBL contracts are long term (five–ten years) and require that the provider manage many aspects of product support throughout the life cycle. A properly structured PBL contract contains DMSMS management requirements.

In a theoretical sense, PBL incentivizes the provider to maintain a proactive DMSMS management program to achieve the required performance outcomes. This is not always true in practice. The contractor will take the most cost-effective approach to meeting its performance requirements within the terms and conditions of its contract. This approach may not be the most cost effective for the government when the contract is completed, which is why DMSMS management should be specifically called out in the PBL arrangement. The government should ensure that its DMSMS management interests are adequately covered in the contract, especially at and near the end of the period of performance.

E.1.1.4 CONFLICTS OF INTEREST

Whenever the government contracts for services, it must determine whether any potential conflicts of interest exist and then manage those situations effectively. For example, there could be a situation in which a non-government DMSMS management provider has a business interest (e.g., potential additional revenue) regarding a specific resolution option, as compared to other options. This situation does not necessarily preclude the use of that DMSMS management provider; however, it does place an additional burden on the government to appropriately oversee and understand the potential repercussions of decisions and to factor them into the program office's decision-making process.

E.2 AN OVERVIEW OF DMSMS ACTIVITIES IN CONTRACTS

When contracting for DMSMS management, a program office should develop a contract that clearly conveys DMSMS management requirements. (The program office also should state, in its RFP and other communications, that DMSMS management-related criteria will be used in source selection). This ensures that the contractor knows its specific responsibilities for DMSMS management and that the government has access to the information it needs for adequate oversight.

E.2.1 Representative Management Activities by Acquisition Phase

The following is a list of representative DMSMS management activities—by acquisition phase—that a program office should consider when developing contracts to cover DMSMS management:

- Design and development
  - The prime contractor and its subcontractors should minimize obsolescence throughout the contract period of performance by selecting products that will avoid or resolve hardware, software, and firmware obsolescence issues. This may be pursued through various DMSMS resilience design considerations, such as selecting technologies or items that are not near their EOL, parts management, open systems design, and so on, as described in Section 3.4.2.
  - The prime contractor and its subcontractors should determine the most cost-effective resolution to obsolescence issues. For the purposes of the contract, hardware, software, and firmware should be considered obsolete when the item can no longer be procured from the OCM as identified in the current TDP.
  - The prime contractor and its subcontractors should flow down DMSMS management requirements to their suppliers, who should flow down requirements in a similar manner.
  - The prime contractor should deliver a parts list and indentured BOM (or notional versions, if that is all that is available at the time), in accordance with DI-MGMT-82274, to the program office at agreed-upon points in the technical schedule.
  - The prime contractor and its subcontractors (and possibly an independent third-party contractor if one is to be used) should monitor the availability of items (with agreed-upon frequency of update) and provide the results to the program office. The government should be notified of pending and emergent obsolescence issues, supplier recall notices, and emergent vendor-implemented changes.
  - The prime contractor and its subcontractors should resolve and document any DMSMS issues before the delivery of the design. (Supplemental funding for the contractor may be necessary.)
  - The prime contractor should deliver a production plan for low rate initial production (LRIP).
  - The prime contractor should deliver a supportability roadmap (with agreed-upon frequency of updates).
  - The prime contractor should deliver a description of how the system is envisioned to be supported after fielding, including the process for assigning the source of repair.
  - The prime contractor and its subcontractors (and possibly an independent third-party contractor if one is to be used) should participate in the government-contractor DMT (with frequency of face-to-face and telephone communications specified).
- Production
  - The prime contractor and its subcontractors should minimize obsolescence throughout the contract period of performance by selecting suppliers that will avoid or resolve hardware, software, and firmware obsolescence issues.
  - The prime contractor and its subcontractors should determine the most cost-effective resolution to obsolescence issues. For the purposes of the contract, hardware, software, and firmware should be considered obsolete when the item can no longer be procured from the OCM as identified in the current TDP.

- The prime contractor and its subcontractors should flow down DMSMS management requirements to their suppliers, who should flow down requirements in a similar manner.
- The prime contractor should deliver a parts list and indentured BOM, in accordance with DI- MGMT-82274, to the program office if it has not already been delivered.
- The prime contractor and its subcontractors (and possibly an independent third-party contractor if one is to be used) should monitor the availability of items (with agreed-upon frequency of update) and provide the results to the program office. The government should be notified of pending and emergent obsolescence issues, supplier recall notices, and emergent vendor-implemented changes.
- The prime contractor and its subcontractors should solve and document any DMSMS issues before delivery of the system for fielding.
- The prime contractor and its subcontractors (and possibly an independent third-party contractor if one is to be used) should participate in the government-contractor DMT (with frequency of face-to-face and telephone communications specified).
- The prime contractor and its subcontractors should develop and execute a plan to transition DMSMS management to the sustainment provider.

- End of production
  - For systems that are required for many decades of continuous service, an in-depth DMSMS study should be performed before the contractual production line schedule ends because when production ends, obsolescence and item unavailability often increase dramatically. The study should determine potential future “end item” readiness impacts with and without the supplier(s)’ production line support.
  - A BCA for extending production line(s) at a reduced output rate at some level of assembly should be made to evaluate options for reducing future resolution costs.
- Sustainment
  - The sustainment provider should minimize obsolescence throughout the contract period of performance by selecting suppliers that will avoid or resolve hardware, software, and firmware DMSMS issues.
  - The sustainment provider, especially in the PBL case, should determine the most cost-effective resolution to DMSMS issues. For the purposes of the contract, hardware, software, and firmware should be considered obsolete when the item can no longer be procured from the OCM as identified in the current TDP.
  - The sustainment provider, especially in the PBL case, should flow down DMSMS management requirements to suppliers, who should flow down requirements in a similar fashion.
  - The sustainment provider (and possibly an independent third-party contractor if one is to be used) should monitor the availability of items (with agreed-upon frequency of update) and provide the results to the program office. The government should be notified of pending and emergent DMSMS issues, supplier recall notices, and emergent vendor-implemented changes.
  - The sustainment provider (and possibly an independent third-party contractor if one is to be used) should participate in the government-contractor DMT (with frequency of face-to-face and telephone communication specified).
  - The sustainment provider should recommend DMSMS resolutions.

- The sustainment provider should work with the program office in areas such as asset management, preservation of tooling and support equipment, and reclamation or use of retired assets as requested.

E.2.2 Exit Clauses

Exit clauses do not fit neatly into DMSMS management in contracts by acquisition phase or by function. Nevertheless, exit clauses for DMSMS management are a critical element in any contract, including PBL contracts. The primary purpose of this type of clause is to mitigate the risk of DMSMS issues at the end of the contract period of performance. Exit clauses require the contractor to ensure all known and forecasted DMSMS issues have been identified and have mitigation plans, so that the program office is not left with a system that is not supportable or sustainable due to DMSMS issues. By requiring the contractor to deliver all accumulated (non-proprietary) DMSMS to the program office in a specified format, exit clauses ensure that the information needed to manage DMSMS issues is provided. They establish procedures and timeframes to ensure the orderly and efficient transfer of performance responsibility upon completion or termination of the contract. The exit clauses should require delivery of those items, identified in the SOW or statement of objectives, within the negotiated contract price.

Exit clauses are necessary but not sufficient to guarantee the transition of DMSMS management responsibilities from one provider to another. As part of its contractor oversight, the program office should develop an understanding of all DMSMS management activities being performed by the contractor. In that way, the program office will be in the best position to ensure that effective DMSMS management continues throughout a transition.

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Appendix F. Developing DMSMS Management Workforce Competencies

This appendix outlines the recommended training required to achieve entry-level, technician-level, and leadership-level competencies and experience associated with the roles and responsibilities of DMSMS management practitioners.

Entry-level training provides an individual with basic knowledge of the processes and procedures required to establish and maintain a robust DMSMS management program. An individual with entry-level competency is not expected to be proficient in analyzing DMSMS issues or in leading a DMSMS management program. An individual with entry-level competency should perform DMSMS analysis only in conjunction with an individual possessing technician-level or leadership-level competency. An individual with leadership-level competency should review all data before they are submitted for approval. An individual with entry-level competency should assist with DMSMS management functions under the supervision of an individual with leadership-level competency.

An individual with technician-level competency is capable of leading, conducting, explaining, and defending the results of any analyses that he or she has led. DMSMS analysts with technician-level competency should submit analyses to a person with a DMSMS management leadership-level competency for approval. A DMSMS analyst with a technician-level competency should be capable of establishing and maintaining a robust DMSMS management program with minimal oversight.

An individual with leadership-level competency is well versed, trained, and experienced in DMSMS analyses, applications, and management practices. This is the desired level for DMT leaders. A leadership-level analyst will have developed and led numerous DMSMS efforts and must be conversant in all aspects of DMSMS management processes and policy. The leadership-level analyst is ultimately responsible for planning the overall DMSMS management effort for a program office.

DMSMS management competency is not developed in a vacuum. It must be obtained in conjunction with DAU DAWIA certifications for government employees and a company analog for industry.[176]

To achieve DMSMS management entry-level competency, an individual should have the following DAU training beyond DAWIA level 1 certification in any career field:

- DMSMS: What Program Management Needs to Do and Why (LOG 0640),
- DMSMS Fundamentals (LOG 0650),
- DMSMS Executive Overview (LOG 0660),
- Introduction to Parts Management (LOG 0630),

[176] The DAWIA was initially enacted as Public Law 101-510 in November 1990. Most of the act is codified in 10 U.S.C. § 1701–1765.

- DMSMS Basic Component Research (LOG 0670),
- Defense Logistics Agency Support to the PM (LOG 0020),
- Market Research (CLC 004),
- Life-Cycle Logistics for the Rest of Us (CLL 004),
- Market Research for Engineering and Technical Personnel (CLE 028),
- COTS Acquisition for Program Managers (CLM 025),
- Preventing Counterfeit Electronic Parts from Entering the DoD Supply System (LOG 0320),
- Counterfeit Prevention Awareness (CLL 062),
- Fundamentals of Systems Acquisition Management (ACQ 101),
- Fundamentals of Test and Evaluation (TST 102), and
- Fundamentals of Systems Engineering (ENG 101).

To achieve DMSMS management technician-level competency, an individual should have the following DAU training beyond DAWIA level 2 certification:

- All entry-level competency requirements;
- Product Support Business Case Analysis (CLL 015);
- Planning, Programming, Budgeting, and Execution (BFM 0050);
- Independent Logistics Assessments (CLL 020);
- Reliability and Maintainability (CLE 301);
- Contracting for the Rest of Us (CLC 011);
- Introduction to Parts Management (LOG 0630);
- Provisioning and Cataloging (LOG 0380);
- Supportability Analysis (LOG 0120, LOG 211V, or LOG 211);
- Introduction to Data Management (CLM 071);
- Improved Statement of Work (CLM 031);
- Technical Reviews (CLE 003);
- Modular Open Systems Approach (CLE 019);
- Risk Management (CLM 093, PMT 0170, ISA 220, BCF 206, or BCF206V);
- Sustaining Engineering (LOG 0470);
- System Retirement, Disposition, Reclamation, Demilitarization, & Disposal (CLL 051);
- Applied Systems Engineering in Defense Acquisition, Part I (ENG 201);
- Introduction to DoD Software Lifecycle Management (CLL 027);
- Additive Manufacturing (LOG 0390) future;

- Performance-Based Logistics (LOG 235); and
- Lead Free Electronics Impact on DoD Programs (CLL 007).

To achieve DMSMS management leadership-level competency, an individual should have the following DAU training beyond DAWIA level 3 certification:

- All technician-level competency requirements,
- Intellectual Property and Data Rights (CLE 068),
- Program Protection Planning Awareness (ACQ 160),
- Technical Data Management (LOG 215),
- Trade Studies (CLE 026),
- Forecasting Techniques (CLB 026),
- Configuration Management (LOG 204),
- Reliability Centered Maintenance (RCM) (CLL 030), and
- Applied Systems Engineering in Defense Acquisition, Part II (ENG 202).

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Appendix G. Programming and Budgeting for DMSMS Management Operations

As a best practice, program office leadership should program and budget for all DMSMS management operations for data collection and management, research, and forecasting using a risk-based approach and in consultation with the DMT and contractors supporting DMSMS management. That risk-based approach determines the subset of items to be proactively monitored and thereby drives the level of effort required. Four enabling best practices are discussed below.

G.1 CONVINCE PROGRAM MANAGEMENT OF THE ROI

While this enabling best practice is not about programming and budgeting per se, it is a key enabler. In some instances, program office management does not recognize the importance of DMSMS management operations. Reasons for this include competing program office priorities, unfamiliarity, and a belief in a number of DMSMS-related myths. The DAU Course LOG 0640 entitled "What Program Management Needs to Do and Why," debunks the following myths. All the following statements are *false*:

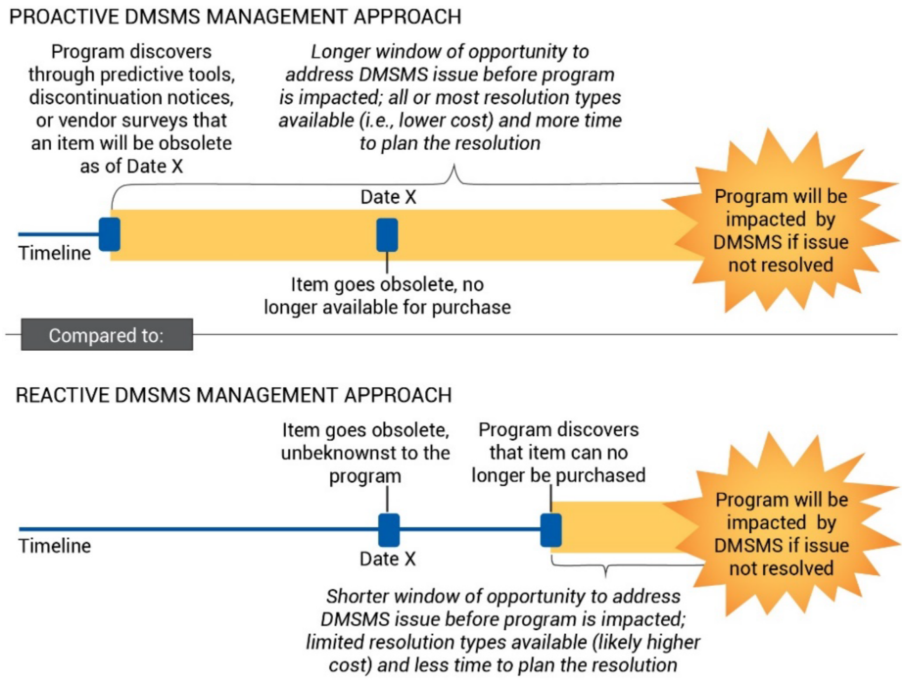
- Myth #1. My system is not in sustainment yet, so obsolescence issues do not exist.
- Myth #2. A design's use of COTS assemblies provides built-in obsolescence immunity.
- Myth #3. DMSMS is just another drain on a program office's budget.
- Myth #4. My system has a performance-based AS, so the prime handles obsolescence.
- Myth #5. PBL forces the vendor to address obsolescence efficiently.
- Myth #6. My system has hired independent DMSMS SMEs, so they handle the resolutions.

Despite these myths, many PMs and PSMs recognize proactive DMSMS management operations as a priority and understand that it will cost a great deal more to deal with problems reactively. However, program office management activities are extremely demanding and time consuming. During design, development, and production, their focus is on meeting cost, schedule, and performance goals. In sustainment, program office management is heavily concerned with operational activities and readiness. Unfortunately, even when the importance is recognized, insufficient priority may be given to DMSMS management operations funding and the program office is forced to be reactive.

The ultimate reason for giving priority to DMSMS management is that it extends the window of opportunity for resolving DMSMS issues. Figure 27, reproduced here for convenience from Section 3.4.3.2.3, depicts the way in which proactive DMSMS management increases the window of opportunity for resolving a DMSMS issue before it impacts a DoD system. A longer window of opportunity improves three key aspects of ROI—increasing the likelihood of implementing a lower cost resolution and decreasing the likelihood of the affected system suffering schedule delays or lower operational availability.

The window of opportunity, highlighted in yellow in Figure 27, can be used as an argument to convince program office management of the ROI for fully funding DMSMS management operations. Tangible benefits of DMSMS management activities can be articulated quantitatively. A program office may be able to demonstrate conclusively how a DMSMS issue identified as a result of proactive DMSMS management (before a failed attempt to procure and before a manufacturer's discontinuation notice would have been received) avoided a more costly resolution or prevented a schedule slip. Such a demonstration would require proof that the resolution selected proactively would not have been feasible at a later point in time as well as an estimate of what would have been done had action been delayed. For example, the following may be used to convince program office management of the need to assign sufficient priority to DMSMS management operations funding.

Figure 27. How Proactive DMSMS Management Increases the Window of Opportunity for Resolving a DMSMS Issue



- Show specific examples of significant cost impacts by being reactive.

  It is best to use actual experience from the specific program office. If none are available, a DMT should seek examples from larger service working groups. LOG 0640 contains the following example:

  – The OEM for a program office identified component obsolescence issues pertaining to three boards within a box and a module of a system. The parts with obsolescence issues were critical to the system. The obsolescence had not been addressed previously because more immediate program office interests and priorities, focused on operational test and evaluation (OT&E) took priority. When the system was in the OT&E phase and ready to begin LRIP, the previously identified obsolescence issues were projected to impact production within three years. The OEM proposed a resolution with a price of $11.6 million. Working with the OEM, the program office was able to isolate the immediate obsolescence issues to five components. For four of the components a complex substitute was possible, but the F3 components still required testing and approval. The fifth component required a more extensive redesign. This resulted in a revised OEM proposal of $6.6 million to resolve the obsolescence associated with the five components. If the program office had acted to resolve obsolescence when it was initially identified, LON buys for the five components covering the quantities necessary for six future lots, could have been purchased for $518,000, avoiding more than $6 million in costs.

- Show specific examples of readiness or schedule impacts associated with reactivity.

  As stated under cost impacts, where possible, use examples of significant schedule and readiness impacts associated with the specific program office or another program office in the service. LOG 0640 contains the following examples:

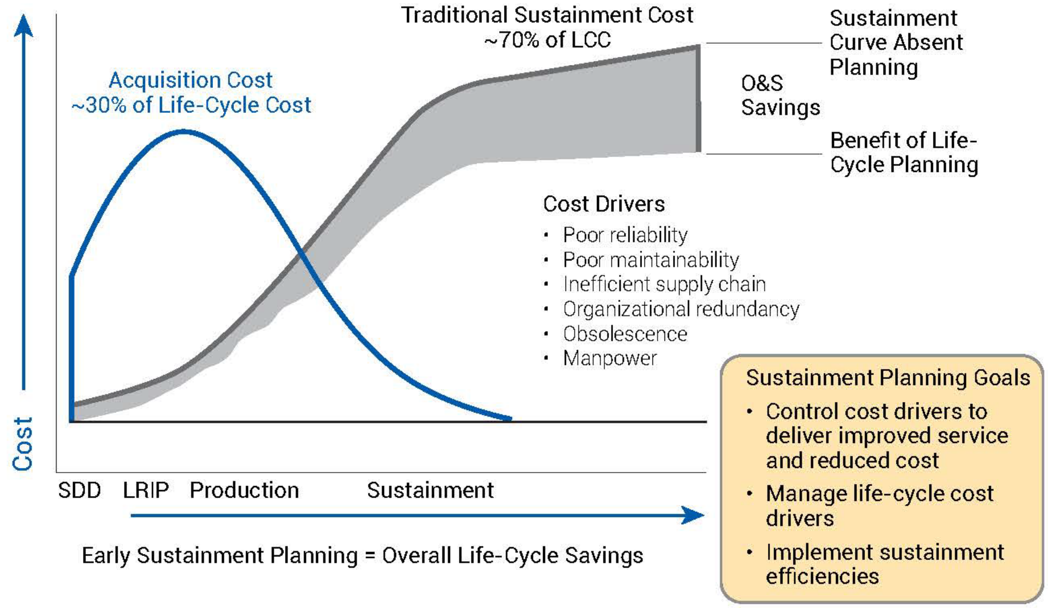
  – *Schedule impact.* A system was about to enter another manufacturing cycle to support the next phase of a multi-year production contract. When the OEM went to contract with a subcontractor for the next lot of media convertors for that system, it was determined that the media converters couldn't be manufactured due to obsolescence. Because there was no F3 alternate, the program office was forced to redesign and transition to a new configuration. The new configuration required requalification and was replaced by attrition. The implementation plan required the program office to support two design configurations during the replacement and sustainment period. This redesign effort stalled production for three–four months, which delayed the overall schedule for the program office a corresponding amount. The entire obsolescence resolution effort cost $800,000 to $1 million.

  – *Readiness impact.* During the production contract for one air platform, an obsolescence issue was identified pertaining to a display LRU. The program office decided to not allow this obsolete LRU to shut down the entire production line. Instead, production of the air platform continued and these platforms were delivered to the field with the plan to install the LRU once available. Unfortunately, the absence of this LRU made the air platform mission incapable and the result, at least for a time was the non-availability of MICAP systems to support training and unit activations to theater.

- Explain how proactive DMSMS management operations can lower the life-cycle cost.

  Figure 28 notionally illustrates that the bulk of life-cycle cost is incurred during sustainment. Robust, proactive DMSMS management operations may provide a basis for lowering that life-cycle cost curve, also as depicted in the figure as the "benefit of life-cycle planning." There is, of course, the complication that the current PM may believe that any effect on life-cycle cost will be far in the future and therefore choose to spend current resources on current problems and not invest in DMSMS management operations. Such a belief is erroneous as illustrated by the first two examples, the impact could be very short term.

Figure 28. Notional Depiction of How Including DMSMS Management Operations in Life-cycle Planning May Lower Sustainment Costs



Source: Hot Topics in DoD Logistics, Briefing by Kristin K. French, Acting Assistant Secretary of Defense for Logistics and Materiel Readiness to the Product Support Managers Workshop, June 6, 2017.

Note: LCC = life-cycle cost; SDD = system development and demonstration.

- Explain how proactive DMSMS management operations are key to accurate programming and budgeting not only for DMSMS resolutions but also for modifications.

  Robust DMSMS management operations benefit program offices beyond providing advance notice of obsolescence. One such benefit is the development of DMSMS health assessments.[177] These health assessments estimate when some assembly or unit will no longer be supportable as a result of either current or anticipated obsolescence taking both stock on hand and expected demand into account.[178] These estimates inform programming and budgeting not only for DMSMS resolutions but also for scheduling technology refreshments, capability improvements, and/or other modifications. Without this information, programmed and budgeted amounts may be insufficient and out of cycle modifications (redesigns) may become necessary to resolve obsolescence issues for the system to remain operational between funded modifications (especially during sustainment).

All these examples (along with ones from the program office itself) should at least be sufficient for the PM to allocate some start-up funding to DMSMS management operations. The result of doing this, should almost always clearly demonstrate its value and establish a desire to continue (and increase where needed) funding.

G.2 EVALUATE THE FUNDING NEEDED

Another enabling best practice is to develop a basis for evaluating the level of funding needed for proactive DMSMS management operations. There are situations where, as a result of a service-wide centralized contract, program offices may obtain independent SME support at no cost. When this occurs, it of course is not necessary to POM/budget for that support.

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[177] See Section 5.3.
[178] See Section 5.3.

The cost of DMSMS management services provided by primes/OEMs/logistics support providers can vary widely. Factors contributing to this variation include contractor experience and in-house capabilities, type and level of services provided, and the ability to separate DMSMS management functions from other similar functions. For example, a single person may be performing parts management, DMSMS management, and engineering functions. It's a best practice to use independent SMEs to technically evaluate the DMSMS management operations functions and associated costs in proposals. In addition, these independent SMEs should also provide technical support to the actual contract negotiations.

Section 3.4.6.1 describes why external SME services should be performed by both the prime contractor/ OEM and independent SMEs. DMSMS management operations costs should be separately estimated for each of these entities because they are funded through different mechanisms. The prime contractor/OEM efforts are normally funded as part of the larger design/development/production/PBL/sustainment contracts.[179] Independent DMSMS management SMEs are normally funded via separate contract vehicles.

The DMT can assist program office leadership in developing its program and budget submissions for funding DMSMS management operations. Two approaches for making these estimates are as follows:

- Estimate based on specific activities

  Section 3.4.1.1 listed the specific activities encompassed by DMSMS management operations. The cost of independent SMEs depends on the services required/provided, the number of items to be monitored, and whether the effort is in a start-up or steady-state mode among other factors. Funding needs could be developed through a determination of the person hours required to perform the work and then multiplying those hours by the appropriate rates. Program office management and engineering can help in making such estimates. They can provide insight on what will be monitored proactively, risk reduction activity, and resource constraints. Nevertheless, this is a complex task and program office personnel may not have sufficient experience to approximate necessary expenditures.

  If a program office is currently receiving independent SME support, then it should be in a good position to estimate future needs. If a program office is not receiving independent SME support, it is a best practice to begin with a person-year of effort (unless there is a reason to do otherwise).[180] After the first year, the program office will be in a better position to estimate future funding requirements based on the value of the support being provided, the functions to be performed, and the expected level of effort to perform them.

- Estimate based on rules of thumb

  The following planning factors will help in determining the cost of using external SMEs (i.e., primes, OEMs, and/or independent SMEs) to conduct DMSMS management operations. It is highly likely that initial person-hour estimates will not be accurate and consequently are subject to revision.

  - Number of parts lists/BOMs to be addressed by the DMSMS management effort (dividing these into critical, mission essential, and non-mission critical may provide a program office

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[179] Separating DMSMS management costs from DMSMS resolution costs may be difficult because these vehicles may also include the implementation of resolutions depending on the terms and conditions of the contract. Appendix E contains more information on contracting.

[180] For example, a mechanical system with a low risk of obsolescence may be able to start with less than a person-year. Highly complex systems may want to begin higher, but an evaluation must be made of whether it is feasible to ramp-up support quickly enough to usefully spend more than one person-year.

with the opportunity to phase in the assessment and analysis, and corresponding costs, of less critical ones over time, rather than all at once);

- Whether the items to be addressed are primarily electronic or primarily COTS or MaSME;
- Number of person-hours required to perform the non-recurring startup tasks for each BOM;
- Number of person-hours required to perform recurring steady-state tasks to monitor each parts list/BOM;
- Number of person-hours required to perform recurring steady-state tasks to assess and analyze each parts list/BOM;
- Number of person-hours required to perform strategic processes such as technology roadmapping, design resilience reviews, and long-term health assessments;
- Number of person-hours required to generate reports; and
- Person-hour costs for participating in meetings.

When estimating external SME person-hours, the level of service is a very important consideration. The DMSMS management program initiation; data collection and management, research and forecasting; and data analysis and oversight activities listed above represent full service. While it is not a best practice, some program offices may not have funding for all aspects of full service, especially those associated with the data analysis and oversight.

With this information, program offices can estimate the funding required to support DMSMS management operations to provide input to formulating the program office's programming and budgeting submissions. A spreadsheet and model originally developed by the Naval Air Systems Command (NAVAIR) and currently available on the DKSP can be used to help estimate certain DMSMS management costs for electronic units (e.g., LRUs or WRAs). The planning factors were developed over five years and were based on averages so they are not tailored to the level of service or the degree of automation. Consequently, for example, recurring costs (e.g., vendor surveys) not specifically identified are embedded into the planning factors. Table 27, excerpted from the model itself, shows the planning factors incorporated. The top half of the table shows startup and other non-recurring activities, while the bottom half shows only recurring tasks.

Table 27. Planning Factors for Estimating DMSMS Operations Cost for Electronic Boxes

Startup and Other Non-Recurring Actives	One Time Hrs.	Total Hrs./BOM	Tech	Engineer	DB Manager	PM
Obtain BOM		0				
Format BOM for Loading into DMSMS		22	22			
Quality Assurance BOM		4	2	2		
Load BOM into the DMSMS Predictive Tool		1	1			
Clean Gray Components		40	32	8		
Additional Research and Analysis of Alternatives, as required		24	12	10		2
Established Database and Tracking System	40				40	
Total Hours	40	91	69	20	40	2
Recurring Activities		Total Hrs./BOM	Tech	Engineer	DB Manager	PM
Monitor Bill of Material		2	2			
Evaluate effect of alerts on BOMs		3	2	1		

Additional Research and Analysis of Alternatives, as required	3	1	2		
Cost Analysis	3	1	1	1	
Update BOM Files	3	2		1	
Assemble Health Data	9	6		3	
Assemble Trend and Reliability Data	12	9	3		
Perform Health Evaluation	8	2	6		
Perform Trend and Reliability Evaluation	15	3	9		3
Total Hours	58	28	22	5	3

The NAVAIR spreadsheet is designed to estimate person-hours not costs; the user is required to input an average cost per person-hour. Assumptions on how BOMs are phased in over time are built in. Person-hours for status reporting, meetings, training, technology insertion planning, and travel expenses are also required inputs.

The spreadsheet shown in Table 27 shows a 40.5% ratio[181] between start-up and steady state associated with a BOM for an electronics box. The level of service represented is somewhere between minimum and full.

Table 28 portrays some other possible person-hour ratios associated with level of service, start-up versus steady state,[182] and COTS versus electronics BOMs. The data used to build Table 28 were based on approximately 1,000 items being monitored. The person-hour requirement for a heavily electronics-oriented BOM for a minimum service level in the steady state has been normalized to 1. Program offices may find this information useful in developing and evaluating estimates of DMSMS operations costs.

Table 28. Person-Hour Ratios for Developing and Evaluating Estimates of DMSMS Operations Cost

	Start Year	Steady State
Electronics		
Minimum Service	1.3	1.0
Full Service	2.1	1.5
COTS		
Minimum Service	2.7	2.0
Full Service	3.7	3.0

G.3 ESTABLISH A DEDICATED POM/BUDGET LINE

All the enabling best practices in this section emphasize the importance of funding DMSMS management operations because of their contributions to lowering cost, maintaining schedule, and preventing readiness degradation due to DMSMS issues. Burying funding for these functions in a POM/budget line for another purpose, without clearly documenting the resources allocated to DMSMS management activities and the rationale for doing so, is *not* a best practice. Attempts to hide this funding should not be

[181] This is a ratio of 184 to 131 since the start-up period includes 131 non-recurring hours plus 53 recurring hours for a single BOM.

[182] The average ratio of start-up to steady state for electronics BOM in Table 28 is 135% which is not a substantial difference from the Table 27 result of 40.5%.

made. In fact, the opposite is true; highlighting the funding and relying on the DMT to oversee the activities informs program office leadership that attention is being paid to a serious management concern. This is especially important during sustainment when O&M funding may be difficult to obtain.

Dedicated DMSMS management operations POM/budget lines are preferable to an allocation of some larger lines. Dedicated lines elevate the visibility and importance of DMSMS management operations to both program office leadership and financial management communities (both internal and external to the program office). In addition, in the case of funding cuts, the DMSMS management activities are less likely to be reduced if they are separately identified.

As discussed previously, primes/OEMs/logistics support providers as well as independent SMEs provide DMSMS management operations services. From a programming and budgeting perspective, all the material associated with this enabling best practice applies to independent SMEs. Therefore, there should be an associated spend plan. When DMSMS management operations are also being provided by others, these activities will likely be a small part of a much larger contract (e.g., a production contract or a PBL contract). In that case, programming and budgeting will normally be for the total contract (and probably the spend plan as well). While it is still preferable to have a separate contract line item for DMSMS management operations, the most important best practice is to ensure that the contracts contain the right requirements and that the DMSMS management operations-related requirements are not dropped during contract negotiations.

G.4 COMMUNICATE THE VALUE OF FUNDING DMSMS MANAGEMENT OPERATIONS

This enabling best practice involves communication of DMSMS programming and budgeting considerations to all stakeholders. DMSMS management practitioners do not solely control the effectiveness and efficiency of DMSMS management-related activities in program offices. Everyone in a program office contributes. Programming and budgeting can only be successful if that is the case. Outreach to key stakeholders is the first essential step. While the need for outreach is mentioned elsewhere in this document, that material is organized by best practice. This section is organized by the stakeholder community interacting both inside and outside the program office. It summarizes the information that should be conveyed and how the stakeholder community can help with regard to DMSMS management-related programming and budgeting.

- Program office management. Although this section uses the term program office management, three specific elements of the program office are principally involved. The PM is the ultimate decision maker. To a large extent, the technical aspects of the programming and budgeting request should be coordinated and supported by the chief engineer and the PSM. First and foremost, the importance of DMSMS management operations (its inclusion in contracts and its associated funding) should be explained to program office management. Program office management must recognize the potential impact of pursuing DMSMS management reactively on cost, schedule, and readiness.

  Program office management also needs to understand the value of a stand-alone programming and budgeting line item for DMSMS management operations in terms of their contributions to proactivity and efficient program office operations. Because technical data is necessary to perform proactive DMSMS management operations, program office management must be in a position to support DMSMS-based contract clauses for this information and the processes that use the data.

- Contracting. Similar to program office management, the contracting community needs to understand the importance of DMSMS management operations and resolving DMSMS issues. Consequently, it becomes imperative to prevent the elimination of associated clauses during contract negotiation processes. Also associated with DMSMS management-related contract clauses (including clauses for technical data), the contracting officer should be made aware of the value of independent DMSMS management SMEs to evaluate contractor proposed technical activities and their associated cost. Finally, the contracting community should explain what it needs from the DMSMS management community to satisfy the DMSMS management community's requests.

- Financial management. Along with program office management stakeholders, the financial management community also must appreciate the importance of having stand-alone line items for DMSMS management and resolution-related programming and budgeting. In addition, the financial management community is also a source of key programming and budgeting information of interest to the DMSMS management community. They can provide information about the process, the types of appropriations that can be used for DMSMS management activities, and help make the justifications for the funding as persuasive as possible. As was the case for contracting, the financial management community should explain what it needs from the DMSMS management community.

- WCF organizations. In some cases, organizations that manage WCFs are the first to learn about an obsolescence issue as a result of an inability to issue a contract to repair an assembly on a system. This is most likely to occur with low demand items. DMSMS management practitioners in program offices should ensure timely communication channels exist with WCF organizations so that the program office learns about such issues as soon as possible. Some WCF organizations also perform DMSMS management operations associated with identifying issues in advance (e.g., equipment specialists). This is another area where there should be communications with the program office to ensure that DMSMS management operations are adequately resourced and that all stakeholders are aware of DMSMS issues, regardless of who discovers them.

- IPTs. This is a generic heading because every program office may have a different IPT structure. IPT stakeholders include those organizations that are concerned with both readiness and system development and modification. DMT interfaces with various IPTs should be done on those IPTs' own terms. For example, it is generally more effective for DMSMS management SMEs to attend the meetings of other IPTs than to invite various IPTs to attend the program office's DMT meetings. The DMSMS management community should convey how it can help the various IPTs and then what the IPTs need to do to enable that support. This could eventually lead to a situation where various IPTs contact the DMT to provide key information.

  DMSMS health assessments should be communicated to the appropriate IPTs as an input to their modification planning. Since the various IPTs may drive technical data requirements, the DMT should inform those communities of its needs in order to be proactive. While the engineering and product support organizations should be represented on the DMT, it is important to emphasize the communication of DMSMS needs to these organizations. All technical information flowing from the DMT to the various IPTs should be coordinated with engineering and product support.

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Appendix H. Benefits from the Record Keeping Framework

The record keeping framework was designed with program offices in mind. By using this framework, program offices will have an improved capability to do the following:

- Prepare and justify DMSMS resolution budget requests;
- Prepare and justify budgets for DMSMS management operations;
- Conduct analyses of alternative DMSMS resolution approaches;
- Identify, evaluate, and potentially reduce case implementation time;
- Determine how far in advance DMSMS resolutions should be budgeted;
- Evaluate both the cost and schedule for alternative resolutions and contract amendments to implement the preferred resolutions;
- Evaluate contract costs for DMSMS management activities;
- Quantify the cost of being reactive;
- Assess how DMSMS management affects readiness and schedule;
- Assess the differences between reactive and proactive DMSMS management on the supply system;
- Assess the ROI from being proactive;
- Enhance DMSMS management process effectiveness;
- Evaluate effectiveness of the DMSMS resolution process in implementing lower cost resolutions; and
- Enable higher level metrics reporting.

Commensurate benefits exist for other organizations. Based on program offices' use of the framework, PEOs and higher-level service organizations will have an improved capability to do the following:

- Evaluate DMSMS resolution budget requests,
- Evaluate DMSMS management operations budget requests,
- Enhance the LON buy process,
- Assess how DMSMS management affects readiness and schedule,
- Assess the ROI from being proactive,
- Monitor the performance of DMSMS efforts and find areas to target for improvement,
- Enhance DMSMS management process effectiveness,
- Evaluate effectiveness of the resolution process in implementing lower cost resolutions,
- Enhance resolution cost sharing,
- Monitor the performance of DMSMS efforts and find areas to target for improvement, and
- Enable higher-level metrics reporting.

In addition, higher-level service organizations and OSD will have an improved capability to do the following:

- Benchmark and promulgate best practices for DMSMS management operations and resolution implementation processes;
- Benchmark, develop, and promulgate DMSMS management cost/workload factors;
- Assess how DMSMS management affects readiness and schedule;
- Enhance DMSMS management process effectiveness;
- Evaluate effectiveness of the DMSMS resolution process in implementing lower cost resolutions;
- Develop cost factors or cost estimating relationships (CERs) to improve DMSMS resolution programming and budgeting techniques after the design has been completed and before the design has been completed for integration into system engineering design tools;
- Facilitate the sharing of DMSMS resolutions for common items throughout the enterprise;
- Assess the ROI from being proactive;
- Assess the magnitude and trends of DMSMS resolution costs and take appropriate actions to reduce them; and
- Improve pertinent aspects of DMSMS management policy and guidance.

Appendixes H.1, H.2, and H.3 provide a substantially more detailed explanation of the value proposition along with examples. The appendixes are associated with the following benefit areas, respectively:

- Programming and budgeting,
- Process improvement, and
- An ROI for DMSMS management.

For each individual benefit, a subset of all of the record keeping data elements provided in Table 8 of Section 3.4.3.1 is shown. The subset only contains the data elements related to that benefit. Appendix H.4 provides a data dictionary of record keeping terms.

H.1 PROGRAMMING AND BUDGETING BENEFITS

H.1.1 Greater Fidelity Cost Estimates for DMSMS Resolutions

H.1.1.1 VALUE PROPOSITION

Table 29 shows the Level 1 and 2 data elements necessary to obtain this benefit.

Table 29. Data Elements Needed to Obtain Greater Fidelity Cost Estimates for DMSMS Resolutions

Information Type	Level 1 Data Element Title	Level 2 Data Element Title
DMSMS resolution cost-related	• Type of Resolution Approved • Resolution Cost • Source of DMSMS Resolution Cost • Redesign Level	• Commodity Type • Operating Environment of the Equipment • DMSMS Item Type
DMSMS management operations efficiency-related	• Item Class	

While it is always preferable to use actual resolution costs or costs based on estimates derived from an analysis of a specific DMSMS problem, there are many instances where another approach is taken. For example, cost estimates can be based on factors published in Table 15.[183] The value proposition for collecting, compiling, and analyzing the Level 1 and Level 2 data elements indicated in Table 29 is associated with the latter: the development of improved cost factors for DMSMS resolutions. These cost factors could be used for programming and budgeting purposes as illustrated in Appendix H.1.3 through H.1.5.

The value proposition for program offices and PEO organizations is that they can benefit from access to improved DoD cost factors generated by OSD or Service HQ, based on the analysis of the identified data elements collected over a large number of systems. Under some circumstances, program offices and PEO organizations could improve cost estimates by using their specific data to independently refine the DoD cost factors for their own use.

The value proposition for OSD and Service HQ is based on access to data from all program offices. Analysis of this data would enable OSD to provide improved DMSMS management guidance through periodic updates and refinements of the DoD cost factors. A multi-dimensional table to break down average resolution cost by characteristics of the platform (e.g., Operating Environment) and the obsolete item (e.g., DMSMS Item Type or Commodity Type) could be generated. This could be done on a routine basis without reliance on (and funding for) an occasional survey. This more systematic data collection would enable OSD to publish more statistically significant resolution cost factors. In addition, it may be feasible for OSD to develop CERs to refine cost estimates even further, thus enabling an improvement over what the DoD cost factors provide today. Service HQ would then be in a position to update Service-specific guidance on the use of the cost tables/CERs. Lastly, an analysis of the distribution of costs for a given resolution may identify a need to further refine resolution types and consequently add greater fidelity to the resolution cost factors.

H.1.1.2 EXAMPLES

The following illustrates how the data elements could be used to benefit PEO organizations and program offices:

- Use of Level 1 data elements would lead to more accurate cost estimates by providing more up-to-date information on resolution costs. For example, the February 2015 version of the SD-22 indicated that the average cost of a redesign at the NHA level was $109,200.[184] Guidance from the previous SD-22 (published six years earlier) stated that the average cost of a major redesign was $467,000.[185]
- Use of Level 2 data elements would lead to more accurate cost estimates by providing data to refine or tailor the overall averages. Specifically, information on the commodity type, operating environment, type of item, redesign level, and whether the item was COTS could be used. For example, Appendix K indicates that the average cost for a redesign at the next higher level of assembly for aviation equipment is $1.61 million and $0.28 million for shipboard equipment. Analysis of actual resolution costs pertaining to a specific system or sets of systems could provide a basis for even further refinement of the Table 15 cost factors.

[183] The reason for including the source of the DMSMS resolution costs is to have a better understanding of what the resolution cost data element represents. That understanding can impact how any analysis of record keeping data elements should be interpreted and used. This comment applies to the remaining descriptions of record keeping benefits.
[184] DSPO, SD-22, Diminishing Manufacturing Sources and Material Shortages—A Guidebook of Best Practices for Implementing a Robust DMSMS Management Program, February 2015, p. 99.
[185] Ibid., September 2009, p. 27.

Examples of benefits to OSD and Service HQ are as follows:

- Periodically updating and refining resolution cost guidance enables the above benefits to PEO organizations and program offices. The data element on the source of the resolution cost is important to consider. Costs that are generated from Table 15 itself should obviously not be considered in the update process.
- Both Level 1 and Level 2 data elements could be used to further refine the DMSMS resolution types. For example, in previous versions of this document, the average cost to develop a new item or source was based on 127 data points from the 2014 Department of Commerce survey. An examination of a histogram of Level 1 data for the 127 data points shows that approximately 20% of the resolutions cost more than $750,000 and some resolutions exceeded $5 million. This implied that the "development a new item or source" resolution category was too broad, so it was replaced by three resolution types based on limited data. Data collected against the Table 29 data elements would ultimately refine these estimates and should facilitate more statistically sound analyses of resolution types for all high-cost[186] resolution categories.
- It may also be possible to use Level 2 data to develop CERs as a function of the extent of variability that can be explained by commodity type, operating environment, type of item, redesign level, and whether the item was COTS.

H.1.2 Improved Cost Estimates for Making LON Buys

H.1.2.1 VALUE PROPOSITION

Table 30 identifies the three data elements that would be used to take LON buy quantities into account in programming and budgeting.

Table 30. Data Elements for Estimating Cost of Purchasing Inventory for a LON Resolution

Information Type	Level 1 Data Element Title	Level 2 Data Element Title
DMSMS resolution cost-related		• Operating Environment of the Equipment • Product Acquisition Cost
DMSMS management operations efficiency-related	• Subsystems	

The value proposition for collecting and analyzing these LON buy data elements is derived from the absence of guidance on how to program and budget for such purchases. The DoD LON buy resolution cost factor does not consider the item purchase itself. The same is true for a LON buy conducted in combination with another resolution—e.g., the reverse engineering cost factor does not take into account any items purchased in conjunction with a reverse engineering resolution.

All the published DMSMS resolution cost factors attempt to measure the average non-recurring costs of a resolution over the life cycle of a DoD system. In the case of a LON buy (either alone or in conjunction with another resolution), the upfront one-time cost of purchasing the items is excluded because that cost would have also been incurred if the item were not obsolete (i.e., the life-cycle cost is zero).[187] There is, however, a possibility that a substantial amount of unplanned funding could be needed in the year that the entire purchase is executed. The data elements shown in Table 30 provide some insight into this.

[186] Analyses of low-cost resolution categories may not be worthwhile if cumulatively they only account for a small percentage of total resolution costs.
[187] Inventory holding cost would be part of the non-recurring cost.

The value proposition for program offices is that there would be data to help estimate and justify a modification to programming and budgeting requests for DMSMS resolutions including cost increases associated with LON buys in the year of execution.[188] If such adjustments were made and the requests approved, program offices would have a diminished need to take extraordinary measures to identify sources of funding on a time critical basis (since the opportunity for LON buys is constrained by the last date of sale as published in an EOL notice).

The program office value proposition should however take into account several additional factors:

- Programming and budgeting for spikes is only applicable in situations where both the quantity of items needed *and* the price of the item is high.
- Since spikes are hard to forecast, provisions must be in place to reallocate the funding to other priorities if the need does not materialize.
- LON buys are only selected as the most cost-effective resolution when justified by a BCA or an AoA.

For PEOs, the value proposition is based on oversight of the program offices in their portfolios. The oversight would encompass ensuring that anticipated LON buy spikes are included in programming and budgeting requests and that those requests are well documented to enable the PEO organization to justify the request to higher level decision makers. The value proposition for Service HQ and OSD would also be based partly on justifying budget requests. There is however one additional benefit, data would be available to develop and promulgate appropriate policy and guidance on this subject.

H.1.2.2 EXAMPLES

OSD guidance would not be based on averages across all program offices. Averages would not account for spikes in the execution year of a budget. As indicated earlier, the guidance would only apply to high-volume and high-cost situations. For example, LON buy costs for an inexpensive component on a high-volume ground-based system might not impact budget execution very severely. Similarly, the need to buy a highly reliable, high cost electronic item on a nuclear propulsion system might not be disruptive either due to the low volume.

The data element for the total number of subsystems in the system would have to be linked to the number of systems fielded (which is not one of the data elements) to determine volume. The environment in which the subsystems operate could potentially be used to identify high-cost situations (or the likelihood thereof). After some analysis of the data, a table of factors could be generated.

Programs offices would see how their experience compares to the entries in such a table to determine whether they need to program and budget for spikes in LON buys, and if so, estimate how much to request for such contingencies. Data extracted from a guidance table should be adjusted by the specific circumstances of the system itself. If the program office has never experienced a spike, then it probably should not program and budget for one. If a program office has substantial LON buys every year, it should give more weight to individual experience than the factors in a guidance table.

[188] If budget requests were based on historic averages, average LON buy costs would be included if the purchase amounts were included. However, averages may not account for spikes.

H.1.3 Improved Programming and Budgeting for Resolutions

H.1.3.1 VALUE PROPOSITION

Table 31 shows the Level 1 and 2 data elements necessary to better develop and defend programming and budgeting requests for DMSMS resolutions. The only difference between Table 29 and Table 31 is that a Level 2 data element for the "Cost of LON Items" is included in Table 31.

The value proposition to program offices for collecting, compiling, and analyzing the Level 1 and Level 2 data elements indicated in Table 31 is that they can use the improved cost estimates (as discussed in Appendix H.1.1) to develop more accurate and more defendable programming and budgeting submissions for DMSMS resolutions including LON buys. Likewise, PEO organizations and Service HQ would be in a better position to evaluate those submissions and defend them to higher level approving authorities. OSD would be in a better position to approve the programming and budgeting figures.

Table 31. Data Elements Needed to Obtain Greater Fidelity Cost Estimates for DMSMS Resolutions

Information Type	Level 1 Data Element Title	Level 2 Data Element Title
DMSMS resolution cost-related	• Type of Resolution Approved • Resolution Cost • Source of DMSMS Resolution Cost • Redesign Level	• Commodity Type • Operating Environment of the Equipment • Cost of LON Items • DMSMS Item Type
DMSMS management operations efficiency-related	• Item Class	

H.1.3.2 EXAMPLES

Program offices could use the data elements to apply one of two common approaches (or a combination thereof) to build programming and budgeting submissions for DMSMS resolutions. The first approach is to analyze past trends in resolution cost for their particular system and then extrapolate those trends into the future. The Table 31 "Resolution Cost" data element collected over time supports such an approach. The second approach is based on predicting the types of resolutions that will occur by year and using the resolution cost factors to estimate the total cost in any given year. One way of predicting the types of resolutions in a given year is to analyze the "Type of Resolution Approved" data element over time to develop averages or trends. More sophisticated methods using predictive tools and vendor surveys can also be used to predict resolutions over time.

A variation on the second approach is to predict only redesigns and use the cost factors, further refined by the "Redesign Level" data element to develop programming and budgeting submissions. The viability of this variation is also something that can be determined by program offices. The 2014 Department of Commerce survey data indicated that 95% of total resolution costs were related to redesign. If individual program offices can use the "Resolution Cost" and "Type of Resolution Approved" data elements over time to verify that redesigns are the principal driver of resolution cost for their systems, then it would only be necessary to predict redesigns in the future and then include a factor for everything else. For example, if redesigns normally accounted for 90% of the resolution costs, the predicted resolution cost in a given year based only on redesigns could be increased by 11% to generate an estimate for the total DMSMS resolution cost.

Program offices could enhance the above calculations by analyzing and considering the "Cost of LON Items" data element when they believe it is necessary to do so. From a programming and budgeting perspective, the impact in a given year may be significant if appropriated funds are needed to execute a

LON buy.[189] For example, for a system in production with large quantities of an expensive item yet to be purchased, and the item is expected to be highly reliable and unlikely to be redesigned, the LON costs in the fiscal year of purchase are likely to be significant. Similarly, a small dollar value system that does not incur many DMSMS problems could experience high LON buy requirements if it involves an expensive component.

Examples of the benefits to stakeholders beyond the program office are straightforward. They involve using the data elements to verify program office calculations and strengthening the justification for funding. There is one additional benefit for OSD. This document is currently silent on the consideration of LON buy costs in programming and budgeting. The Table 31 data elements could be used to improve guidance in the future.

H.1.4 Improved Evaluation of Contractor Costs for Resolutions

The Table 29 data elements also apply here. A further enhancement of the value proposition associated with greater fidelity cost estimates for DMSMS resolutions (see Appendix H.1.1) is that program offices would have additional information useful for evaluating cost proposals to resolve DMSMS issues. This could strengthen the program office's contract negotiating capability and potentially result in lower contract cost.

For example, if a cost estimate were very close to the associated cost factor, a program office might have a certain degree of confidence in its acceptability. In situations where the cost proposal is considerably less than the cost factor indicates, the program office may want to take steps to ensure that the contractor understands the complexity of the resolution. Finally, when the cost estimate is well above the cost factor, the program office should attempt to understand why that is the case. The program office should be prepared to either negotiate the price downward or seek other bidders.

H.1.5 Improved Understanding of Proactivity and Risk Linkages

H.1.5.1 VALUE PROPOSITION

Linking DMSMS management proactivity with risk provides an indication of the extent to which the level of DMSMS management operations is sufficient to mitigate DMSMS risk. Table 32 shows the Level 1 and 2 data elements necessary to obtain this benefit.

Table 32. Data Elements Needed to Obtain an Improved Understanding of the Link between DMSMS Management Proactivity and Risk

Information Type	Level 1 Data Element Title	Level 2 Data Element Title
DMSMS resolution cost-related	• Type of Resolution Approved • Resolution Cost • Source of DMSMS Resolution Cost	• Commodity type
DMSMS management operations efficiency-related	• Nomenclature • Item Class • Case Proactivity Indicator • Reason Issue Was Discovered Reactively	

[189] DoD cost factors do not include these costs because 1) there could be large variation and 2) the life-cycle cost is zero because the items would eventually be purchased over time based on failure rate.

These data elements provide information on the impact of the risk being taken with respect to the extent of item monitoring[190] that a program office is funding. The value proposition for program offices is that they will have a quantitative basis for either increasing or decreasing the level of monitoring activity and associated funding.

The data elements show the cases that were opened reactively because of a conscious decision by the program office not to monitor the affected items. This is a direct measure of the risk taken as part of the risk-based approach to DMSMS management. How those issues were resolved along with the associated resolution costs enables an assessment of whether too much risk is being taken. This assessment should lead to a decision of whether the level of DMSMS monitoring is sufficient.

The data elements also provide an indication of whether too many resources are being applied to DMSMS management. The goal of proactive DMSMS management is not to have zero cases opened reactively. There are commodity products (e.g., resistors, capacitors) that become obsolete frequently. The resolution is normally to identify another off-the-shelf item that has the same specifications. This can be accomplished very quickly; and consequently, there is generally no need to try to identify such issues far in advance. Resources spent on proactive monitoring of such items may be inefficient.

The value proposition for PEOs is based on an evaluation of the amount of risk being taken by program offices within the PEO organization's portfolio to indicate whether any of the program offices is taking too much or too little risk. Adjustments can be made based on quantitative data. A more detailed examination of the impact across program offices within the portfolio could help make an informed judgement regarding an appropriate level of risk.

Service HQ and OSD could examine such data to obtain a broad understanding of the extent to which risk-based, proactive DMSMS management activities occur on a broad scale. Such information could inform new policy and guidance.

H.1.5.2 EXAMPLES

The basis of the difference between the value propositions for Level 1 and Level 2 data is some additional refinement in terms of determining whether an obsolete item should have been monitored. Level 2 data allows for a slightly more refined examination. Level 1 data determines whether an item is commercial or not and it also provides the item nomenclature. Level 2 data add the commodity type (e.g., electronics, mechanical).

The first two program office examples below use only Level 1 data. The third program office example also uses Level 2 data.

- Assume a program office opened 20 DMSMS cases in a given year and that five of those cases were opened reactively for commercial electrical items that were deliberately not monitored. Further assume that in all five cases, the resolution was a simple substitute. There is no indication that the program office is accepting too much risk.
- On the other hand, if two of the resolutions were costly redesigns for commercial electronics items, the same conclusions should not be immediately drawn. There would be a strong indication that too much risk is being taken in terms of what should be monitored.

[190] Monitoring is usually the basis for developing an initial cost estimate for DMSMS management operations. In the first year, estimates may be based on experience from similar systems. After the first year, more refined estimates can be made based on experience from the system itself.

- A third circumstance might be that none of the 20 cases were opened reactively and all cases were resolved with a simple substitute. If for example, the items were all mechanical, it would be a good idea to investigate in more detail whether some items are being monitored unnecessarily.

Examples for PEO organizations would be similar. PEOs would be looking for circumstances where the level of DMSMS management activities should be adjusted for program offices within their portfolio. This would be accomplished by determining whether too much or too little risk was being taken by different program offices. If two similar program offices were having dissimilar results, then that would be a further indication that the DMSMS management activities of at least one of the program offices should be changed.

Service HQ, PEO organizations, or OSD might be interested in using the data in aggregate. For example, a histogram of the types of resolutions used for reactively opened cases could be generated. The level of high cost resolutions implemented could be used as an indicator of how much cost could be avoided with greater investment in proactive DMSMS management operations.

H.1.6 Improved DMSMS Management Cost and Workload Metrics

H.1.6.1 VALUE PROPOSITION

Table 33 shows the Level 1 and 2 data elements necessary to obtain this benefit.

Table 33. Data Elements Needed to Obtain Improved Cost and Workload Metrics for DMSMS Management

Information Type	Level 1 Data Element Title	Level 2 Data Element Title
DMSMS management cost-related	• DMSMS Management Operations Cost Paid to Prime/OEM • DMSMS Management Operations Cost Paid to Independent SME Organizations • Management Operations Cost for Internal DMSMS-Related Activities	• Value of Management Operations Activities Received at No Cost from a Centralized Service Source
DMSMS management operations efficiency-related	• Subsystems • Subsystems Monitored • Components • Components Monitored	

The value proposition for these data elements is that program offices will have a much better basis for estimating what DMSMS management operations might cost, although there might be a large variance among program offices. The only guidance available today is based on a limited sample size, and only provides relative cost estimates.

Having much more refined DMSMS management operations cost factors published in guidance will be far more useful to program offices. The data elements portrayed in Table 33 would provide specific cost estimates by breaking down cost by provider and obtaining a much more refined measure of the workload involved. Finally, the new DMSMS management operations cost factors would be more accurate since they would be based on data from hundreds of program offices.

The value proposition for PEO organizations is very similar to that for program offices. PEOs would be in a position to compare DMSMS management operations costs among the program offices in their portfolios to identify opportunities to reduce cost based on the cost factors. Furthermore, by comparing similar program offices, other efficiencies may manifest themselves.

For OSD, the value proposition will be enabling the issuance of comprehensive guidance. For Service HQ, there is an opportunity to tailor the results potentially based on the availability of a centralized DMSMS management service provider.

H.1.6.2 EXAMPLES

The difference between the value proposition for Level 1 and the Level 2 data elements is that the Level 2 data element also provides the program office with information about support resources provided at no cost to the program office (when that situation applies). Therefore, the Level 2 data element could provide additional insight on the total cost of DMSMS management operations at the program office although it does not impact program office programming and budgeting.

Program office and PEO examples are relatively straightforward. They would be in a position to develop cost estimates based on their specific situation.

Given the data elements shown in Table 33, OSD and Service HQ would be in a position to publish DMSMS management operations cost factors. However, through the use of the current unpublished guidance, additional considerations (e.g., start-up versus steady state, level of DMSMS management operations services) could be integrated into new cost factors. Furthermore, potentially through the use of some other data elements not included currently in Table 33, other refinements could be developed. For example, there may be a difference between management operations costs as a function of system complexity which may be visible from the operating environment data element. Such a hypothesis could be tested before the guidance is published.

H.1.7 Improved Programming and Budgeting for Operations

Table 34 shows the Level 1 and 2 data elements necessary to better develop and defend programming and budgeting requests for DMSMS management operations.

Table 34. Data Elements Needed to Obtain an Improved Ability to Develop and Defend Programming and Budgeting Requests for DMSMS Management Operations

Information Type	Level 1 Data Element Title	Level 2 Data Element Title
DMSMS management and resolution cost-related data elements	• Type of Resolution Approved • Resolution Cost • Source of DMSMS Resolution Cost • DMSMS Management Operations Cost Paid to Prime/OEM • DMSMS Management Operations Cost Paid to Independent SME Organizations • Management Operations Cost for Internal DMSMS-Related Activities	• Commodity Type
DMSMS management operations efficiency-related data elements	• Nomenclature • Item Class • Case Proactivity Indicator • Subsystems • Subsystems Monitored • Components • Components Monitored • Reason Issue Was Discovered Reactively	

The value proposition is straightforward. Program offices will be in a better position to obtain the DMSMS management operations resources they need through strong justification for what is needed. PEOs will be in a better position to oversee the programs in their portfolios and defend programming and budget requests to Service HQ. In turn, Service HQ would be in a better position to defend funds requests to OSD and OSD would have greater confidence in the accuracy of the requests.

Examples are also straightforward. Initial estimates would be data driven. That justification would be seen by higher level organizations. The difference between Level 1 and Level 2 data is greater refinement to the estimates themselves, as discussed in Appendix H.1.6.

H.1.8 Improved Evaluation of Contractor Costs for Operations

The Table 34 data elements also apply here. Not all companies have the same skills and capabilities for DMSMS management operations. Some companies are far more experienced than others. There have been instances where DMSMS management operations cost proposals have been vastly different. Therefore, having guidance available on DMSMS management operations cost factors (see Appendix H.1.6) would provide program offices material that could be used to evaluate cost proposals for DMSMS management operations taking into account the extent of DMSMS management operations conducted inside the program office. This could strengthen the program office's contract negotiating capability and potentially result in lower contract cost.

As discussed in Appendix H.1.3, if a cost estimate were very close to the cost derived from guidance, a program office might have a certain degree of confidence in its acceptability. In situations where the cost proposal is considerably less than the cost factor indicates, the program office may want to take steps to ensure that the contractor understands the program office's DMSMS management operations requirements. Finally, when the cost estimate is well above the cost factor, the program office should attempt to understand why that is the case. The program office should be prepared to either negotiate the price downward or seek other bidders.

H.2 PROCESS IMPROVEMENT BENEFITS

H.2.1 Improved Efficiency for Case Processing Time

H.2.1.1 VALUE PROPOSITION

Table 35 shows the Level 1 and 2 data elements necessary to obtain this benefit. The efficiency related data elements are all associated with case processing time. The remainder of the data elements are concerned with characteristics of the situation that could have an impact on case processing time.

Table 35. Data Elements for Case Processing Time Improvement

Information Type	Level 1 Data Element Title	Level 2 Data Element Title
DMSMS resolution cost-related	• Type of Resolution Approved	• Commodity Type • Operating Environment of the Equipment • DMSMS Item Type
DMSMS management operations efficiency-related	• Item Class • Date Alert Received • Date Case Opened • Date Resolution Submitted for Approval • Date Case Resolved • Date Case Closed	

The value proposition for case processing time is associated with comparing the times required to open, determine the optimal resolution, submit the resolution for approval, receive approval for the resolution, and implement the resolution. The comparisons would be made as a function of the type of resolution with Level 1 data only and as a function of the commodity type, the operating environment, and the DMSMS item type for Level 2 data. When comparisons indicate potential issues, further analyses would be initiated.[191]

From a program office perspective, actual times could be compared to expected times in an attempt to determine whether any part of the process is taking too long. If there are no expectations, then the program office could compare itself to the benchmarks developed from other program offices' data. If this comparison were to indicate that the program office is taking longer, investigations into the process itself could be initiated to identify potential problems and initiate process improvement. This is the basis of the value proposition to the program office.

PEO organizations could compare case processing times reported by the program offices within its portfolio. This could indicate those program offices within the portfolio that are being less efficient than desirable in their DMSMS management approach; therefore, identifying program offices that could benefit from additional attention. Similar to program offices, a PEO organization could benefit from having access to a larger data repository to provide a more broadly populated set of case processing time benchmarks.

OSD and Service HQ would be able to assess whether anything can be gleaned from an analysis of case processing times, aggregated across organizations and program offices, as a function of the data elements in Table 35 to highlight DMSMS management efficiencies and inefficiencies. This would provide evidence to support desirable changes/initiatives to improve DMSMS management policy and guidance. For OSD and Service HQ, there could be a project to identify a further breakdown of the timing to identify contract lead time and programming and budgeting lead time. Once these are factored out, the differences between case processing time might not be meaningful. Alternatively, this could imply that OSD should concentrate policy and guidance on the non-DMSMS management-related aspects of processing time (e.g., decision-making, contracting, and programming and budgeting).

[191] Some might think that as long as the case is closed before the implementation is needed, then there is no concern about processing time. If this were the only criterion for process improvement, inefficient processes could continue and they may eventually negatively impact the program when a rapid implementation is needed. For that reason, the implementation need date is not included in Table 34.

H.2.1.2 EXAMPLES

Several years ago, an unpublished analysis was conducted pertaining to this case processing time topic. The analysis included only the time required to implement resolution types based on data for several hundred cases. Observations made from that data raised questions which serve as examples for the following types of questions that a larger, more complete set of data might answer:

- The average time to close a LON buy was 497 days. Since most LON buy cases are opened when a discontinuation notice is received and the typical amount of time given to make a final purchase is less than one year, why would the *average* be one year and four months? There were also examples where it took up to four years to close some of the LON cases. Given that LON buys are generally time sensitive, why was that the case?
- The average time to implement a simple substitute resolution was 319 days, the average for a complex substitute was 387 days, and the average time for development of a new source was 198 days. Why is the time difference between simple and complex substitutes so small? Why does the seemingly much more complex development of a new source take so much less time than a simple substitute?

Table 50 contains the results of a more recent calculation of the average time to close a case. Why are these values substantially different from the numbers in the above two bullets?

In addition, when comparing the data from one program office to the aggregate data, performance trends could be identified and, if needed, corrected.

H.2.2 Improving the Effectiveness of Item Monitoring Processes

H.2.2.1 VALUE PROPOSITION

Level 1 and 2 data elements associated with this benefit are listed in Table 36. As was the case for Table 35, the operations efficiency data elements provide insights into performance and the cost-related data elements represent potential consequences of poor performance.

Table 36. Data Elements for Improving Item Monitoring Process Effectiveness

Information Type	Level 1 Data Element Title	Level 2 Data Element Title
DMSMS resolution cost-related	• Type of Resolution Approved • Resolution Cost • Source of DMSMS Resolution Cost • Redesign Level	
DMSMS management operations efficiency-related	• Reason Issue Was Discovered Reactively	• Monitoring Techniques

The two DMSMS management operations efficiency-related data elements shown in Table 36 are intended to capture information about the effectiveness of a program office's DMSMS monitoring processes. If monitoring is inefficient, cases may be opened reactively where they could have been opened proactively. For proactive cases, there is also the possibility that the source of the information used to open a case was not the most efficient (i.e., did not indicate an item discontinuation in a timely manner). If so, then there would be a possibility that the case could have been opened earlier.

The value proposition for the program office has three primary components:

- First, Level 1 data could be used to conduct a risk analysis to determine whether the items managed reactively led to resolutions with a pronounced adverse impact on cost or readiness (see Appendix H.3). This may lead to an adjustment to the risk-based approach to increase the number of items monitored proactively.

- Second, using Level 1 data, analyses of the monitoring process should be conducted for specific instances where proactive processes did not identify a DMSMS issue before a failed attempt to buy the item. This would serve as a way to measure the effectiveness of the tools and techniques used in monitoring (quality). These data can help answer the question "Why did the tools miss this particular instance?"
- Third, through an examination of resolution costs as a function of the means by which a DMSMS issue was discovered proactively, insights may be obtained about the efficiency of one type of monitoring versus another. This type of examination would require Level 2 data. For example, if one program office has a lower rate of reactive issues for monitored parts than another program office, then further investigation could be done to determine what tools are being used.

The two latter components of the value proposition may require the analysis of multiple program offices because in a given program office, most cases will be opened as a result of something identified by the most efficient monitoring technique being used by that program office. That program office would therefore need to analyze data from other program offices to make a determination of the efficiency of other monitoring processes not being used. These analyses could identify actions to enable the earlier detection of DMSMS issues.

The latter two components of the value proposition also apply to PEOs. PEO organizations would also be better able to compare process efficiency as a result of proactivity. This could provide an indication of those program offices within the portfolio that are being less efficient than desirable in their DMSMS management approach, therefore identifying program offices that could benefit from additional attention.

The value proposition for OSD and Service HQ would be realized through an ability to use factual evidence to a greater degree when making determinations of the extent and effectiveness of proactivity associated with the monitoring techniques across all program offices. "Extent" indicates the degree to which program offices were being proactive. "Effectiveness" indicates the extent to which cases that should have been opened proactively were in fact opened reactively. This data could be used to identify causes of reactivity and thereby improve policy, guidance, and best practices, especially when cost or readiness impacts can be associated with that reactivity.

Furthermore, since one of the monitoring areas deals with surveillance of LON stocks, to determine whether the quantity procured remains sufficient, an additional value to OSD and Service HQ is associated with the methods and processes to calculate and procure those items. If a pattern emerges, new policy and guidance may result.

H.2.2.2 EXAMPLES

One possible analysis could correlate actual program office proactivity data based on DMSMS monitoring approaches (e.g., are they using predictive tools?, do they rely solely on the GIDEP?) with resolution costs. It could result in the discovery that some less proactive monitoring techniques lead to a greater number of expensive resolutions such as redesign. As a result, efforts could be undertaken by program offices to become more proactive or improvements could be made to the efficiency of the less effective monitoring techniques. In addition, the analysis might reveal that some monitoring methods may not be worth the added cost for the results they provide.

Another analysis could be conducted to study the pattern of reactive cases. If, for example, it was found that items were not being monitored, then an increased level of DMSMS management operations funding might be needed. If there were a correlation between reactive cases and the scope or technique of monitoring, then something could be done to increase the effectiveness of the monitoring by altering the scope or technique.

Associated with the monitoring of LON buy quantities, another study could focus on how well LON buy quantities are determined. Some organizations who conduct LON buys may have a history of miscalculating demand, resulting in too few or excess stock of the items. That might prompt a more detailed examination of that organization or better guidance on computing the size of LON buys.

H.2.3 LON Buy Process Improvement

Table 37 identifies the single Level 2 data element needed to achieve this benefit in conjunction with Level 1 cost data.

Table 37. Data Elements Improving LON Buy Processes

Information Type	Level 1 Data Element Title	Level 2 Data Element Title
DMSMS resolution cost-related	• Type of Resolution Approved • Resolution Cost • Source of DMSMS Resolution Cost • Redesign Level	
DMSMS management operations efficiency-related		• LON Buy Preferred Indicator

The value proposition here requires Level 2 data; it is associated with the LON buy process within an organization. This process may involve many stakeholders internal and external to a program office. The LON preferred indicator identifies cases where a LON buy was the most cost effective resolution but could not be executed. Principal reasons why a LON buy was not feasible include sufficient funds were not available, there was not enough time to execute the process, the process was broken, or a limitation was imposed on the quantity to be procured.

The resolution cost data may be used to estimate how much more is being spent over the life cycle of a system as a result of such an inability to execute. If these amounts were significant, program offices, PEO organizations, and Service HQ would use this information to improve their LON processes. If the primary obstacles to LON buys were legislative or regulatory, OSD could initiate modifications.

H.2.4 Detection of Anomalies in DMSMS Resolution Cost

It is beneficial to detect anomalies because they are an indication that further analyses are needed. For this benefit, Level 1 and 2 data elements are shown in Table 38. There are no operations efficiency data elements included.

Table 38. Data Elements for Detecting Anomalies in DMSMS Resolution Cost

Information Type	Level 1 Data Element Title	Level 2 Data Element Title
DMSMS resolution cost-related	• Type of Resolution Approved • Resolution Cost • Source of DMSMS Resolution Cost • Redesign Level	• Commodity Type • Operating Environment of the Equipment • DMSMS Item Type

Appendix H.1 discussed benefits associated with developing resolution cost factors and using resolution cost data to support programming and budgeting. In this case, an examination of the differences in resolution cost under somewhat similar circumstances across program offices and more aggregate organizations could be made. Level 1 data elements enable such a comparison. Level 2 data elements portray some of the reasons why there may be differences and thereby enable a much more detailed analysis.

The value proposition of program offices would be in situations where Service HQ or OSD published guidance about the range of costs to expect for DMSMS resolutions. A program office might find that its costs were high. This could indicate that there is something inefficient (or overly expensive) about the way resolutions are implemented. At minimum, it would generate questions that should be answered. The PEO organization could make similar comparisons, probably just among the program offices in its portfolio.

OSD and Service HQs would use the entire data repository to assess how DMSMS resolution costs are broken down among organizational entities. There are valid reasons why one Service may be spending different amounts relative to another Service or one set of platforms is spending more or less than another set of similar platforms. OSD and Service HQs would identify potential differences, verify that the differences are significant, and attempt to determine the root causes. This could lead to changes in policy, guidance, or best practices. Service HQs may choose to analyze just their own portions of the data repository to do this.

H.3 ROI-RELATED BENEFITS

The value proposition associated with all of the ROI-related benefits is similar. It is based on the ROI concept itself, there will be some benefit or return resulting from the investment of resources in risk-based, proactive DMSMS management.

The benefit may be monetary, schedule-related, or availability-related. In the latter case, some benefits may apply directly to avoiding impacts to supply system operations such as:

- Fewer backorders or
- On-hand stock representing something below the optimal level of days of supply.

Another indirect benefit associated with operational availability is reducing the number of days needed to implement a resolution. The shorter the implementation time, the greater the likelihood of avoiding any ill-effects.

Inherent in this value proposition is the improved capability to demonstrate the benefits of risk-based, proactive DMSMS management. From a program office perspective, articulating such benefits increases the likelihood of successfully programming and budgeting for the resources needed to conduct the right amount of DMSMS management operations. The same holds true at the PEO level, however PEOs also would obtain sufficient evidence to be convinced that they are supporting important and necessary functions. Service HQ and OSD would aggregate such data. In doing so, they would increase their understanding of the value of DMSMS management activities as well as issue policy and guidance to institutionalize the necessary level of support.

H.3.1 Estimating the Cost of Being Reactive

Table 39 lists the data elements needed for estimating the cost of being reactive. This benefit is achievable with Level 1 data.

Table 39. Data Elements for Estimating the Cost of Being Reactive

Information Type	Level 1 Data Element Title	Level 2 Data Element Title
DMSMS resolution cost-related	• Type of Resolution Approved • Resolution Cost • Source of DMSMS Resolution Cost	
DMSMS management operations efficiency-related	• Case Proactivity Indicator • Reason Issue Was Discovered Reactively	

Appendix H.2.2 focused on the adequacy of risk-based DMSMS management and monitoring and made suggestions for improvement. This section adds the refinement of estimating the cost of being reactive. Appendix H.1.3 discussed the fact that the bulk of DMSMS resolution costs are associated with redesigns because redesigns are costlier than other DMSMS resolutions. Therefore, insight on the cost of being reactive may be obtained from just redesigns rather than all cases. The following three steps may be taken:

- Extract all cases where the resolution was a redesign at one of three different levels—either at the item, the NHA, or the major subsystem level;
- Select the subset of those redesigns where cases were opened reactively based on the Case Proactivity Indicator; and
- Calculate the total cost of that subset of the redesigns.

The cost of redesigns as a result of cases being opened reactively represents an estimate of the cost of being reactive. The estimate may be high because some redesigns might have occurred even if the case had been opened proactively. Since the cases were not opened proactively, it is not possible to know when a redesign would still have been the resolution. In addition, this representation assumes that when a lower cost resolution was feasible reactively, a similar cost resolution would have been feasible proactively. The data elements are not able to provide any additional insight.

The data element for the reason the issue was discovered reactively is included because it can be used to make inferences about the reason for incurring a significant cost of being reactive.

H.3.2 Estimating the Cost Avoidance for Being Proactive

A new best practice is to define cost avoidance as the difference between the cost of the resolution implemented when a DMSMS issue is found proactively and the cost of the resolution had the DMSMS issue been found reactively. This requires that those responsible for determining cost avoidance perform an analysis of which solution would have been chosen had the issue been discovered reactively.

The process for determining the cost avoidance requires that the resolution of a proactive DMSMS issue has been implemented and that the costs are known or can be estimated. The estimated cost of the reactive resolution is based on two factors:

- The date that the DMSMS issue was likely to be identified reactively. This will usually be the date when the existing supply of the item reaches its reorder point based on the demand rate.
- An analytical determination of the cost of the resolution had the DMSMS issue been found reactively.

The cost avoidance is then calculated by subtracting the cost of the proactive resolution from the estimated cost of the reactive resolution. In situations where a single DMSMS issue affecting multiple assemblies or multiple DMSMS issues are solved with a single solution, the cost of the reactive solution would be determined by summing the costs for each unique assembly or solution, taking into consideration that common costs should only be applied once.

There may be situations where no cost avoidance will be realized.

- The reactive and proactive resolutions were the same.
- When the proactive resolution was a redesign. It is assumed that a redesign is always an option whether the issue was found proactively or reactively.
- When the DMSMS issue was identified reactively, since cost avoidance only applies to issues found proactively.
- In cases where the proactive resolution used was not the least expensive for some programmatic reason, there is the potential for there to be a negative cost avoidance. If this occurs, the cost avoidance could be discarded or the same assumptions used in the proactive solution could be applied to the reactive solution and the costs determined using those assumptions.

Table 40 lists the Level 1 data elements needed for estimating the cost avoidance for being proactive. There is a close relationship between the cost of being reactive as discussed in Appendix H.3.1 and the cost avoidance for being proactive. For Appendix H.3.1, the perspective is from a reactive program office considering what would have been the case (i.e., how much money it could have saved) had it been proactive. In this section, the perspective is from a proactive program office estimating what would have been the case (i.e., how much spending it avoided) had it been reactive.[192]

Table 40. Data Elements for Estimating Cost Avoidance for Being Proactive

Information Type	Level 1 Data Element Title	Level 2 Data Element Title
DMSMS resolution cost-related	• Type of Resolution Approved • Resolution Cost • Source of DMSMS Resolution Cost	
DMSMS management operations efficiency-related	• Case Proactivity Indicator • Resolution Avoided • Cost of Resolution Avoided	

One difference from Appendix H.3.1 is that the data elements extended the focus to all resolutions, not just redesigns. In this situation, the resolution avoided data element identifies situations where the case was opened proactively, and potentially a different resolution would have been required if it had been opened reactively. Determining what that resolution would have been involves: identifying when in the future there would have been a failed attempt to purchase; assessing which of the current feasible resolutions would still be feasible at that future date; and selecting which of those feasible resolutions would have been the cost effective choice.[193] The cost avoidance for being proactive would be the sum

[192] The cost avoidance of being proactive cannot be calculated accurately for reasons similar to those stated in Appendix H.3.1 for why the cost of being reactive cannot be calculated precisely.

[193] In Appendix H.3.6, the resolution avoided data element also refers to the proactive resolution that could have occurred had the DMSMS issue been identified proactively. Determining what that resolution would have been involves: identifying when discontinuation information could have been known in the past; assessing what additional resolutions would have been feasible at that time; and selecting the resolution that would have been the most cost effective at that time.

over all cases of the differences between the cost of the resolution avoided and the actual resolution cost. Such cost estimates should be made using the following in descending order of precedence.

- Estimates provided in the process of determining the best resolution to use or from other sources (e.g., the prime contractor).
- Actual costs used for similar resolutions or similar items within the program office. Similar items means same type of item, same operating environment, and same complexity.
- Average resolution costs for similar items that were generated within the program office.
- Average resolution costs for similar items generated by higher level organizations.

H.3.3 Improved Understanding of Schedule Impacts

The Level 1 and Level 2 data elements associated with identifying DMSMS impacts on schedule are shown in Table 41.

Table 41. Data Elements for Understanding DMSMS Impacts on Schedule

Information Type	Level 1 Data Element Title	Level 2 Data Element Title
DMSMS resolution cost-related	• Type of Resolution Approved	
DMSMS management operations efficiency-related	• Case Proactivity Indicator • Reason Issue Was Discovered Reactively • Date Case Closed • Date Implementation Needed	• Effect on Production Schedule

The Level 2 data element's effect on schedule indicates the number of months that a production schedule for fielding an augmenting capability was delayed as a result of DMSMS issues. While it is difficult to monetize such delays, such data should have an impact at all levels of aggregation in terms of the value proposition stated earlier.

Two Level 1 data elements could provide supplemental information. A comparison of the date closed and the implementation date needed indicates whether there was an impact to the program office. While the impact could be production schedule, which is captured in the Level 2 data element, the impact may be elsewhere because the implementation need date is defined as the date that there will be an impact on the program office. For example, the impact could be related to operational availability or the impact could drive a cannibalization action which ultimately affects cost.

Three other data elements included in Table 41 may provide a better understanding of both of these Level 1 and Level 2 impacts. For example, analysis of the correlation between the type of resolution and whether the case was opened proactively or reactively (and the associated reason) could help explain why the delay occurred. Depending on the results of that analysis, potential process improvements (as well as policy and guidance changes) could be initiated. The analysis could also simply indicate that delays may be a result of the inevitability of DMSMS issues even when managed proactively.

H.3.4 Improved Understanding of Operational Availability Impacts

Table 42 presents the Level 1 and 2 data elements relating to this benefit. With the exception of the logistics response time data element, the Table 42 data elements are analogous to Appendix H.3.3 for schedule impacts. The only difference is that the schedule delays are replaced with mission capability impacts.

Table 42. Data Elements for Understanding DMSMS Impacts on Operational Availability

Information Type	Level 1 Data Element Title	Level 2 Data Element Title
DMSMS resolution cost-related	• Type of Resolution Approved	
DMSMS management operations efficiency-related	• Case Proactivity Indicator • Reason Issue Was Discovered Reactively • Date Case Closed • Date Implementation Needed	• Effect on Logistics Response Time • Effect on Mission Capability

The inclusion of the logistics response time data element provides further insight. While mission capability is affected by logistics response time, a logistics response time delay may not be sufficient. For example, an analysis of differences in the occurrence of logistics response time and mission capability impacts should lead to finding out about risk of mission capability impacts sooner.

H.3.5 Estimating Supply System Impacts Avoided by Being Proactive

The Level 1 and 2 data elements listed in Table 43 help demonstrate the benefits of DMSMS management proactivity on the supply system.

Table 43. Data Elements for Estimating Supply System Impacts Avoided by Being Proactive

Information Type	Level 1 Data Element Title	Level 2 Data Element Title
DMSMS management operations efficiency-related	• Case Proactivity Indicator • Resolution Avoided	• Resolution Avoided Implementation Time • Consumption Rate • Stock on Hand

There is a relationship between backorders in the supply system and operational availability. Depending on the level of safety stock and availability of work-arounds such as cannibalization, backorders will eventually lead to decreased operational availability. Therefore, backorders avoided can be a more sensitive indicator of the benefits of risk-based, proactive DMSMS management.

Reactive DMSMS management will lead to a greater number of backorders of the obsolete item than proactive DMSMS management because there is a shorter implementation window from issue discovery to impact. The implementation activities only begin when the supply system is at its reorder point and additional quantities are not available for purchase. Backorders occur if the demand during the implementation time period exceeds the stock available at the reorder point.

A Back Orders Avoided (BOA) metric, which would only apply to situations where the case proactivity indicator specifies proactive, should be calculated as follows:

- Determine the estimated quantity of the item that would be required during the time it takes to implement the resolution that would have been chosen had the issue been discovered reactively (resolution avoided data element). This is simply the resolution avoided implementation time data element multiplied by the consumption rate date element.
- Subtract the stock on hand data element to estimate BOA.

A closely related metric is days of supply impact avoided (DSIA). DSIA is BOA divided by the consumption rate data element. For both metrics, when working with cases that involve multiple solutions, calculate the quantities for each item and sum them prior to performing the final proactive or reactive calculation. Finally, use the same items for both the proactive and reactive calculations.

Some caveats on the use of both metrics are as follows:

- The metrics are only applicable during sustainment since they are related to availability and the supply system.
- The metrics assume there are no backorders for the proactive resolution. This is the goal of proactive DMSMS management, but sometimes may not necessarily be the case. Coordination between the program office and the inventory manager helps minimize supply availability impacts for the proactive resolution.
- The metrics may portray inaccurate results if the reactive resolution time is less than the proactive resolution time. This could happen in a situation where different assumptions (often in terms of risk tolerance) are employed to resolve a resolution reactively. For example, a proactive resolution might be the use of a complex substitute where there may be some development work and substantial testing. If the reactive resolution involved a waiver of a qualification test (which is also a complex substitute), the resolution time could be substantially less.

H.3.6 Estimating Improvements in Resolution Implementation Time from Being Proactive

Another factor that could have an impact on availability is the time necessary to implement a resolution—the longer the time, the higher the likelihood of an impact. Table 44 show the Level 1 and 2 data elements needed to examine the differences between reactive and proactive DMSMS management.

Table 44. Data Elements for Estimating Improvements in Resolution Implementation Time from Being Proactive

Information Type	Level 1 Data Element Title	Level 2 Data Element Title
DMSMS management operations efficiency-related	• Date Case Opened • Date Case Closed • Case Proactivity Indicator • Resolution Avoided	• Resolution Avoided Implementation Time

There are two ways to calculate resolution time decrease.

- When the case is opened proactively (i.e., the case proactivity indicator data element signifies proactive), the resolution time decrease from being proactive is the reactive resolution avoided implementation time minus the actual proactive resolution implementation time. The actual proactive resolution time would be the time elapsed between the data elements for date case opened and date case closed.
- When the case is opened reactively (i.e., the case proactivity indicator data element signifies reactive), the potential resolution time decrease that could be achieved by proactive DMSMS management is the reactive resolution time minus the proactive resolution avoided implementation time. The actual reactive resolution time would be the time elapsed between the data elements for date case opened and date case closed.

For both metrics, the formula varies slightly when working with cases that involve multiple solutions. Determine the implementation times for each case and sum them prior to performing the final calculation. Also, use the same items for both the proactive and reactive calculations. When aggregating at the program office level, sum the factors for all cases being aggregated and calculate the metrics using those summed factors.

Some caveats on the use of both metrics are as follows:

- As indicated in the previous section, there may be instances where the reactive resolution implementation time is less than the proactive resolution implementation time.
- The fact that there is a difference between the two implementation times may not have any impact on availability. The key is whether the resolution was implemented before the supply system exhausted its inventory.

H.3.7 Determining an ROI for DMSMS Management

A calculation of an ROI for DMSMS management can be made with the Level 1 and 2 data elements itemized in Table 45.

Table 45. Data Elements for Determining an ROI for DMSMS Management

Information Type	Level 1 Data Element Title	Level 2 Data Element Title
DMSMS management and resolution cost-related	• Type of Resolution Approved • Resolution Cost • Source of DMSMS Resolution Cost • DMSMS Management Operations Cost Paid to Prime/OEM • DMSMS Management Operations Cost Paid to Independent SME Organizations • Management Operations Cost for Internal DMSMS-Related Activities	• Value of Management Operations Activities Received at No Cost from a Centralized Service Source
DMSMS management operations efficiency-related	• Case Proactivity Indicator • Resolution Avoided (Cases where issue was found proactively only) • Cost of Resolution Avoided	

It is important to understand that the concept of ROI does not apply to a single case; it pertains to a DMSMS management program. ROI is generally defined as the money earned (return) because of an investment. The formula for ROI is as follows:

$$ROI = \frac{Return - Investment}{Investment} \; x \; 100$$

The data elements in Table 45 include most of the data elements from Appendix H.3.2, which pertains to the cost avoidance of being proactive. It is that cost avoidance of being proactive that equates to the return part of the ROI calculation. Data elements for the total cost of DMSMS management operations are also included in Table 45. They represent the investment part of the equation. Applying the basic ROI formula to DMSMS management should then be the ratio of the two as shown:

$$ROI = \frac{DMSMS\ Cost\ Avoidance - Total\ Cost\ of\ DMSMS\ Management\ Operations}{Total\ Cost\ of\ DMSMS\ Management\ Operations} \; x \; 100$$

H.4 RECORD KEEPING DATA ELEMENT DICTIONARY

Table 46 shows the Level 1 DMSMS management and resolution cost-related data elements.

Table 46. Level 1 DMSMS Management and Resolution Cost-Related Data Elements

Name of Field	Data Collected	Description of Data Collected
Type of Resolution Approved	Approved item	See Table 12 for definitions
	LON buy	
	Simple substitute	
	Complex substitute	
	Extension of production or support	
	Repair/reclamation	
	Development of a new source	
	Design refreshment	
	Redesign of the NHA	
	Redevelop the item	
	Redesign complex/system replacement	
Resolution Cost	Cost to develop and implement (exclude LON item costs and costs to procure non-developmental and test items)	Costs related to engineering and design of the solution, include: Engineering/Engineering Data Revision, Qualification of New Items, Software Development or Modification, Startup Costs, Tooling/Equipment/Software and one-time costs related to the implementation of the solution: Computer Programs/Documentation, Interim Support, Supply/Provisioning Data, Support/Test Equipment, Technical Manuals, Training/Training Equipment, Installation Costs. The cost of items for LON purchases and of the actual item beyond testing items should not be included. Note: For a multi-phase resolution, capture this information for each phase.
Source of DMSMS Resolution Cost	Actual costs	This item is selected if the development and implementation cost are actual costs.
	Estimated costs	This item is selected if the development and implementation cost are estimated costs.
	Costs from DoD cost tables	This item is selected if the development and implementation cost are derived from Table 15.
Redesign Level (if redesign involved in the resolution)	Item (piece parts, device, commercial item)	A component—a smaller, self-contained part of a larger entity.
	Assembly (card, SRA, SRU), may be a commercial or NDI item)	Assemblies are items built from items.
	Subsystem (boxes, WRA, LRU)	Subsystems are complete functional items built from assemblies, and items.
DMSMS Management Operations Cost Paid to Prime/OEM	The amount paid to the prime contractor/OEM for DMSMS management operations	DMSMS management costs only. Does not include the cost to resolve DMSMS issues.
DMSMS Management Operations Cost Paid to Independent SME Organizations	The amount paid to independent SME organizations for DMSMS management operations	DMSMS management costs only. Does not include the cost to resolve DMSMS issues.

Name of Field	Data Collected	Description of Data Collected
Management Operations Cost for Internal DMSMS Activities	Amount to fund internal DMSMS operations	DMSMS management costs only. Does not include the cost to resolve DMSMS issues.

Table 47 shows the Level 1 DMSMS management operations efficiency-related data elements.

Table 47. Level 1 DMSMS Management Operations Efficiency-Related Data Elements

Name of Field	Data Collected	Description of Data Collected
OCM/OEM Part Number	OCM/OEM part number	The part number associated with the DMSMS case.
OCM/OEM CAGE code	OCM/OEM CAGE code	The CAGE Code is a unique identifier assigned to suppliers to various government or defense agencies, as well as to government agencies themselves and also various organizations. CAGE codes provide a standardized method of identifying a given facility at a specific location.
Nomenclature	Nomenclature	Name of item.
Item Class	Commercial item	Commercial items include any item of a type customarily used by the general public, or by non-governmental entities, for purposes other than governmental purposes that has been sold, leased, or licensed, or offered for sale, lease, or license to the general public (see the Federal Acquisition Regulation [FAR] 2.101).
	NDI	See FAR 2.101 and definitions section of 48 C.F.R. § 2.101.
	Developmental item	A developmental item (DI) is any item that is not commercial and not NDI.
Case Proactivity Indicator	Reactive	Items found to be obsolete after a failed attempt to purchase them or no bid on repair work as a result of obsolescence.
	Proactive	Items determined to be obsolete before an attempt to purchase them. For this document, proactively implies the item was found to be obsolete as a result of a discontinuation notice from any source, such as a predictive tool, a vendor survey, research on the item, or an attempt of a LON buy.
Reason Issue Was Discovered Reactively (Only When Case Proactivity Indicator Was Reactive)	Not monitored by choice	Items which are not monitored due to choice of the program office.
	Vendor survey failed to identify	Items monitored by a vendor survey for obsolescence, which are determined to be obsolete after a failed attempt to purchase them.
	Predictive tool failed to identify	Items monitored by a predictive tool for obsolescence, which are determined to be obsolete after a failed attempt to purchase them.
	Discontinuation notice not received	Items dependent on a notification from the manufacturer or other source, but which are determined to be obsolete after a failed attempt to purchase them.
	Data error	Items proactively monitored, but the monitoring failed because of data errors.
	Other (provide details)	All other circumstances where products are monitored.
Date Alert Received	Date alert received	The date the DMSMS alert was received.
Date Case Opened	Date case opened	The date the case was opened to determine resolution.
Date Resolution Submitted for Approval	Date resolution submitted for approval	The date the resolution for the case was submitted for approval.
Date Case Resolved	Date case resolved	The date a resolution for the case was approved.

Name of Field	Data Collected	Description of Data Collected
Date Case Closed	Date case closed	Date the case was fully implemented. In situations where the implementation requires installation/retrofit over long periods, this can be the date when the development work was complete and the first installation/retrofit is successfully completed.
Date Implementation Needed	Date implementation needed	The date by which a case must be implemented to prevent an impact on the system.
Resolution Avoided	Approved item	See Table 12 for definitions. *Note:* For a proactive resolution, the resolution avoided is the resolution that would have been implemented had the DMSMS issue been opened reactively at the point in the future where there would have been a failed attempt to purchase the item. For a reactive resolution, the resolution avoided is the resolution that could have been implemented had the DMSMS issue been identified and opened proactively at the point in the past where information such as PDN could have been discovered.
	LON buy	
	Simple substitute	
	Complex substitute	
	Extension of production or support	
	Repair/reclamation	
	Development of a new source	
	Design refreshment	
	Redesign of the NHA	
	Redevelop the item	
	Redesign complex/ system replacement	
Cost of Resolution Avoided	Cost to develop and implement (exclude LON costs) the resolution avoided	Costs related to engineering and design of the resolution, include Engineering/Engineering Data Revision, Qualification of New Items, Software Development or Modification, Startup Costs, Tooling/Equipment/Software and one-time costs related to the implementation of the solution: Computer Programs/Documentation, Interim Support, Supply/ Provisioning Data, Support/Test Equipment, Technical Manuals, Training/Training Equipment, Installation Costs. The cost of items for LON purchases and of the actual item beyond testing items should not be included.
Subsystems	Total number of subsystems in the system	Total number of subsystems whether monitored or not. Subsystems are items that are built from assemblies and in some cases components. Components are the lowest level items used in assemblies.
Subsystems Monitored	Total number of subsystems in the system being monitored	Total number of subsystems that are monitored.
Components	Total number of components	Components within the system/subsystem.
Components Monitored	Total number of monitored components	Components that are being monitored within the system/ subsystem.

Table 48 shows the Level 2 DMSMS cost-related data elements.

Table 48. Level 2 DMSMS Cost-Related Data Elements

Name of Field	Data Collected	Description of Data Collected
Commodity Type	Software	Software is a sequence of instructions written in a programming language that computers, microprocessors, microcontrollers, or other processing devices can interpret and execute. Types of software include operating systems, applications, drivers, firmware, and utilities. Market categories of software include commercial, government, open-source, and freeware. Programming languages range from machine code (device language) to 4th and 5th generation languages. Each generation tends to further abstract the language from the device.
	Electronics	Electronic devices control electrical energy by electrically manipulating the flow of electrons. Electronics encompasses electrical circuits that involve active electrical components such as vacuum tubes, transistors, diodes, integrated circuits, associated passive electrical components, and interconnection technologies. Commonly, electronic devices contain circuitry consisting primarily or exclusively of active semiconductors supplemented with passive elements; such a circuit is described as an electronic circuit.
Commodity Type *(continued)*	Electrical/ electro-mechanical	Electro-mechanical devices carry out electrical operations by using moving parts. Electro-mechanical devices deal with the generation, distribution, switching, storage, and conversion of electrical energy to and from other energy forms using wires, motors, generators, batteries, switches, relays, transformers, resistors, and other passive components.
	Mechanical	Mechanical devices are machines or parts of machines which are primarily related to or controlled by physical forces. Examples include bearings, machined devices, castings, valves, screws, bolts, panels, and so forth.
	Materials	Materials are the substance or substances of which a thing is made or composed. Materials can include raw, refined, or manufactured items that are used in the manufacture of other items. Examples include glues, metal, fabric, minerals, gases, liquids, chemicals, paints, and so forth.
Operating Environment of the Equipment	Air	Items that are used in or on airborne equipment.
	Arctic	Items that are used in an arctic environment.
	Desert	Items that are used in a desert environment.
	Ground, tactical	Items that are used in or on ground equipment in a tactical environment.
	Ground, benign	Items that are used in or on ground equipment in a non-tactical environment.
	Marine	Maritime surface items: ships, boats, drones, barges, and so forth.
	Space	Items that are used outside of the earth's atmosphere.
	Undersea	Items that are used in an undersea maritime environment: subs, torpedoes, mines, drones, and so forth.

Name of Field	Data Collected	Description of Data Collected
Product Acquisition Cost	Cost of items purchased as part of a resolution	The total cost of actual items purchased for a LON buy resolution or for other resolutions where some quantity of the new items was purchased in conjunction with any non-recurring engineering and testing to develop that new item (e.g., the funded resolution may have been reverse engineering but a quantity of the new reversed engineered item was purchased at the same time).
DMSMS Item Type	Component (piece parts, device, commercial item)	A component—a smaller, self-contained part of a larger entity.
	Assembly (card, SRA, SRU, may be a commercial item) or NDI	Assemblies are items built from items.
	Subsystem (boxes, WRA, LRU)	Subsystems are complete functional items built from assemblies, and items.
Value of Management Operations Activities Received at No Cost from a Centralized Service Source	Value of resources provided from a centralized command source	DMSMS management costs only. Does not include the cost to resolve DMSMS issues.

Table 49 shows the Level 2 DMSMS management operations efficiency-related data elements.

Table 49. Level 2 DMSMS Management Operations Efficiency-Related Data Elements

Name of Field	Data Collected	Description of Data Collected
LON Buy Preferred Indicator	Yes	This should be limited to situations where a LON would have been the best approach but was unavailable (e.g., we were notified too late, there was no budget, procurement time took too long, and so forth).
	No	
Monitoring Techniques (Only When Case Proactivity Indicator Was Proactive)	Vendor survey	The need for a case was established by a monitoring process where the manufacturer of the item is contacted directly to determine the production status of a part.
	Predictive tool	The need for a case was established by a monitoring process where the production status of a part is determined by the use of a predictive tool.
	DLA notice	The need for a case was established by obtaining a notification from DLA.
	GIDEP notice	The need for a case was established by obtaining a notification from GIDEP.
	OEM notice	The need for a case was established by obtaining a notification from the prime contractor or component manufacturer.
	Prior LON buy inadequate quantity	The need for a case was established when the items purchased for a previous LON buy solution did not last as long as planned.
Effect on Production Schedule	Number of months of schedule slip	Months of production delay for fielding a capability as a result of the issue that initiated the DMSMS case.
Effect on Logistics Response Time	Number of days of extended logistics response time	Days of logistic response time increase as a result of the issue that initiated the DMSMS case.
Effect on Mission Capable Rate	Percentage change in MICAP rate	Percentage points that MICAP rate decreased as a result of the issue that initiated the DMSMS case.

Name of Field	Data Collected	Description of Data Collected
Resolution Avoided Implementation Time	Estimated time to implement the resolution avoided	Days required to implement the resolution avoided (either a proactive one or a reactive one), i.e., the total time required to close a case. Most DMTs consider a case closed when all activities are complete, including changes to drawings and technical manuals. When a resolution will take a long time to complete, for instance, when it is being back fitted by attrition, the case can be considered closed when the initial installations are complete and planning for future installations are in place. Days required to implement the resolution avoided (either a proactive one or a reactive one), i.e., the total time required to close a case. Most DMTs consider a case closed when all activities are complete, including changes to drawings and technical manuals. When a resolution will take a long time to complete, for instance, when equipment is being back fitted by attrition, the case can be considered closed when the initial installations are complete and planning for future installations are in place. This data element should be determined on the basis of engineering judgement. In the absence of other data, Table 50 may be used with caution to estimate the implementation time based on the resolution avoided. The information in Table 50 was derived from an analysis of 39,535 different cases. While this table reflects actual case resolution times, the impact and the impact time-line also influence the results. For example, if an issue were predicted to occur in five years, the personnel working this case may elect to defer resolution actions, especially if a preliminary assessment indicates a simpler solution or no sense of urgency. Furthermore the criteria for case closure was not defined. For example, some DMSMS teams may consider closure at the approval point, others at contract implementation and others at complete documentation update (e.g., technical manuals, engineering drawings, etc.).
Consumption Rate	Demand per quarter	The expected quarterly demand for the obsolete item based on all systems using the item in question, not just the program office maintaining records.
Stock on Hand	Stock on hand in the supply system	Estimated stock that would be on-hand in the supply system at the time that the DMSMS issue was reactively identified. Typically this is the reorder level including all safety stock.

Table 50. Mean Days to Close a Case

Solution Type	Mean
Approved Part	179
Life of Need Buy	187
Simple Substitute	136
Complex Substitute	225
Extension of Production or Support	440
Repair, Refurbishment, or Reclamation	265
Development of a New Source[194]	190
Design Refreshment[194]	190
Redesign—NHA	301
Redevelop the Item[194]	190

[194] As described in Section 6, the resolution “Development of a New Item or Source” has been replaced by three resolution types. The mean time data shown in this table were based on that previous resolution type.

Solution Type	Mean
Redesign—Complex/System Replacement	644

Appendix I. Considerations for Acquiring or Building a BOM

I.1 INTRODUCTION

This appendix focuses on the portion of the *Identify* step (Section 4, more specifically Section 4.3.1.2.1) that introduces the topic of obtaining BOMs. The objective of this appendix is to highlight considerations for a program office that is faced with acquiring (when not contractually required up front) or developing BOMs to support proactive DMSMS management.

The appendix contains four sections. First, there is a section that addresses precursor considerations that apply to BOMs. More specifically, these considerations include IP and the importance of ensuring that there is a business case that supports the acquisition or development of a BOM. The second section then documents best practices for acquiring a BOM[195] if it was not delivered on contract. The third section documents best practices for creating or building a BOM. Finally, the fourth section describes processes for identifying and correcting gaps in BOM data.

The Annex to Appendix I shows potential data elements for a BOM in priority order.

I.2 PRECURSOR CONSIDERATIONS

I.2.1 Intellectual Property

Both a contract deliverable for a BOM (or other technical data) and the appropriate use rights are necessary for DoD to be able to use the data in the manner needed. Obtaining a BOM, either on the original development contract or after the fact, does not mean that DoD can automatically use the BOM for DMSMS management purposes. There must also be an agreed upon determination of DoD's use rights, which could entail restrictions on how DoD can use the information. To act upon its use rights, DoD must obtain the data via a contract deliverable.

I.2.1.1 ESTABLISHING A CONTRACTUAL REQUIREMENT FOR DATA ACCESS

Establishing a contract requirement to acquire the data is therefore, the first step in obtaining a BOM.[196] All DoD contracts must specify the technical data to be delivered under a contract and delivery schedules for the data.[197] There are several ways in which the requirement can be established. Typically, the contract requirement is explicitly expressed as a CDRL and an associated DID. Without such an explicit

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[195] This document is focused on BOMs for non-commercial hardware. Commercial item monitoring is usually focused on the item itself and is carried out via vendor surveys.

[196] If a company objects to a technical data requirement in a contract, the program office and its contracting officer must resolve the situation during the contract negotiation process. Once the contract is signed, there have been instances where companies refused to deliver the technical data called for via the requirements on a contract because of IP concerns. It is up to the individual program office to determine whether to dispute this. If there was a contract requirement to deliver the data, the contractor does not have much leverage. More than likely, the contractor would have negotiated the requirement out of the contract if the issue were important enough.

[197] 48 C.F.R. § 252.227-7013, Rights in Technical Data—Noncommericial Items, available at https://www.law.cornell.edu/cfr/text/48/252.227-7013.

requirement, the government may compel the contractor to deliver data up to three years after the acceptance of all items called for in the contract under the FAR “Additional Data Requirements”[198] or the Defense Federal Acquisition Regulation Supplement (DFARS) “Deferred Ordering”[199] clauses. Lastly, the government may include a specifically written contract clause for access to data.[200]

Any of these requirements can be established in the original contract or in a contract modification. Absent one of these contractual mechanisms to obtain a BOM, the contractor is not required to provide it to the government, regardless of use rights, because data delivery requirements may have a cost associated with the packaging and delivery of the data.

I.2.1.2 ENSURING THE GOVERNMENT’S RIGHTS TO USE DATA MATCHES THE PROGRAM OFFICE’S NEEDS

The second step is to ensure that government rights to use the data meet a program office’s needs. Three types of technical data rights are most pertinent to contract requirements to deliver data needed for DMSMS management:[201]

- Unlimited Rights. “In the case of an item or process that is developed by a contractor or subcontractor exclusively with Federal funds, [the government has] unlimited rights to use the technical data pertaining to the item or process; or release or disclose the technical data to anyone outside or inside the government or permit the use of the technical data by such persons.”[202]
- Government Purpose Rights. “In the case of an item or process that is developed in part with Federal funds and in part at private expense,”[203] the government has government purpose rights. This implies that the government has rights to “use, modify, reproduce, release, perform, display, or disclose technical data within the Government without restriction; and release or disclose technical data outside the Government and authorize persons to whom release or disclosure has been made to use, modify, reproduce, release, perform, display, or disclose that data for United States Government purposes.”[204]
- Limited Rights. “In the case of an item or process that is developed by a contractor or subcontractor exclusively at private expense,” the government’s data rights may be restricted to limited rights. In that case, the government cannot “release or disclose technical data pertaining to the item or process to persons outside the government or permit the use of the technical data by such persons”[205] without the written permission of the contractor.

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[198] See 48 C.F.R. § 52.227-16, Additional Data Requirements.

[199] See 48 C.F.R. § 252.227-7027, Deferred Ordering of Technical Data or Computer Software.

[200] DFARS 227.7108 (48 C.F.R. § 227.7108, Contractor Data Repositories) provides some guidance on contractor data repositories that relate to access. Even beyond the question of government use rights, access to DMSMS management data is problematic. Only accessing BOM data without taking delivery of the BOM itself can be problematic if the data is in a form that cannot readily be input into a DMSMS monitoring tool. Consequently, DoD would have to possess the data in a usable format at some point in the process. Furthermore, access would normally be limited to the duration of a contract. DoD uses BOMs throughout the life cycle of the subsystem, not the period of performance of the contract. There is no standard contract clause governing rights to data that is accessed but not formally delivered.

[201] Specifically negotiated license rights allows government purpose rights to be tailored. For commercial items where the government funded none of the development, standard commercial license rights apply. Restricted rights associated with computer software documentation are not discussed.

[202] 10 U.S.C. § 2320, Rights in Technical Data.

[203] Ibid.

[204] 48 C.F.R. § 252.227-7013(a)(13).

[205] Ibid.

It might seem that it is easy to make a determination of whether an item or process is developed in whole, in part, or not at all with federal funds. That is not the case. There can be disagreements over what it means to develop an item.[206] For example, there have been situations where the contractor developed a breadboard design with private funds and the government funded the update to a design that can be manufactured, but did not obtain unlimited rights. Also, developed exclusively at private expense encompasses "costs charged to indirect cost pools, costs not allocated to a government contract, or any combination thereof."[207] That means that both independent R&D and bid and proposal funds are included under private expense even though some of those costs are recoverable.

Consequently, government contracts normally include an assertions table[208] which identifies:

- The technical data to be furnished with restrictions,
- The basis by which the restrictions have been asserted, and
- The asserted rights category.

The assertions table may be limited to the data required by CDRL, however the contractor often includes everything known at the time an offer is made to the government. The assertions table may be revised when new data is generated in the performance of the contract. If the government chooses to exercise the deferred ordering clause,[209] the assertions table may be updated to reflect this request as part of a contract modification.

Assertion tables are normally prepared at the lowest practical level (doctrine of segregability). That means that the data rights for an assembly are defined by the sum of the data rights associated with the subassemblies. The government therefore may only have limited rights to certain subassemblies that are essential to the performance or maintenance of the assembly.

A program office may challenge[210] the rights asserted in the assertions table.[211] The challenge can literally occur at any point in time.[212] The steps in the process include the following:

- A pre-challenge request for information by the government contracting officer.
- A formal challenge by the government contracting officer.
- The contractor response (considered a claim under the Contracts Disputes Act). Contractors are required to maintain records (time sheets, project records, engineering records, and so forth) to justify the validity of restricted data rights.[213]

[206] Developed is defined in 48 C.F.R. § 252.227-7013(a)(7).
[207] 48 C.F.R. § 252.227-7013(a)(8).
[208] 48 C.F.R. § 252.227-7017, Identification and Assertion of Use, Release, or Disclosure Restrictions.
[209] Deferred ordering applies only to data generated in the performance of the contract. The contractor is compensated for converting the data into a prescribed form, reproduction, and delivery.
[210] IP challenges virtually never are concerned with who owns the data. The contractor always retains title to the data according to FAR and DFARS clauses. Only the terms of the government's license to use the data is at issue.
[211] 48 C.F.R. § 252.227-7037, Validation of Restrictive Markings on Technical Data.
[212] Data rights for products or processes do not automatically change over time or expire. There are instances where the original manufacturer has gone out of business or no longer has any interest in selling the product or process. Under these or similar circumstances, DoD can only change data rights with the permission of the company (or its traceable successor company or escrow agent) that originally established the data rights.
[213] 48 C.F.R. § 252.227-7013.

- The contracting officer's final decision.
- Contractor appeal or suit.

When there is a strong disagreement regarding asserted rights, litigation may be the only way to resolve the situation. Program offices often choose not to recommend litigation over data rights and inform the contracting officer that the government should accept limited use rights. Reasons for this decision include the time and money involved to litigate, the difficulty in convincing multiple levels of management to support the litigation[214] (sometimes in the presence of contractor lobbying efforts to avoid litigation), maintaining a good working relationship with the contractor, and the absence of immediate consequences to the current PM.

To avoid disagreements, the government should have an understanding of what the use rights on technical data will be before the data is delivered with a marking on it. It is therefore a best practice for the government and the contractor to come to a common understanding about use rights to avoid misunderstandings after the data is delivered. In fact, where possible, the results of that common understanding should be specified in the contract CDRL that calls for the data.

Use rights are identified by the contractor's marking on the data.[215] When the clause at 48 C.F.R. § 252.227-7013 (entitled Rights in Technical Data–Noncommercial Items) is placed on contract and the contractor "desires to restrict the government's rights in technical data [the contractor must] place restrictive markings on the data."[216]

Unlimited rights or government purpose rights are more than sufficient for DMSMS monitoring (and resolution) purposes. Limited rights are problematical because many DoD program offices use commercial predictive tools to determine the obsolescence status of items being monitored. At issue is whether the use of a commercial predictive tool implies that the data is being released "outside the government." Several arguments can be made for why the use of commercial predictive tools is allowed under limited data rights.

- Such tools take a parts list with the manufacturer's part number as input. If this is the only information being input to a predictive tool, and the parts list is not associated with anything, then an argument can be made that the BOM itself is only being used inside the government.
- A covered government support contractor is exempted from the limited rights restriction "outside of government." A covered government support contractor is defined as a contractor under a contract where "the primary purpose of which is to furnish independent and impartial advice or technical assistance directly to the Government in support of the Government's management and oversight of a program or effort (rather than to directly furnish an end item or service to accomplish a program or effort)."[217] It can be argued that the use of a commercial predictive tool is technical assistance directly to the government.
- Technically, when using predictive tools, the government is not releasing the data to anyone. The predictive tool provider would assure the government that its data is secure. Compromising the data would therefore require an overt act by the predictive tool provider.

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[214] Ultimately, the Department of Justice would have to agree to litigate.
[215] Per 48 C.F.R. § 227.7103-10(c)(1), "Technical data delivered or otherwise provided under a contract without restrictive markings shall be presumed to have been delivered with unlimited rights." There also are instances where companies provide technical data with improper markings (e.g., proprietary). In that situation, the government should challenge the markings, but in the meantime the government must act as if there are limited use rights.
[216] 48 C.F.R. § 227.7103-10(b)(1).
[217] See 48 C.F.R. § 252.227.7013(a)(5).

- There are two exceptions that allow the government to provide technical data for use by an outside contractor: 1) when the data include only F3 information (along with qualification requirements) and (2) when the data is necessary for operations, maintenance, installation, or training (other than detailed manufacturing or process data). An argument can be made that the data is necessary for O&M.[218]

None of these arguments has been tested in court. Consequently, if the government only has limited rights to a BOM, the government may want to consider obtaining contractor permission to use the data in a predictive tool.

I.3 ENSURING THERE IS A BUSINESS CASE TO ACQUIRE OR BUILD A BOM

The "Acquire or Build the BOM" blocks in Figure 29 implicitly includes a BCA to determine whether it is worthwhile in a situation where it has been determined that it is desirable to proactively monitor a subsystem per the above criteria, but the subsystem BOM has not previously been obtained via contract. Such a BCA should consider the following:

- How much would it cost to acquire or construct the BOM? Cost encompasses both obtaining the data and converting the data into a form that is usable by predictive tools.
- How severe are the risks if the subsystem were monitored reactively? Proactive DMSMS management increases the window of opportunity to implement a resolution to a DMSMS issue. The longer the window of opportunity, the greater the likelihood that 1) the issue will not impact a production schedule or readiness and 2) the cost to implement the resolution will be lower. Reactive DMSMS management minimizes the window of opportunity. The second factor is an assessment of the likelihood of a severe negative repercussion for the particular types of items found in the subsystem. Considerations in making this assessment include the following:
  - What are the items in the subsystem where a longer window of opportunity will significantly reduce the likelihood of a severe negative outcome (i.e., unrepairable and/or expensive items where the time to implement a resolution is lengthy)?
  - What is the likelihood that there will be a DMSMS issue associated with any of these items within their LON? Some factors affecting this likelihood include the life cycle of the underlying technology, reliability, and supply chain vulnerability. The likelihood should be considered over the entire period of time that the subsystem will be operational. An event that is unlikely to occur in the next year may be much more likely to occur within five years. Furthermore, if more than one item is under consideration (from the first bullet), then the likelihood of multiple events should be taken into account. If all these likelihoods are vanishingly small, then it may not be worthwhile to attempt to acquire or construct the BOM. On the other hand, if the likelihoods are large or even small but not insignificant, then acquiring the BOM data should be considered further.
  - How large is the negative outcome likely to be, measured in dollars, relative to the cost to acquire or construct the BOM, if a DMSMS issue is identified reactively, rather than

[218] Although not the subject of this document, this footnote provides a brief discussion of the implications of limited data rights on implementing DMSMS resolutions. (There are no implications for unlimited or government purpose rights.) Limited rights data cannot be used to support resolutions unless the resolution will be implemented using only government or government support contractors. This is very unusual. The exception that allows the government to provide technical data for use by an outside contractor to implement a resolution when the data is necessary for operations, maintenance, installation, or training (other than detailed manufacturing or process data) may be sufficient. Unfortunately, the terms in the exemption are not defined in law. Furthermore, a contractor can legally challenge government release of limited use data under either of these exceptions because there can be disagreements on whether the conditions were met. Such a challenge may result in a law suit.

proactively? If it's relatively inexpensive to acquire or construct the BOM data, then it may be worthwhile to pursue it. If the possible cost of a severe negative repercussion is very high as compared to the cost of acquiring the BOM then a decision maker may try to acquire or construct the data even when the likelihood of a DMSMS issue is low.

- To what extent would the acquired or constructed BOM reduce the risks? The third factor affecting the decision is whether acquiring the BOM data will sufficiently reduce the risk of a severe negative repercussion. Different ways of acquiring the data have different degrees of risk reduction. Risk reduction is affected by the level of detail (completeness) that will be available in the BOM, the currency of the data, and the accuracy of the data. For example, if it is unlikely that the acquired or constructed BOM will contain enough information to proactively monitor the items of concern, then it may not be worthwhile to pursue the BOM.

I.4 ACQUIRING A BOM

If a BOM was not delivered on contract, it is a best practice to attempt to acquire the BOM before trying to build it. Figure 29 shows a process for doing that.

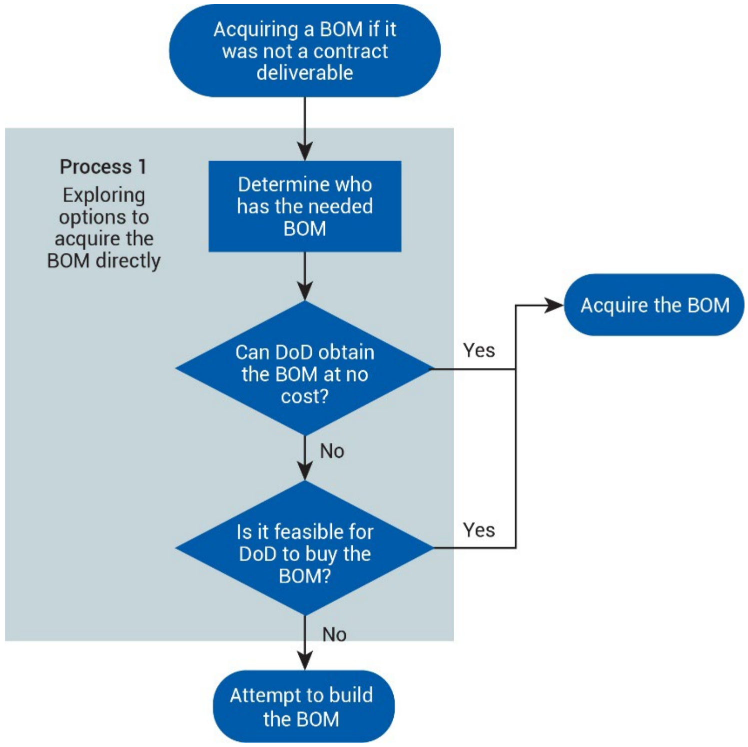
- Acquiring a BOM if it was not a contract deliverable. In this context, the term, BOM, refers to an engineering BOM or EBOM. The EBOM shows the items and materials used along with their OEM Cage code/manufacturer's part number. The SD-26 references the DID that should be used when purchasing a BOM on a development contract. To some extent when acquiring a BOM using the Figure 29 process (but much more so when building a BOM using the process in the next section of this document) it is not necessary to pursue all the data elements with equal priority. Section 4.3.2.1 identifies potential data elements to pursue, indicates which of those data elements are essential, and suggests levels of desirability for the non-essential ones.

  Two outcomes of the Figure 29 process are possible: either the data are obtained or there is an attempt to build a BOM using the process in the next section.

- Determine who has the needed BOM data. Unless the subsystem is part of a legacy system where there is no industry support, it is likely that some commercial entity will have a BOM. The prime may have the data (if the prime is the OEM or has obtained the data from the OEM). Of course, the OEM (or its traceable successor company or escrow agent) should have it. If the item is government furnished, then the data may reside within another program office or if not, with the OEM that produced the item for that program office. Lastly, it is also possible that another DoD program office already has a BOM.

- Can DoD obtain the BOM at no cost? There are several aspects to this question.
  - First is the case where another program office has already obtained the same (or even a similar) BOM and the program seeking to obtain a BOM can possibly acquire it from that other program office. There are no data rights issues when the government program office with the BOM has unlimited or government purpose rights to the data. Limited data rights do not preclude one government program office from giving a BOM that it purchased to another government program office that uses the same or a similar subsystem. Under limited data rights, it is a best practice for there to be a formal agreement between the two program offices that includes a statement of the data rights under which the receiving program office must operate.

Figure 29. A Process for Acquiring a BOM If It Was Not Delivered on Contract



- Second is the situation where the DMSMS management service provider works directly with the owner of the data. Sometimes the data may be obtained by simply asking for it. Explaining that what is being requested is not the delivery of the entire TDP, but rather specific data fields as outlined in DI-MGMT-82274, DMSMS Life Cycle Management Data, or by arguing that it is important for the government to have the data for national security purposes. DoD may also agree to provide its DMSMS monitoring findings to the OEM to help it manage its product in return for the BOM. There is no legal basis for these types of agreements, but they occur in practice. If such an agreement to obtain the data is reached, the people involved should honor the terms of the agreement which would normally be restricted to DMSMS monitoring purposes.[219] In these situations, providing the BOM is solely at the discretion of the contractor. The contractor may terminate the agreement at any time.
- A third possible scenario (which is similar to the second) occurs when the contractor wants to implement an ECP or obtain a waiver or deviation on the DMSMS item. The government may need a BOM to approve the change. The rights conveyed on the use of the BOM would be determined by the markings on the BOM. As indicated earlier, the contractor should not be in a position to mark the BOM in any way that it wants. There should have been a discussion and agreement between the contractor and the government on what the markings will be.
- A fourth scenario is the situation where there was no disagreement that the government owns the data (i.e., it was developed entirely at federal expense). If the data exist, the government can ask to see it and copy it.

- Is it feasible for DoD to buy the BOM? There are multiple dimensions to the word "feasible."
  - Was there an option to buy in the contract, and can that option be exercised?

[219] In some instances, companies have asked for a non-disclosure agreement that specifies how the data can be used.

- Is the data owner willing to sell it? If the data owner learns that DoD will be conducting a physical product audit (PPA) to construct a BOM or actually considering a reverse engineering project, then the data owner may become more willing to provide the data at a lower cost.
- If DoD can buy the data, does it have the money and a contracting vehicle to do so? One approach for a contracting vehicle is a contract action to perform an ECP. The associated (modification of a) contract could be an opportunity to add a CDRL to purchase the data. If it happens that the ECP is on the assembly where the data are needed, then adding the CDRL in the contract is even easier. As previously indicated, the usage rights must also be stipulated.

If a program is not able to convince an OEM to share or offer for purchase, the required BOM data and it is not available through another source (e.g., other government program office), then a program office may need to consider building a BOM or BOMs to enable proactive DMSMS management.[220] In addition, a DMT should plan to leverage future redesigns and modifications to upgrade system capability as opportunities to include the requirement for BOMs as a contract deliverable for those new efforts.

I.5 BUILDING A BOM

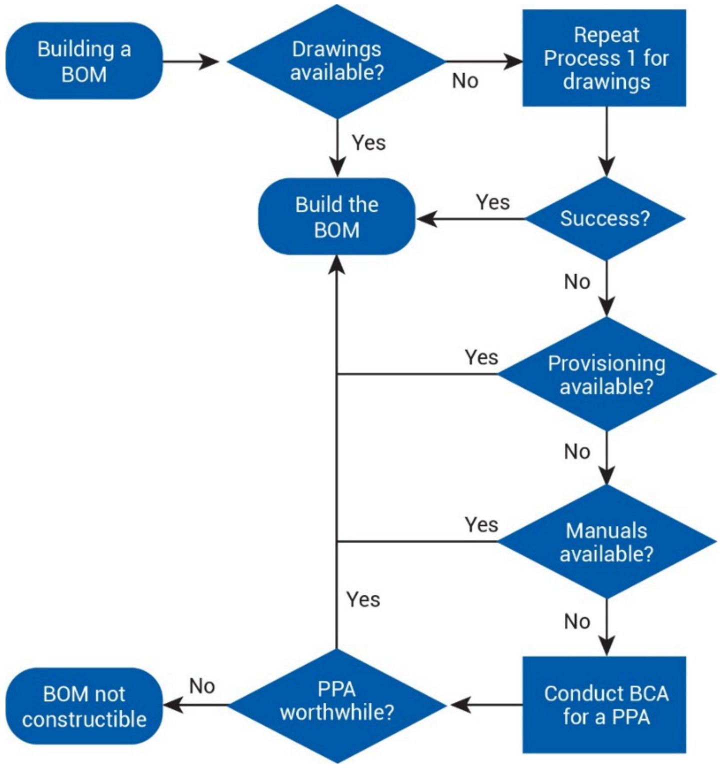
Figure 30 addresses a process for building a BOM.

The BOM building process first attempts to use drawings, then provisioning data, then manuals, and ultimately may rely on a PPA. This ordering of the sources of technical data goes from greatest to least detail. The drawings purchased may not be complete and may not be at a low enough level of detail. Provisioning data are limited to those items to be purchased through the supply system and often may not have a sufficient level of detail about subcomponents. Manuals usually do not provide the appropriate level of detail either. PPAs can be expensive and depending on how they are conducted, may have even less detail because part numbers may not be visible.[221] If the PPA is not destructive, the resulting BOM will miss many of the items. If the PPA is destructive, it will be even more expensive. Every one of these technical data sources may also be out of date.

Usage rights on a constructed BOM are defined by the usage rights of the technical data sources. If limited rights data were used, the government's rights to use the resulting BOM would be similarly limited. Usage rights apply to drawings and manuals. The government would decide on the use or disclosure of provisioning data because it belongs to the government.

[220] Another possibility is that the supplier who owns the BOM is willing to perform the proactive DMSMS management functions desired by the program office in an acceptable way, and also agrees to share the results with the government. In this situation, it may not be necessary to build a BOM.
[221] If a PPA is performed, the program office should ensure that it uses the current version of the item. Older versions may contain obsolete components that have more recently been eliminated.

Figure 30. A Process for Building a BOM



In general, there are no usage rights limitations on BOMs obtained from a PPA (or TDPs obtained through reverse engineering).[222] A key exception is for patented articles where financial penalties may be imposed.[223] Since markings are required on any patented article, any patent identified in a PPA or a reverse engineering effort should be analyzed to ensure that there is no patent infringement.

- Drawings available?[224] Reaching this block of Figure 30 implies that the initial application of Process 1 (who has the data needed?) did not result in obtaining a BOM. It assumes that the next step is to try to build a BOM from drawings, assuming that the drawings were delivered to DoD and are at the appropriate level of detail. The difference between access and possession could also be important here because predictive tools require input to be formatted properly. In addition, there may be some ambiguity whether access is sufficient because the drawings that DoD accesses may be marked proprietary (and consequently, building a BOM may not be an allowed use). In addition, part of this process step includes checking whether the assembly where a drawing is needed has been provisioned elsewhere. Another program may have drawings and be in a position to share under the same conditions as discussed above for sharing of BOMs.
  - Drawings provide a hierarchical representation of items in a system. The top level drawing shows the major subsystems and lower level drawings give details about the items in that subsystem ultimately down to the level of assembly (or component) applicable to the specific situation for which a CAGE code and part number are provided. That lowest level is dependent on what was purchased and the repair or maintenance strategies for the subsystem or assembly. For example, if the assembly were to be replaced and never

222 Some procurement contracts (more so with commercial items) prohibit reverse engineering of the items being bought.
223 28 U.S.C. § 1498 establishes that financial penalties may be imposed on U.S. government infringements of patents issued by the U.S. Patent and Trademark Office.
224 This question is asked from the perspective of building a BOM using drawings, not from the perspective of how drawings can support recommending a resolution.

repaired, then having the drawings stop at the assembly level would be sufficient. There may be situations where a repair could be feasible if obsolescence on one part were resolved. Typically, more detailed information would be sought only after the assembly is obsolete.[225] Various types of drawings may be found at that lowest level. It could be a source control drawing which are mainly used to provide CAGE code and part number for sole source items. Vendor item control drawings are typically found for items that can be purchased from multiple sources. These drawings identify potential suppliers and include quality and performance requirements as well as interchangeability data. Specification control drawings give performance characteristics and physical dimensions of the item.

- Repeat Process 1 for drawings. This step is included in Figure 30 for completeness. If Process 1 did not lead to obtaining a BOM, then it is very unlikely that it will be successful in obtaining drawings (less likely to be given, since drawings contain even more detailed data and the cost of drawings will almost certainly be more than the cost of a BOM). The one mitigating factor is that drawings have many users beyond the DMSMS management community in a program office. Therefore there may be more leverage for Process 1 to be successful.
- Provisioning data available? If a BOM could not be constructed using drawings, the next option is to attempt to use provisioning data. Provisioning data encompasses the range and quantity of support items necessary to operate and maintain an end item of materiel for an initial period of time.[226] All DoD systems have provisioning data to the extent that they are supported by the DoD supply system. This will be limited for situations where sustainment is being implemented through CLS or PBL. Also, if systems are provisioned at high levels of assembly, then generally there will not be a sufficient level of detail to build a BOM, although, another system may be provisioned at a lower level of detail and therefore may be a source for the data necessary to build a BOM assuming DoD has sufficient rights to enable the sharing of that data.

Given the potentially substantial benefit to the DMSMS management community from the provisioning process, there should be closer relationships between these two communities. It may be useful to include provisioners and item managers in a program office's DMT. The DMSMS management community should also encourage provisioners to include as much lower level detail as possible.

- Manuals available? While DoD normally has maintenance and repair manuals consistent with its support strategy, these manuals may not be kept up-to-date and may not reflect the most current support strategy. In addition, these manuals often do not have the level of detail necessary to construct a BOM for all subassemblies, especially the ones that are provisioned at a high level of assembly. Lastly, the questions about sufficiency of access versus possession discussed for drawings also applies here. Process 1 is not applicable, manuals are generally not available after the fact. Manuals are normally created because the customer buys them.

  There can be situations where a contractor is providing sustainment and consequently there may not be much government provisioning data, but repair and maintenance manuals exist and provide some data down to the level of repair. It is also possible for the provisioner to include data below the level of repair. In general, every potential source of technical data should be considered, as long as a BCA indicates that it is worthwhile to expend the effort.
- Conduct BCA for a PPA. The purpose of this BCA is to determine whether a PPA is worthwhile. Appendix I.2 described BCA considerations. Those considerations also apply to drawings, provisioning data, manuals, as well as attempts to buy the data. The BCA is mentioned explicitly for a PPA for two reasons: 1) a PPA may be expensive and 2) it may not provide a sufficient level of detail. PPAs are often nondestructive, because there are additional expenses associated with

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[225] It is uncertain whether a manufacturer would provide data years after the original contract work is completed.
[226] DoDM 4140.01, DoD Supply Chain Materiel Management Procedures: Demand and Supply Planning, Volume 2, Change 1, December 13, 2017.

requirements to restore the assembly back to a serviceable condition. If the assembly was obsolete, then it may be a very precious asset since there may be very few in the supply system. Even if it is not obsolete, the assembly could be very expensive to replace. A nondestructive PPA is limited to items that can be readily seen and identified. Items on a card may be visible, but the identification markings may be hidden. Typically, only 50%–60% of the items can be determined from a non-destructive PPA. A destructive PPA[227] will increase accuracy and nearly all the items should be able to be determined.

I.6 IDENTIFYING AND CORRECTING GAPS IN BOMs

I.6.1 Identifying Gaps in BOMs

Figure 31 expands upon the "Identify gaps in BOM data" block in Figure 11 to determine the adequacy of either a delivered BOM or a constructed one.

The principal blocks in Figure 31 are as follows:

- Conduct high-level risk analyses. Whenever a BOM (or any other DMSMS management-related contract deliverable for that matter) is delivered on a contract, or acquired through the processes in Figure 29, or a BOM is built using the processes depicted in Figure 30, a high level analysis is conducted to determine its acceptability.[228] Some key acceptability criteria[229] with respect to its adequacy are as follows:
  - Whether it is complete (i.e., are there any major omissions).
  - Whether it is structurally and hierarchically sound. For an indentured BOM, structural errors imply that an item is both the parent and child of another item.
  - Whether it is up-to-date.
  - Whether key item information is missing or in error (e.g., CAGE code, manufacturer's part number, nomenclature).

  A determination of acceptability usually happens quickly. Unfortunately, a program office's ability to assess these issues is limited at the point of time that the deliverable is received. While missing data elements are relatively easy to spot and structural soundness can be determined from an automated analysis, it may not be clear if there are major omissions, it is up-to-date, or there are data errors. Sometimes these latter three concerns can be identified by inconsistencies among documents (e.g., BOMs, tombstone charts, drawings). However, finding such inconsistencies requires a more extensive examination of data that does not usually occur before a potential obsolescence situation is detected.

  If no gaps are detected, the Figure 29 process is complete. In that case, the next steps would be to determine what items to monitor using a risk-based process and then load the selected items into a predictive tool and/or commence vendor surveys as appropriate. When gaps are identified, then the Figure 29 process continues.

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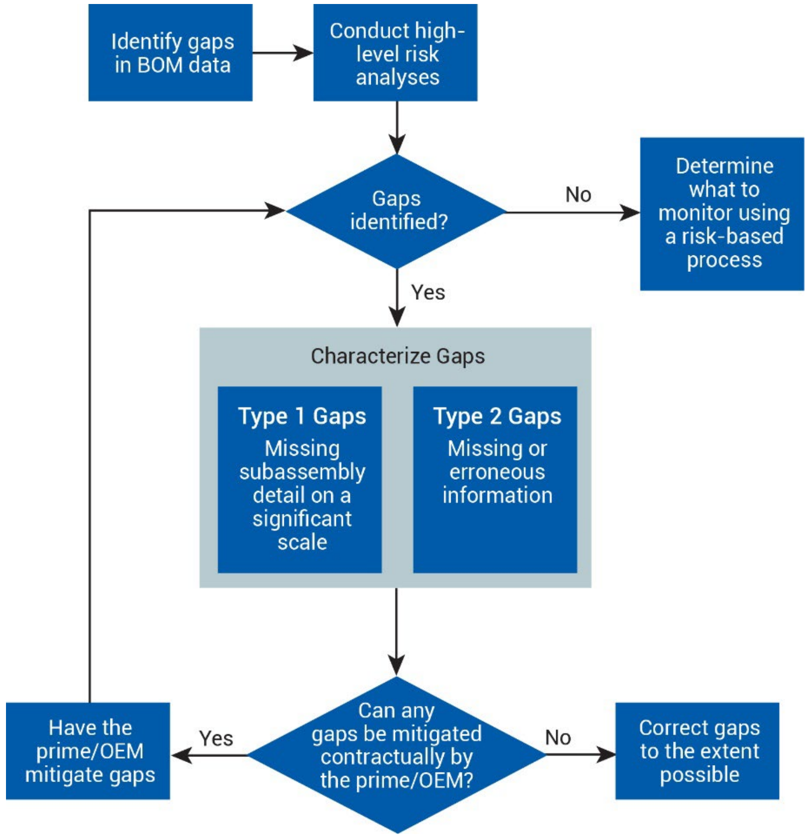
[227] A destructive PPA could be the first step in reverse engineering. Reverse engineering must also identify the function of all the items. That additional information is not necessary to build a BOM.

[228] Although not portrayed in Figure 25, it is a best practice to apply the Figure 25 process to drawings, provisioning data, and manuals to identify acceptability of contract deliverables, identify gaps, and mitigate those gaps where possible.

[229] Three of the acceptability criteria for BOMs are relevant across the board: completeness, whether it is up to date, and whether key information is missing or in error. The criterion for indenture issues is not relevant.

Figure 31. Process for Identifying Gaps in BOMs Where Additional Data Are Needed



- Characterize the gaps. The gaps correspond to the acceptability criteria. They are categorized into two different types because the mitigation approach is different.
  - *Type 1 Gaps.* These gaps are large. In this instance, BOMs would be lacking subassembly detail on a significant scale. The mitigation for such gaps is an attempt to construct the missing sections of the BOMs using the processes in Figure 11.[230]
  - *Type 2 Gaps.* These gaps are characterized by missing or erroneous information.[231] They include the following:
    - Lower level assemblies need to be identified,
    - Missing manufacturer's part numbers or other data omissions,
    - Indenture issues,
    - Out-of-date data, and
    - Data errors (e.g., an incorrect part number).

  The first and the last two of these gaps may be hard to identify. In the former case, it is difficult to recognize missing parts or assemblies. Asking for a drawing index on contract helps identify such

[230] Type 1 gaps for drawings, provisioning data, and manuals would be the same ones as above for BOMs. These gaps are large. In this instance, drawings/provisioning data/manuals would be lacking subassembly detail on a significant scale.
[231] The Type 2 gaps for drawings, configuration data, and manuals would be similar to those for BOMs. Lower-level COTS assemblies need to be identified, data omissions, and out-of-date data all apply. Only indenture issues are not applicable.

gaps. For the latter, maintaining data in its most current version is difficult. Even a PPA may be out-of-date if updated items have not been fully fielded.

Processes and techniques for closing these gaps are further illustrated in the following section.[232]

- Can any gaps be mitigated contractually by prime/OEM? Obviously, if the BOM was constructed per Figure 11, the answer is no. If the BOM were a contract deliverable, then DoD should not accept the deliverable and the contractor should mitigate the gaps. Even if the deliverable was accepted by DoD, the prime/OEM should be asked to mitigate the gaps, commonly as a deliverable on a subsequent contract. It has also been the case that DoD did not specify BOM requirements adequately and the delivered product was not usable. In this case, the only remedies are to rely on the good graces of the contractor or modify the contract.

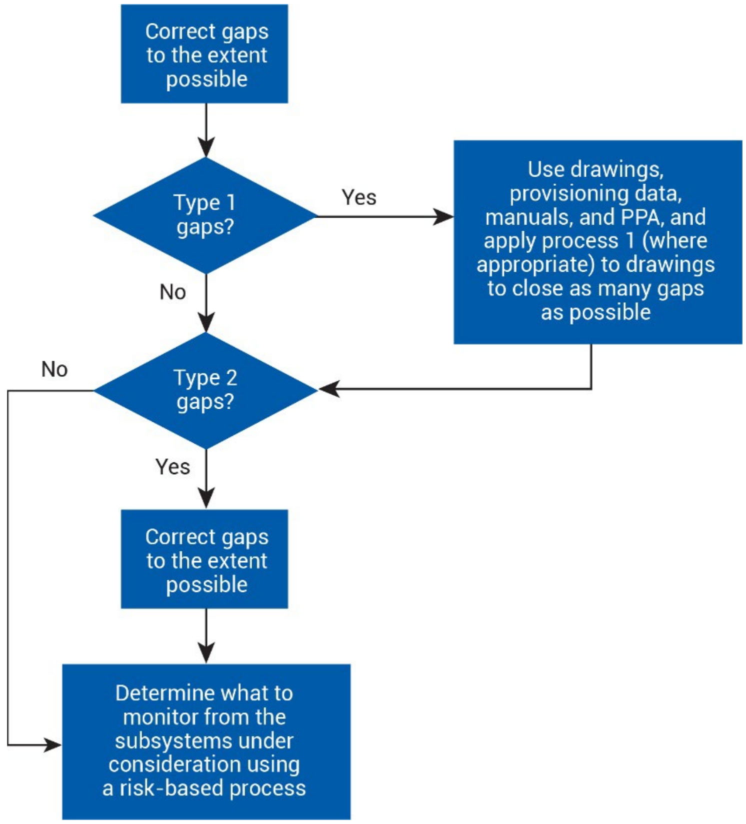
I.6.2 Correcting Gaps to the Extent Possible

Figure 32 is a continuation of Figure 31. Once gaps have been identified, Figure 32 depicts a process for correcting those gaps. This process ends at either (a) the point at which a risk-based process is used to determine what to monitor or (b) the point at which sufficient data cannot be obtained or constructed to allow proactive monitoring and therefore a reactive DMSMS management approach for that subsystem is the only possibility.

Drawings, provisioning data, and manuals often do not contain sufficient useful information to build a BOM or to fill in gaps. Although depicted linearly in Figure 28, the process of closing gaps in BOM data is labor intensive and highly iterative. All sources of data are used. Other manuals and drawings may be available elsewhere in the DoD supply or maintenance systems. This is especially true for provisioning data; another program may have provisioned the same assembly at a lower level of detail. It may be necessary to identify actual part numbers associated with NSNs and then research those part numbers in greater detail.

[232] Mitigation approaches for drawings, configuration data, and manuals include asking the prime or OEM to mitigate the gaps before acceptance, modify the contract to buy the needed information, and the Figure 31 process.

Figure 32. Closing Gaps in BOM Data



A brief discussion of the principal blocks in Figure 32 follows.

- Type 1 gaps? Type 1 gaps are closed by using a process similar to the one for constructing a BOM. Drawings, configuration data, manuals, and potentially a PPA are examined/considered to try to obtain the missing data. If that is unsuccessful, Process 1 within Figure 29, may be used to try to obtain the necessary drawings. Ultimately as many Type 1 gaps as possible are closed. Any remaining portions of the system for which Type 1 gaps still exist will be dealt with reactively. Although not explicit in Figure 32, as discussed previously, before any significant effort to close Type 1 gaps is undertaken, a BCA should be conducted.

- Type 2 gaps? Type 2 gaps are normally addressed by research. As stated earlier, these gaps are characterized by lack of COTS detail, missing data, or structural issues. Often, Type 2 gaps are associated with a lack of detail or questions associated with individual items. Several research avenues are possible, the order through which they are pursued is often an individual preference, sometimes constrained by access to the source. Similar to Type 1 gaps, before any significant effort to close Type 2 gaps is undertaken, a BCA should be conducted. Potential research avenues are as follows:

  – *Internet research.* This is a common first course of action. Many researchers collect as much data as possible before having discussions with an SME.

  – *Supply system analysis.* Previous discussions explained how provisioning data may allow BOMs to be built or augmented. However, for items that are provisioned, a significant amount of additional data is available and this individual data may be sufficient to close the gap or if not, point the researcher in a direction to close the gap. Even though the item may not have been provisioned by the system in question, the item may have already been provisioned by another system and consequently the data may provide a point of contact associated with that other system who can provide the data to resolve the Type 2 gap.

– *Contact an SME.* The vendor is one source of expertise. Equipment specialists in the supply system or program office are another possibility. There may be others in the program office who can also provide the needed information. It may not always be necessary to obtain more data. SMEs may also be in a position of assessing the risk of not obtaining the data, and, if that risk is small, making further effort unnecessary.

- Correct gaps to the extent possible. At this point in the process, all existing Type 1 and Type 2 gaps will be closed to the extent possible using the approaches described above. The result will be a BOM with as much detail that can be obtained.

ANNEX TO APPENDIX I. ESSENTIAL AND DESIRABLE DATA ELEMENTS TO BE OBTAINED IF CONSTRUCTING A BOM

Table 51. BOM Fields, Definitions, and Essentiality

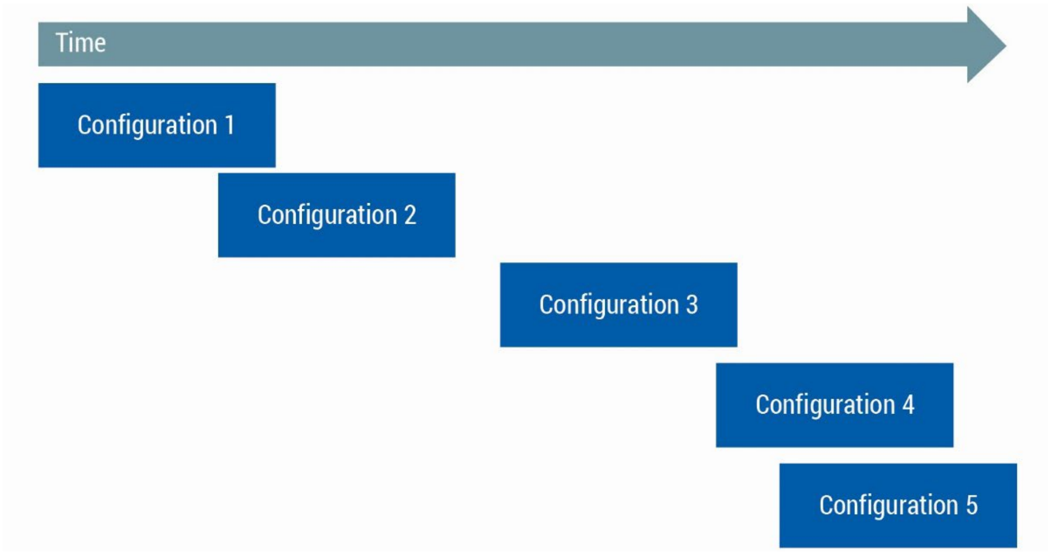
Field Name	Definition	Essentiality/ Desirability
Nomenclature	The name or designation of the referenced item.	Essential
Manufacturer's Item Number	The complete orderable number assigned by the actual manufacturer of the referenced item. This number will be used to monitor the item for obsolescence issues.	Essential
Manufacturer's Name	The full legal name of the entity that actually manufacturers the referenced item.	Essential
Manufacturer's CAGE	The CAGE code of the entity that actually manufacturers the referenced item.	Essential
OEM Item Number	The item number assigned by the OEM. This may be the same as the manufacturer's number but more often than not it is different. Sometimes referred to the Configuration Part Number or the Drawing Number.	Most desirable
Indenture Level	A number that represents the specific level of the top down structure specified on the BOM.	Most desirable
NHA Item Number	The OEM item number of the referenced item's parent NHA. If the referenced item is software or firmware then the NHA is the item the software is used on.	Most desirable
NSN	NSN of the referenced item.	Most desirable
Software/ Firmware Version	The designator assigned to the version of software/firmware used on the referenced item.	Second highest desirability
OEM Name	The full legal name of the entity that is providing the referenced item to the government. Sometimes referred to as the Prime Integrator or Prime.	Third highest desirability
OEM CAGE	CAGE code of the OEM.	Third highest desirability
Revision Designator	The designator of the revision of the referenced item.	Third highest desirability
Reference Designator	A reference designator identifies the referenced item. ASME Y14.44-2008 and IEEE-315-1975 provide details for the proper configuration and use of reference designators.	Third highest desirability
Find Item or Index Number (FIIN)	FIIN refers to the TDP drawing ordinal number that gives an ID tag to the referenced item in an item list (list of materials, BOM, part list).	Third highest desirability
NHA CAGE	CAGE code of the OEM of the NHA.	Third highest desirability

Field Name	Definition	Essentiality/ Desirability
Quantity	The count of the referenced item per NHA.	Third highest desirability
Provisioning Status	The referenced item number has been provisioned in a services supply system (Yes/No).	Third highest desirability
APL, AEC, or RIC	Allowance Parts List (APL), Allowance Equipage Code (AEC), or Repairable Identification Code (RIC) for the referenced item.	Third highest desirability
COG	Cognizance (COG) Code: A two-item alphanumeric designator used by the Navy to provide supply management information.	Third highest desirability
Manufacturer's Address	The physical address of the item's manufacturer, including country.	Third highest desirability
Manufacturer's Website	The web address of the item's manufacturer.	Third highest desirability
Alternate For	The OEM item number of the item the referenced item is the alternate for.	Third highest desirability
Monitoring Status	Identifies whether the referenced item is being proactively monitored for DMSMS issues.	Third highest desirability
Item Class	Identifies whether the item is COTS, NDI, or DI.	Third highest desirability
Item Type	Enter the type of the referenced item number based on the following: An assembly is comprised of components and potentially other assemblies (e.g., a circuit card or a transmission). A component is a single item of manufacture used to make an assembly (e.g., a microcircuit or a screw). Software is an item of a computer system that consists of data or computer instructions, in contrast to the physical hardware from which the system is built. Material is the products used manufacture the assembly (e.g., wire, fiberglass, steel, glue).	Third highest desirability

Appendix J. Building Roadmaps

While additional supporting information may be included, Figure 33 depicts a notional, minimalistic product roadmap. It portrays when the product's (system's) configuration changes over time.[233] The length of the boxes in the time dimension could denote the start and end date for implementing the configuration changes.[234] Other supporting information may include a description of the change, contract information for making the changes (indicating funding), the number of systems with each different configuration, and the life cycle of a system configuration.

Figure 33. Notional Product Roadmap



Source: Adapted from Petrick, Irene J., *Developing and Implementing Roadmaps: A Reference Guide*, Pennsylvania State University, nd.

Several factors can drive configuration changes reflected in a product roadmap and IMS:

- Inability to support the product, potentially coupled with the need to extend the service life of the system,
- Changes to the threats the product faces or its mission,
- Safety deficiencies,
- Additional information assurance or software security requirements,
- Introduction of new statutory or regulatory requirements (e.g., environmental or security requirements),
- Insufficient reliability or maintainability (especially for drivers of operations and sustainment costs as part of a deliberate cost reduction initiative), and
- Changes to technology enabling additional capability or enhanced supportability.

[233] The large overlap between configurations 4 and 5 indicates that the configuration changes are associated with different subsystems or different technologies associated with the two configurations.
[234] The configuration remains operative after the end time indicated on the figure.

Roadmaps vary in level of detail, format, and coverage. A program office might not maintain a single, multipurpose roadmap that encompasses all the factors driving change at some level of aggregation (e.g., for a subsystem). Therefore, the notional depiction in Figure 33 could represent the configuration changes for the entire system or any subset of the entire system. When the product roadmap represents the entire system, or major elements thereof, all the configuration changes for an assembly or subsystem can be collapsed into a single line.

In addition, how program offices label various types of roadmaps, as a function of their purpose, varies. This appendix describes the following types of roadmaps:

- Product improvement roadmaps apply to changes in capability to address a new threat, safety deficiencies, information assurance, or the introduction of new statutory or regulatory requirements.
- Supportability roadmaps encompass improvements in maintainability or sustainability of the product, product reliability, or service life.
- Technology roadmaps capture technology changes that enable the two previous types of roadmaps and, consequently, the technologies are driven by product and supportability improvements.

In DoD, product improvements (and by implication, product improvement roadmaps) are the principal driver of product roadmaps. Product improvement roadmaps should reflect the lowest-cost path to the desired capability levels. Supportability roadmaps deal with aspects of the operating and support cost.

The generic form of Figure 33 also applies to a notional product improvement roadmap or a notional supportability roadmap. However, a notional technology roadmap looks different. The following sections describe product improvement, supportability, and technology roadmaps in more detail.

J.1 PRODUCT IMPROVEMENT ROADMAPS

A product improvement roadmap for capability improvements, safety enhancement, or other new requirements considers the following:

- When new capabilities need to be in place,
- When the technology needed to achieve the new capability requirements will be demonstrated successfully in relevant or operational environments (i.e., sufficient maturity, according to the technology readiness level[235] scale),
- When the associated hardware and software changes will be producible, and
- Planned funding.

As is the case for product roadmaps, product improvement roadmaps can exist for different levels of a system's design hierarchy. These varied product improvement roadmaps fall under the purview of different stakeholders. For example, the program office manager is responsible for the roadmap for the entire system. Lower-level improvement roadmaps are the responsibility of a cognizant IPT. Depending on the program office, the IPTs may be associated with a subsystem (e.g., fire control) or a functionality

[235] Assistant Secretary of Defense for Research and Engineering, "Department of Defense Technology Readiness Assessment Guidance," April 2011, p. 2-13 and 2-14, https://www.dau.edu/cop/pm/_layouts/15/WopiFrame.aspx?sourcedoc=/cop/pm/DAU%20Sponsored%20Documents/TRA%20Guide%20OSD%20May%202011.pdf.

or condition (e.g., readiness). Not every subsystem has an IPT, especially during sustainment, and not every IPT has a product improvement roadmap.

The concept of product improvement aligns closely with technology insertion. Technology insertion integrates mature technologies with capability requirements and logistics planning to expand system capability as well as increase readiness, lower life-cycle costs, and reduce the logistics footprint. A program office can avoid significant costs by determining optimum technology insertion timeframes. For example, a redesign to upgrade a product should simultaneously seek to eliminate obsolete or near-obsolete parts (as identified via a health assessment [see Section 5.3.1]) because it is usually more cost effective to resolve DMSMS issues in conjunction with other design changes rather than as standalone, out-of-cycle redesigns.

Depending on how a program office is organized and the stage in the system's life cycle, product improvement roadmaps contain none, all, or some supportability roadmap data. In some instances, no product improvements are planned and, therefore, no product improvement roadmap is created. This normally occurs toward the end of the system's sustainment phase. When product improvements are planned, the product improvement roadmap may be a convenient place to maintain all product changes, including supportability changes, thereby eliminating the need for a separate supportability roadmap. In some program offices, the product improvement roadmap only includes the supportability changes associated with the product improvement work package, requiring a separate supportability roadmap for other changes generated by the cognizant IPT or the PSM.[236]

J.2 SUPPORTABILITY ROADMAPS

The first and most important element of the supportability roadmap focuses on resolving DMSMS issues before they affect the availability of the system. System non-availability occurs because items can no longer be purchased and there are not enough in the supply system to sustain the system through its expected life. As such, the DMSMS community supplies the associated roadmap data (see Section 4.6). Availability often causes major cost implications for the supportability roadmap.

The second element of a supportability roadmap encompasses any planned modifications to reduce operating and support costs.[237] Changes would be designed to affect the major cost drivers. Modifications may also be planned to reduce downtime. Readiness suffers when poor reliability affects system up-time. The general process for developing the supportability roadmap includes the following:

- Identify the principal cost drivers and reliability inhibitors (that are not cost drivers),
- Determine and price alternative approaches for addressing the issues associated with those drivers,
- Perform a cost-benefit analyses to estimate potential life-cycle savings and break even points,
- Present the alternatives to decision-makers,
- Secure funding to implement the changes approved by the decision-makers, and
- Add the information to the overall product roadmap, IMS, and product improvement roadmaps.

[236] Since supportability is a PSM responsibility, as a best practice, the PSM should have the lead role in supportability roadmaps. However, the cognizant IPT has significant influence over its content.
[237] Many program offices find implementing this type of change difficult because it requires an upfront investment to reduce costs over the life cycle.

The concept of multiple levels of roadmaps applies to supportability. The PSM is responsible for the overall system. At lower levels, the responsible IPTs share the responsibility with the PSM. When no associated IPT exists, responsibility falls entirely on the PSM. The maintenance and DMSMS communities supporting the PSM develop options to meet the desired objectives.

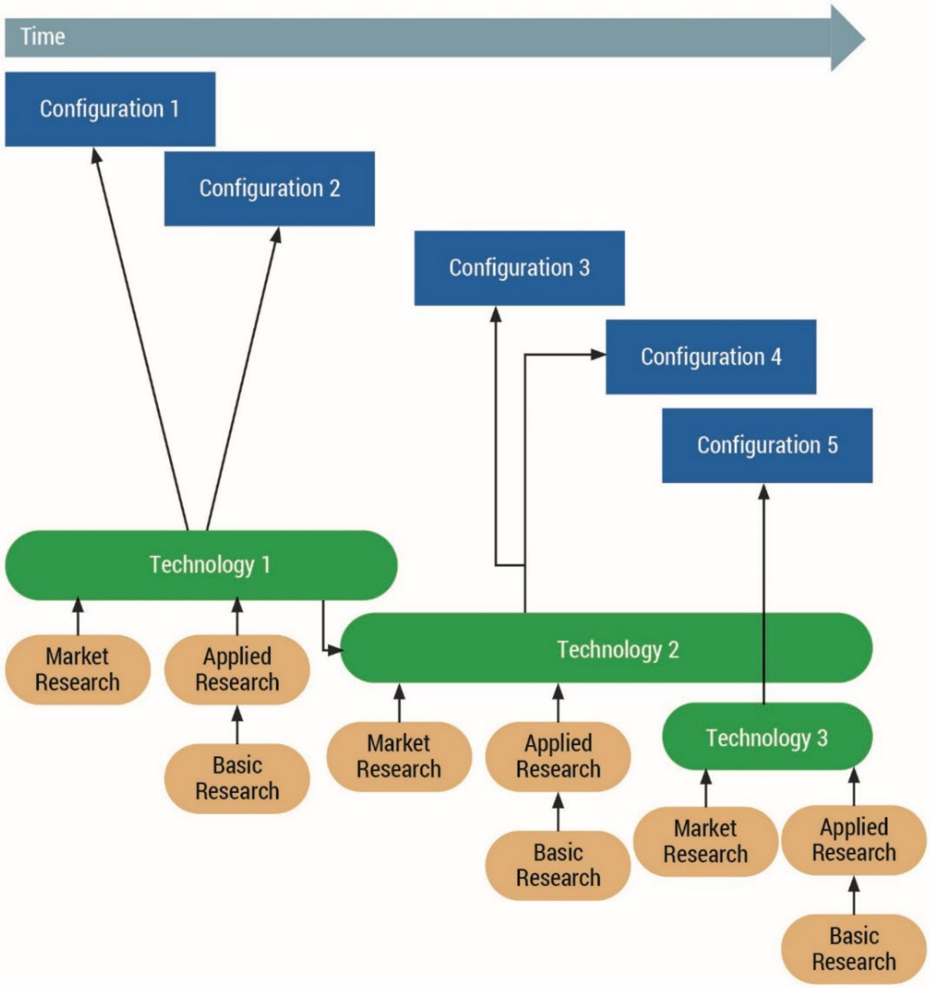
J.3 TECHNOLOGY ROADMAPS

Both product improvement and supportability (including technology refreshment) considerations are based on specific technology advancements. Therefore, product improvement and supportability roadmaps determine which technology roadmaps are needed. As these technology roadmaps are planned and pursued, they enable capability and supportability improvements. Technology roadmaps uncover alternative technology paths for meeting performance targets.[238]

Figure 34 superimposes a notional (and minimalistic) technology roadmap onto Figure 33. It indicates how basic, applied, and market research (technology management) contribute to technology maturation (for three notional technologies) and then when the mature technologies are incorporated into the configuration changes. A more complete roadmap would contain the specifics, such as what the technologies are, what they provide, and relevant specifications.

[238] Garcia, Marie L., and Olin H. Bry, *Fundamentals of Technology Roadmapping*, SAND97-0665 (Albuquerque, NM: Sandia National Laboratories, April 1997).

Figure 34. Notional Technology Roadmap and Interactions with a Product Roadmap



Source: Adapted from Petrick, Irene J., *Developing and Implementing Roadmaps: A Reference Guide*, Pennsylvania State University, nd.

An actual technology roadmap can portray more than three technologies, depending on the level of aggregation of the product roadmap supported. In this notional example, technology 2 is a replacement for technology 1 and technology 3 is independent of the other two. The length of the technology ovals along the time dimension could represent the period of sale for those technologies. In the notional picture, technology 1 is available for implementation into configurations 1 and 2. (Other technologies and factors could contribute to those configuration changes.) Toward the end of the technology 1 life cycle, technology 2 becomes available as a replacement and remains available through the end of the configurations depicted. Technology 3 becomes available for configuration 5 implementation.

A technology roadmap codifies the results of technology management activities. Unlike product improvement or supportability roadmaps, technology roadmaps (and their underlying technology management activities) are typically developed external to the program office but can be funded in part by the program office. Effective technology management begins with a strategic understanding of the market and its trends. Market research for a program office, particularly before a system begins the sustainment phase of its life cycle, entails collecting information about existing and emerging technologies, products, manufacturers, and suppliers. It has two components:

- Market surveillance. A continuous canvassing of the commercial market to identify existing and future technologies, vendors' products, and market trends with the potential to meet existing and emergent requirements from a strategic perspective. Market surveillance methods include searching the internet, attending trade shows, reading technology publications, hiring consultants, issuing requests for information from prospective manufacturers and suppliers, visiting manufacturer and supplier facilities, and viewing product demonstrations.
- Market investigation. A focused process of finding and evaluating whether specific technology products meet functional requirements. Market investigation includes system obsolescence profiling to plan for continued support or replacement of soon-to-be obsolete products. This product-level information and the associated budget requirements form the basis for sustaining the operation or functionality of a system. Market investigation methods include beta testing; prototyping; testing for compliance, conformance, and compatibility; and querying of manufacturers and suppliers about product obsolescence status.

Market research occurs in all system life-cycle phases, enabling the acquiring activity to do the following:

- Anticipate obsolescence situations due to rapid and asynchronous product changes;
- Plan and budget using a broader range of product obsolescence management options;
- Maintain insight into technology trends, as well as internal product changes by the manufacturer, and test the effects of those changes on the system;
- Assess the quality of a manufacturer and the effect on a system of a product's change, including its suitability for the user, information security characteristics, and supportability; and
- Determine the manufacturer's support period and inventories for a particular product.

Ignoring market research increases the likelihood of poor product and technology selections as well as an inability to predict and mitigate obsolescence impacts, leading to out-of-cycle redesigns. This can negatively affect system performance, schedule, and cost.

Technology management also encompasses basic and applied research activities to develop new technologies to close military capability gaps driven by product improvement needs. The process is summarized in a few basic steps.[239]

- Assess technology performance requirements.
- Define the scope of the technology development in terms of the initial technology gaps to be closed.
- Establish a technology development strategy.
- Initiate research to mature the technologies.
- Evaluate the effect of the technologies on the gaps.
- Continue research and evaluation until the technology is demonstrated to close the initial gaps in a relevant environment.
- Repeat the process as further capability enhancements are needed or low-cost technology discriminators that improve mission performance become available.

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[239] Adapted from Phaal, Robert, Clare J.P. Farrukh, and David R. Probert, *Technology Roadmapping—A Planning Framework for Evolution and Revolution*, May 26, 2003.

The combination of the results of market research, an understanding of current and future mission needs, and DoD-planned basic and applied research activities enables the development of a technology roadmap. The lead for obtaining a technology roadmap is the cognizant IPT and the PSM for supportability elements. Some program offices only minimally use technology roadmaps, especially late in the system's life cycle.

Appendix K. Health Assessment Methodology

Health assessments may be conducted for several purposes.

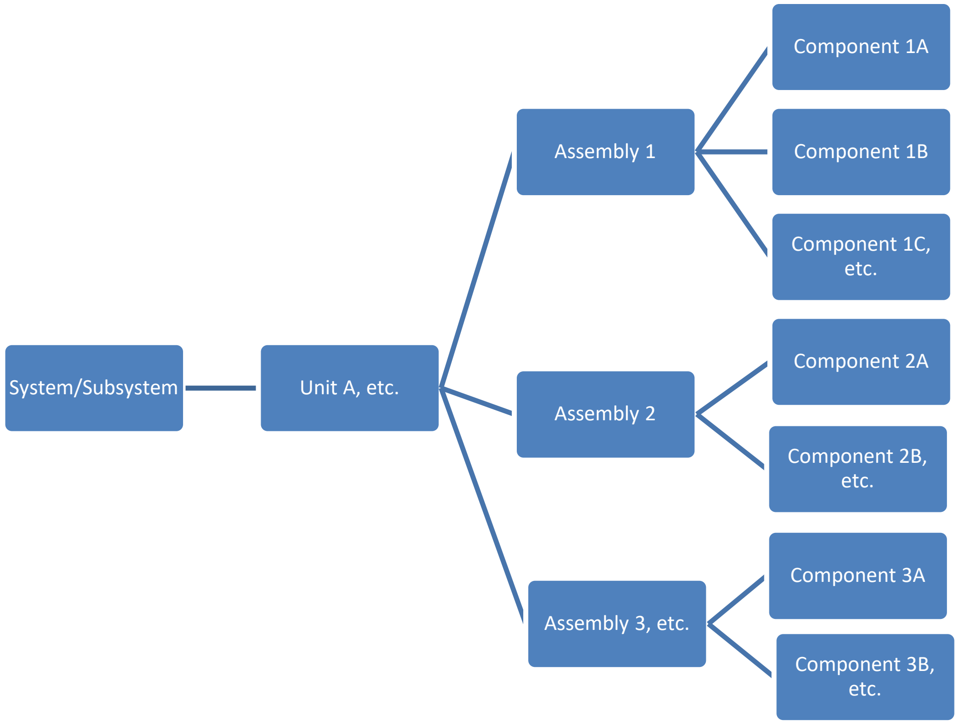
- Proactive DMSMS monitoring. Hardware and software health assessments may be used to identify items where more intensive monitoring should be applied because of both an increased likelihood of near-term obsolescence and the potential ill effects of obsolescence on readiness (or operational availability) if no mitigating action is taken within the window of opportunity for that action.
- Monitoring inventory levels. As determined by the hardware health assessments, the dates when obsolescence issues will affect the system are based in part on assumptions about demand and inventories of obsolete items (at inventory control points, elsewhere in DoD's possession, and/or available from commercial sellers as appropriate). These dates may change as a result of uncertainties in those assumptions and consequently the timing of mitigating actions will be affected. The health assessment should identify items of high interest for the watch list (as discussed in Section 3.4.5).
- Resolution prioritization. Hardware and software health assessment results are an important consideration in the determination of when a DMSMS issue will have an impact. The impact date is a key determinant of when the resolution should be initiated.
- Programming and budgeting. Hardware and software health assessment supports the determination of when funding for a DMSMS resolution should be programmed/budgeted by estimating when that DMSMS issue will impact readiness. The impact analysis itself provides substantive material for use in program/budget justification as well the development or update of technology refreshment/insertion plans and associated funding.

The following sections portray the steps involved in making a health assessment. Obtaining the data needed for steps 2, 3, and 4 can be difficult. The information necessary may not be centralized and the quality of the data can vary as a function of where it is found.

K.1 STEP 1: ESTABLISH A SYSTEM/SUBSYSTEM HIERARCHY

The first step of the health assessment lays out the pertinent system/subsystem hierarchy or items (as shown generically in Figure 35) that will be monitored for DMSMS issues as a result of a risk-based assessment. For example, the system/subsystem under consideration might be a radar. Below that, a unit could be a power supply. A regulator assembly is one of the assemblies within the power supply and components within that may be a voltage regulator or a radio frequency amplifier. Although not depicted graphically, there can be more units, assemblies, and components within the system/subsystem.

Figure 35. Generic Health Assessment Hierarchy



A health assessment can be conducted for various portions of the system hierarchy as a function of the objectives of the assessments.

- Health assessments associated with cases begin with lower level components that can no longer be procured or have a PDN associated with them. The objectives of this health assessment are principally to determine the priority of implementing a resolution (as a function of the impact date) and to develop the data needed to determine the appropriate level of assembly for the resolution. To accomplish these objectives, the hierarchy should stop at the highest level of assembly where a resolution may occur. This is most often at the unit level. The components considered in the hierarchy should not only include those that cannot be purchased or those with a PDN, but also encompass those projected to become obsolete as described in Section 4.6.
- Health assessments may also be conducted at higher levels of assembly that cut across subsystems and units. Such health assessments may be thought of as the sum of the health assessments done at the individual component level and for projected item obsolescence that is too far in the future to open a case (e.g., resource expenditures are not warranted at the current time). These health assessments are used to better integrate DMSMS resolutions with modifications plans and funding.

K.2 STEP 2: CALCULATE THE DEPLETION YEAR FOR EACH OBSOLETE COMPONENT

The second step of the health assessment calculates a depletion[240] year for all components that can no longer be purchased. Table 52 portrays a notional way of making that calculation. It shows the initial on-

[240] The calculations shown in the remainder of this appendix implicitly use averages for failure rates, wearout rates, and so forth. In reality, these rates will be governed by a Poisson probability distribution. When making these

hand inventory for each component. The formula just subtracts the annual demand from the inventory levels at the end of the prior year. By subtracting the average annual demand for each component, the year in which the component is depleted (i.e., its on-hand inventory is negative and shaded in the table) can be determined.

The calculations are made over the expected operational life of the system/subsystem. For this example, the EOL of the system/subsystem is FY24. If a component is projected to have inventory beyond that point, its depletion year is shown as EOL + 1 or FY25. The depletion years that occur before the EOL are highlighted.

There are two aspects of demand data: production and sustainment. For any given component, both aspects of demand may apply. Early in the life cycle, the demand may be solely production based. During production, the demand is likely to be a combination of the two because some units will already be fielded while others are still being produced. Late in the life cycle, the demand may be entirely driven by sustainment. The Table 52 example makes a simplifying assumption that does not apply in all situations. Future demand does not have to be constant. Neither the production schedule nor failure rates which drive demand during sustainment are constant over time.

Table 52. Notional Calculation of the Depletion Year of DMSMS Components

Components	Initial Total Inventory	Annual Demand	Depletion Fiscal Year
Comp 1A	92	15	FY21
Comp 2A	1	0	FY25
Comp 2B	85	22	FY18

Comps	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24
1A	77	62	47	32	17	2	(13)	(28)	(43)	(58)
2A	1	1	1	1	1	1	1	1	1	1
2B	63	41	19	(3)	(25)	(47)	(69)	(91)	(113)	(135)

The production aspect of demand should be determined from the production schedule. Demand for sustainment must take into account all users of the component in question that draw upon the sources used for the initial inventory determination, not just the specific program conducting the health assessment. Therefore the usage aspect of demand data should be obtained from the organization that manages the component (either DLA or a Military Department supply organization).[241] This demand rate may be too low because programs have been known to purchase some components directly from commercial sources. However, it is unlikely that a specific program will have a basis for adjusting for this situation. Early in the life cycle, the demand should be based on predicted reliability until field-level usage can be compiled and analyzed.

The initial total component inventory should include as many sources as possible. Beyond DoD supply systems, contractors and potentially DoD depots may hold inventory (especially when they are performing

calculations, a program office may want to increase its confidence level that depletion will not occur earlier than estimated by adding a standard deviation to the averages.

[241] The program office demand could also be considered. If the program office is the only user, then the program office demand should be used. (The program office demand should equal the supply system demand unless the program office makes purchases in the commercial market. However, if there are other users and inventory cannot be reserved, then using the program office demand will lead to an overly optimistic calculation of the item quantity required.

maintenance on the assembly or there is new production). Individual programs may hold inventory as well. To the extent feasible, such inventory data should be included.

K.3 STEP 3: CALCULATE THE DEPLETION YEAR FOR EACH OBSOLETE ASSEMBLY

The fact that a component's stock level is depleted does not imply that the supportability impact will occur immediately. There may be spare assemblies that can be used to defer the impact. Therefore, the third step of the health assessment determines the year that the assemblies containing obsolete components are expected to be depleted. The notional computations for this step are shown in Table 53 and Table 54 which are built on the results determined in Table 52. The underlying idea behind these calculations is that when an assembly fails, it is returned to the supply system for repair and a new/refurbished assembly is provided to the user.[242]

Table 53. Notional Calculation of the Depletion Year of DMSMS Assemblies (Part 1)

Assembly	Qty in Stock	Qty in Repair	Other Qty	Wearout Rate	Survival Rate	Annual Demand	Obs Degrader	EOL FY	Obs Impact FY
Assembly 1 (contains components 1A, 1B, etc.)	6	12	1	0.02	1.00	36.00	0.50	24	21
Assembly 2 (contains components 2A, 2B, etc.)	5	15	3	0.14	0.88	18.00	0.50	24	18

Table 54. Notional Calculation of the Depletion Year of DMSMS Assemblies (Part 2)

	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22
Calculated Wearout Rate	0.02	0.02	0.02	0.02	0.02	0.02	0.52	0.52
Demand/Year	36	36	36	36	36	36	36	36
Add-on Assemblies/Year	4	3	2	—	—	—	—	—
Reusable Units	35	35	35	35	35	35	17	17
Assembly 1 Year End Inventory	22	24	25	24	23	22	3	(15)
Calculated Wearout Rate	0.14	0.14	0.14	0.64	0.64	0.64	0.64	0.64
Demand/Year	18	18	18	18	18	18	18	18
Add-on Assemblies/Year	—	—	—	—	—	—	—	—
Reusable Units	14	14	14	6	6	6	6	6
Assembly 2 Year End Inventory	14	9	4	(8)	(20)	(32)	(44)	(56)

Table 53 shows most of the inputs to the calculations. Beyond the year that an obsolete component is depleted (calculated in Table 53 and highlighted yellow in Table 52), there are three types of input as follows:

- Inventory sources for assemblies. Three sources are shown. The quantity in stock are the assets ready for issue. The quantity in repair are the ones being refurbished. The other stock would include any other potentially available assets (e.g., in the pipeline, test units). Table 54 also allows for an increase in the number of assemblies due to decommissioned units and cannibalization to the extent it can be determined.

[242] If the assembly is not repaired (i.e., it is thrown away) then its depletion year should have been determined in step 2 as there would be no need to look at components in the assembly.

- Assembly demand. As discussed in step 2 at the component level, there could be both production and sustainment aspects of the demand and the comments made about determining the component demand (and its potential changes over time) apply to the assembly level as well.
- Ability to repair failed assemblies. Not all assemblies are repairable. Table 54 indicates three factors that should be used to determine whether a repair can be made.
  - A wearout rate indicates the fraction of assemblies that cannot be repaired because it would be expected to fail very quickly after being returned to service. For the example from Table 52 that is extended into Table 53, wearout rates of 0.02 and 0.14 were used for assembly 1 and assembly 2, respectively.
  - Some assemblies cannot be economically repaired.[243] The survival rate indicates the fraction of assemblies that can be economically repaired. Table 53 uses 1.0 and 0.88 for assemblies 1 and 2, respectively.
  - An obsolescence degrader is defined as the fraction of the assembly repairs that require an obsolete component. Table 53 uses 0.5 for both assemblies 1 and 2. In the calculation of an assembly depletion date, the obsolescence degrader only has an impact on an assembly when one of its obsolete components has been depleted. According to Table 52, those dates are FY22 and FY18, respectively. For the notional calculation, the obsolescence degrader is added to the wearout rate in Table 54 since both have the same effect on available inventory. For assembly 1, this adjustment begins in FY22 and for assembly 2, it is FY18.

Assembly depletion year calculations are shown in Table 54. The basic formula being used is that the end of year assembly inventory is equal to the starting inventory plus any add-ons from decommissioning and/or cannibalization minus losses associated with failed assemblies that cannot be repaired. The losses are determined as the difference between the total number of failed assemblies and the total failures reduced by the survival rate and by 1 minus the calculated wearout rate. The formula for the losses per assembly is as follows:

$$(\text{failures/year}) \times (1 - \text{calculated wearout rate}) \times (\text{survival rate}).$$

For the first year of the calculation, the starting inventory is the sum of the quantity on-hand, other assemblies available, and the number of assemblies in repair reduced by those that cannot be repaired. The formula for the starting inventory is as follows:

$$(\text{quantity in stock} + \text{other quantity} + (\text{quantity in repair} - \text{quantity that cannot be repaired})) \times (1 - \text{calculated wearout}) \times (\text{survival rate}).$$

As can be seen (tan shaded area) in Table 54, the depletion year for assembly 1 is FY22 and the depletion year for assembly 2 is FY18. These are the years that the inventory becomes negative.

K.4 STEP 4: CALCULATE WHEN THE OBSOLETE UNIT AFFECTS READINESS

The third step explained why a depleted component does not always translate into its higher level assembly being depleted at the same time. There may be spare assemblies. The same holds true for a depleted assembly. There may not be a supportability concern because there may be spare units. Consequently, the fourth step of the health assessment calculates the year that the number of units

243 For an obsolete item, it may be 1.0 to avoid impacting operational availability. Even though it would cost more to repair the item than the item is worth, it may be worthwhile to repair it because a replacement cannot be purchased.

containing the obsolete assemblies falls below the number required by fielded assets. That event implies that the unit will be insupportable because the MICAP rate will be affected. The notional computations for this step are shown in Table 55, built from the results given in Table 54.

Step 4 computations and assumptions at the unit level are nearly the same as those for step 3 at the assembly level. In some cases, when a unit fails, the organization level repair can determine which assembly has failed, but in other cases, the failed assembly cannot be determined. The former case would be reflected in the demand for assemblies and included in Table 54. Table 55 applies to the latter case where failed units are replaced with new/refurbished units from the supply system.

Table 55. Notional Calculation of the Depletion of DMSMS Units

Unit Spares Qty	Assemblies in Unit	Assembly Depletion FY		FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23
4			Annual Unit Demand	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	Assembly 1	22	Year End Inventory	22	24	25	24	23	22	3	(15)	(33)
	Assembly 2	18	Year End Inventory	14	9	4	(8)	(20)	(32)	(44)	(56)	(68)
			Calculated Wearout Rate	0.10	0.10	0.10	0.40	0.40	0.40	0.40	0.65	0.65
			Reusable Units	2.03	2.03	2.03	1.35	1.35	1.35	1.35	0.79	0.79
			Year End Units	13.0	12.0	11.0	9.0	7.0	5.0	3.0	1.0	—
			Systems in Service	10								
			Unit Wearout Rate	0.1	10% of failed units are beyond repair							
			Assembly 1 Obs Degrader	0.25	Chance unit fails because of assembly 1							
			Assembly 2 Obs Degrader	0.3	Chance unit fails because of assembly 2							
			Unit Survival Rate	0.9	90% of the reparables are economically worthwhile to repair							

The inputs to the unit depletion calculation parallel the inputs to the assembly depletion calculation.

- Inventory sources for assemblies. Table 55 differs from Table 54 in that it combines all sources into a single input. The number of units in the supply system is assumed to be four. No add-on assets are included in Table 55, but they could be as a result of decommissioned systems/ subsystems. To actually measure the supportability, one additional input is needed: the number of units in place on fielded systems (assumed to be ten for this notional example).
- Unit demand. The annual demand for units is shown as 2.5 annually.[244] This figure would include both production and sustainment analogous to the way it was done for assemblies in Table 53 and Table 54 and for components in Table 52.
- Ability to repair failed units. Analogous to Table 54, this ability is reflected by a unit wearout rate (0.1) and a unit survival rate (0.9). In addition, obsolescence degraders for the obsolete assemblies are used. The figure 0.25 is the probability that the unit failure is due to assembly 1, and the figure 0.3 is the probability that the unit failure is due to assembly 2. These figures are added to the wearout rate when the associated assembly is depleted, FY22 and FY18 respectively, as calculated in Table 54 and highlighted in Table 55.

The Table 55 calculation for the depletion of units is also identical to the assembly calculation in Table 54. The basic formula being used is that the end of year unit inventory is equal to the starting inventory minus

[244] For example, demand may be calculated as a function of operating tempo and mean time between failures.

losses associated with failed units that cannot be repaired. The losses are determined as the difference between the total number of failed units and the total failures reduced by the survival rate and by 1 minus the calculated wearout rate. The formula for the losses per assembly is as follows:

(annual unit demand) × (1 – calculated wearout rate) × (unit survival rate).

For the first year of the calculation, the starting inventory is the sum of the quantity on-hand and the number of units in the fielded systems/subsystems. The formula for the starting inventory is:

(unit spares quantity + systems in service +
(annual unit demand)) × (1 – calculated wearout) × (unit survival rate).

When unit spares are depleted, further failures attributable to one of the obsolete assemblies leads to readiness degradations. As indicated by the tan shading, if no mitigating action is taken, in FY18, only nine of the ten fielded assets will have an operational unit. Two years later, only half of the units will be operational.

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Appendix L. Complete Department of Commerce Cost Survey Results

This appendix can be used, with caution, to modify the averages shown in Table 15, based on more specific circumstances. The appendix is a three-part table (see Table 56) that contains the complete results from the 2014 Department of Commerce survey. The rows of the table show the above resolution options subdivided by environment (aviation, ground, shipboard, space, and undersea). The columns show the commodity type (electrical, mechanical, and electronics) subdivided by item type (assembly, component, raw material, and software). Entries in the table are average cost (adjusted to FY22 dollars) and sample size. Little confidence should be placed in entries with a low sample size.

Table 56. Number of DMSMS Resolutions Reported and Average Cost (FY22 $s) by Type, Commodity, and Environment (Part 1)

	Electrical					
	Assembly		Component		Electrical Total	
	No.	Average	No.	Average	No.	Average
Approved Parts	86	$3,172	901	$228	987	$484
Aviation	10	$1,721	191	$1,075	201	$1,107
Ground	76	$3,362	0	—	76	$3,362
Shipboard	0	—	0	—	0	—
Space	0	—	710	—	710	—
Life of Need Buy	3	$6,623	24	$14,305	27	$13,452
Aviation	0	—	1	$65,404	1	$65,404
Ground	3	$6,623	3	$16,140	6	$11,382
Shipboard	0	—	0	—	0	—
Space	0	—	20	$11,474	20	$11,474
Simple Substitute	0	—	190	$3,804	190	$3,804
Aviation	0	—	89	$5,691	89	$5,691
Ground	0	—	4	$24,240	4	$24,240
Shipboard	0	—	0	—	0	—
Space	0	—	97	$1,230	97	$1,230
Undersea	0	—	0	—	0	—
Complex Substitute	1	$148,021	33	$17,860	34	$21,689
Aviation	0	—	0	—	0	—
Ground	1	$148,021	29	$16,570	30	$20,952
Shipboard	0	—	4	$27,209	4	$27,209
Undersea	0	—	0	—	0	—
Extension of Production or Support	27	$30,981	0	—	27	$30,981

	Electrical					
	Assembly		Component		Electrical Total	
	No.	Average	No.	Average	No.	Average
Aviation	27	$30,981	0	—	27	$30,981
Ground	0	—	0	—	0	—
Shipboard	0	—	0	—	0	—
Repair, Refurbishment, or Reclamation	1	$8,606	0	—	1	$8,606
Aviation	0	—	0	—	0	—
Ground	1	$8,606	0	—	1	$8,606
Shipboard	0	—	0	—	0	—
Undersea	0	—	0	—	0	—
Development of a New Item or Source data is no longer used.						
Redesign–NHA	1	$369,038	1	$22,949	2	$195,994
Aviation	1	$369,038	1	$22,949	2	$195,994
Ground	0	—	0	—	0	—
Shipboard	0	—	0	—	0	—
Redesign Complex/System Replacement	12	$24,228,724	0	—	12	$24,228,724
Aviation	12	$24,228,724	0	—	12	$24,228,724
Ground	0	—	0	—	0	—
Shipboard	0	—	0	—	0	—

Table 57. Number of DMSMS Resolutions Reported and Average Cost (FY22 $s) by Type, Commodity, and Environment (Part 2)

	Electronics									
	Assembly		Component		Raw Material		Software		Electronics Total	
	No.	Average	No.	Average	No.	Average	No.	Average	No.	Average
Approved Parts	47	$2,679	269	$905	0	—	0	—	316	$1,169
Aviation	31	$71	207	$342	0	—	0	—	238	$306
Ground	1	$5,213	45	$859	0	—	0	—	46	$955
Shipboard	15	$7,901	17	$7,672	0	—	0	—	32	$7,901
Space	0	—	0	—	0	—	0	—	0	—
Life of Need Buy	86	$4,115	547	$5,924	0	—	0	—	633	$5,679
Aviation	44	$5,030	392	$6,072	0	—	0	—	436	$5,967
Ground	10	—	75	$2,040	0	—	0	—	85	$1,800
Shipboard	32	$4,142	68	$2,071	0	—	0	—	100	$2,734
Space	0	—	12	$47,198	0	—	0	—	12	$47,198
Simple Substitute	91	$3,831	1,141	$17,478	1	$22,949	0	—	1,233	$16,475
Aviation	80	$2,768	989	$18,715	1	$22,949	0	—	1,070	$17,526
Ground	0	—	105	$8,467	0	—	0	—	105	$8,467
Shipboard	11	$11,566	47	$11,566	0	—	0	—	58	$11,566

	Electronics									
	Assembly		Component		Raw Material		Software		Electronics Total	
	No.	Average	No.	Average	No.	Average	No.	Average	No.	Average
Space	0	—	0	—	0	—	0	—	0	—
Undersea	0	—	0	—	0	—	0	—	0	—
Complex Substitute	63	$23,072	268	$32,258	0	—	0	—	331	$30,511
Aviation	40	$4,693	265	$32,526	0	—	0	—	305	$28,876
Ground	4	$289,206	3	$8,721	0	—	0	—	7	$168,998
Shipboard	19	$5,737	0	—	0	—	0	—	19	$5,737
Undersea	0	—	0	—	0	—	0	—	0	—
Extension of Production or Support	9	$15,777	54	$12,793	5	$224,441	0	—	68	$28,749
Aviation	9	$15,777	51	$13,432	5	$224,441	0	—	65	$29,989
Ground	0	—	3	$1,913	0	—	0	—	3	$1,913
Shipboard	0	—	0	—	0	—	0	—	0	—
Repair, Refurbishment, or Reclamation	12	$102,414	26	$67,059	0	—	0	—	38	$78,224
Aviation	0	—	4	$201,574	0	—	0	—	4	$201,574
Ground	1	$44,062	1	$850,258	0	—	0	—	2	$447,160
Shipboard	5	$145,324	21	$4,142	0	—	0	—	26	$31,293
Undersea	6	$76,382	0	—	0	—	0	—	6	$76,382
Development of a New Item or Source data is no longer used										
Redesign–NHA	56	$1,907,014	72	$751,105	0	—	4	$2,582,311	132	$1,296,982
Aviation	16	$1,850,976	25	$1,651,902	0	—	1	$1,553,873	42	$1,725,406
Ground	33	$2,271,518	5	$188,824	0	—	3	$2,925,123	41	$2,065,356
Shipboard	7	$316,722	42	$281,855	0	—	0	—	49	$286,836
Redesign Complex/System Replacement	22	$6,595,559	9	$9,138,748	0	—	0	—	31	$7,333,905
Aviation	11	$6,150,828	7	$11,336,530	0	—	0	—	18	$8,167,491
Ground	3	$1,669,315	2	$1,446,511	0	—	0	—	5	$1,580,193
Shipboard	8	$9,054,406	0	—	0	—	0	—	8	$9,054,406

Table 58. Number of DMSMS Resolutions Reported and Average Cost (FY22 $s) by Type, Commodity, and Environment (Part 3)

	Mechanical								All Res. Types/ Environment	
	Assembly		Component		Raw Material		Mechanical Total			
	No.	Average	No.	Average	No.	Average	No.	Average	No.	Average
Approved Parts	0	—	228	$3,873	8	$10,666	236	$4,103	1,539	$1,180
Aviation	0	—	0	—	3	$7,650	3	$7,650	442	$721
Ground	0	—	226	$3,837	1	$5,145	227	$3,843	349	$3,357
Shipboard	0	—	2	$7,946	4	$14,306	6	$12,186	38	$8,578
Space	0	—	0	—	0	—	0	—	710	—

Life of Need Buy	1	$13,196	5	$5,820	0	—	6	$7,049	666	$6,006
Aviation	1	$13,196	0	—	0	—	1	$13,196	438	$6,119
Ground	0	—	5	$5,820	0	—	5	$5,820	96	$2,608
Shipboard	0	—	0	—	0	—	0	—	100	$2,734
Space	0	—	0	—	0	—	0	—	32	$24,871
Simple Substitute	3	$7,170	72	$7,010	2	$44,177	77	$7,982	1,500	$14,434
Aviation	0	—	0	—	1	$2,295	1	$2,295	1,160	$16,606
Ground	3	$7,170	72	$7,010	0	—	75	$7,017	184	$8,218
Shipboard	0	—	0	—	0	—	0	—	58	$11,566
Space	0	—	0	—	0	—	0	—	97	$1,230
Undersea	0	—	0	—	1	$86,059	1	$86,059	1	$86,059
Complex Substitute	5	$30,792	19	$23,041	21	$25,055	45	$24,841	410	$29,157
Aviation	0	—	1	$29,834	4	$34,137	5	$33,276	310	$28,947
Ground	0	—	0	—	1	$37,411	1	$37,411	38	$48,657
Shipboard	5	$30,792	18	$22,663	15	$15,829	38	$21,035	61	$16,675
Undersea	0	—	0	—	1	$114,745	1	$114,745	1	$114,745
Extension of Production or Support	0	—	2	$24,945	1	$22,949	3	$24,280	98	$29,228
Aviation	0	—	0	—	1	$22,949	1	$22,949	93	$30,201
Ground	0	—	0	—	0	—	0	—	3	$1,913
Shipboard	0	—	2	$24,945	0	—	2	$24,945	2	$24,945
Repair, Refurbishment, or Reclamation	1	$2,908	0	—	0	—	1	$2,908	40	$74,601
Aviation	0	—	0	—	0	—	0	—	4	$201,574
Ground	1	$2,908	0	—	0	—	1	$2,908	4	$226,459
Shipboard	0	—	0	—	0	—	0	—	26	$31,293
Undersea	0	—	0	—	0	—	0	—	6	$76,382
Development of a New Item or Source data is no longer used										
Redesign–NHA	2	$152,610	2	$576,225	0	—	4	$364,418	138	$1,253,994
Aviation	1	$160,643	1	$989,673	0	—	2	$575,158	46	$1,608,900
Ground	0	—	0	—	0	—	0	—	41	$2,065,356
Shipboard	1	$144,578	1	$162,777	0	—	2	$153,678	51	$281,614
Redesign Complex/System Replacement	1	$1,319,564	0	—	0	—	1	$1,319,564	44	$11,804,893
Aviation	0	—	0	—	0	—	0	—	30	$14,591,984
Ground	1	$1,319,564	0	—	0	—	1	$1,319,564	6	$1,536,755
Shipboard	0	—	0	—	0	—	0	—	8	$9,054,406

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Appendix M. Programming and Budgeting for DMSMS Resolutions

As introduced in Section 7.1, this appendix includes best practices and additional information related to programming and budgeting for DMSMS resolutions. Four topics are organized as follows:

- M.1 Best practices,
- M.2 Considerations for funding DMSMS resolutions in the year of execution,
- M.3 Leveraging WCFs to fund DMSMS resolutions, and
- M.4 Other resources that may be available to finance DMSMS resolutions.

M.1 BEST PRACTICES

These six enabling best practices encompass processes and procedures for determining funding requirements, taking other sources of funding into account, the type of appropriations that may be used, justification, communications, and the very important need to utilize POM/budget line items dedicated to this subject. Section 7.2 provides additional information on the relationships between DMSMS resolution funding and modification planning.

M.1.1 Estimate the Funding for DMSMS Resolutions

The first enabling best practice is for program offices to establish processes and procedures to estimate the funding required to resolve its known and anticipated DMSMS issues within the programming and budgeting horizon. Known DMSMS issues are the items that are obsolete at the time that programming and budgeting takes place. However, given the inevitability of obsolescence, additional DMSMS issues will materialize during the programming time horizon. Since there is a lack of certainty about what items will become obsolete and how those issues will be resolved, the term anticipated obsolescence is used in this document. This best practice discusses resolution cost estimating techniques for programming and budgeting for both known and anticipated issues.[245]

Regardless of uncertainty, program offices should resist falling victim to the myth that predicting DMSMS resolution costs is not possible or too hard. Successful programming and budgeting submissions must be convincing to decision makers; and therefore submissions should be based on a reasonable estimation approach. Although additional criteria may be applicable as a function of the specific situation, an approach should have the following characteristics:

- Realistic and defensible assumptions are used to calculate cost estimates in a repeatable way.
- The methodology is easy to understand and explain.

[245] Section 6.3 describes the AoA used to determine the preferred resolution.

- Estimates should be methodologically sound and based on as much actual data as possible.
- More than one estimating method is considered.

The timeframe for routine programming/budgeting is from two to six years in the future. Typically, budget estimates are developed two years in advance of budget execution. Often, at the point in time when a DMSMS issue is identified, without reprogramming funds, it is too late to impact the current (or execution) year or even the following year because the budgets have been finalized (or if not finalized, out of the Department's control).[246] When cost estimates for the second year are approved, they become the basis for the next budget. Cost estimates beyond that year are part of the POM.

Estimates should be developed by the DMT. A number of approaches can be used to assist in estimating resolution costs and, therefore, inform the program office on what is required to support resolution funding. Despite diligent efforts to apply an appropriate cost estimation method for the system, stakeholders understand that funding requirements for DMSMS resolutions and corresponding budget requests, which are based on the best available data, will almost always be either too high or too low. Because DMSMS management is not standalone from a financial management perspective, there will always be opportunities to use extra funding for other reliability, maintainability, or supportability issues. If program office resources are not sufficient to implement a preferred resolution, other alternatives are possible.

Table 59 summarizes different approaches that could be pursued to estimate resolution funding. These approaches are listed by the extent of analytical rigor in deriving the estimate (with the most rigorous at the bottom). Each program office will have to make its own assessment regarding the level of effort, and degree of difficulty, it is willing to pursue to estimate DMSMS resolution costs to inform programming and budgeting. A key consideration is the amount of rigor necessary to successfully defend the funds requests.

Table 59. Description of DMSMS Resolution Cost Estimation Approaches

Approach	Description
Estimate by prior trends	Calculate and use the historical average costs and trends for each resolution type
Estimate by technology segment	Analyze technology segments and what is known of their lifespans to determine when and where obsolescence is predicted to impact a design
Estimate by cases	Analyze specific items to estimate discontinuation time

Building programs/budgets using any one of these approaches implies assumptions about the timing of DMSMS impacts so that appropriate resolution funding is in place to avoid those impacts. These three approaches are discussed in the next three sections. In all cases, the final estimate should be adjusted by SME opinion. The DMT should develop recommendations in conjunction with the prime/OEM/logistics support provider, where applicable. When a commercial company is involved, generally it will make initial recommendations on the resolutions. The DMT considers these recommendations, but goes through the analysis process as described in Section 6.3 to determine its recommended resolutions.

M.1.1.1 ESTIMATE BY PRIOR TRENDS

These estimating methods apply both for a well-established program office and a new program office. The new program office would use data from a similar system.

[246] Reprogramming is always possible, however, that should not be a consideration in program/budget formulation.

The simplest way of making these estimates uses an annualized average of historical cost data as the estimated requirements for each year in the programming timeframe. A slightly more complex approach takes trends into account. Generally, obsolescence events increase with age because the useful life of items is finite. Estimates are based on an extrapolation of historical data based on trend lines or moving averages and SME opinion to adjust for factors not captured in the trends. For example, when a product roadmap indicates a near-term change, SME adjustments will be necessary. The extrapolations should also take into account any changes in the extent of proactive monitoring being conducted, in which case, the extrapolations should be limited to the portions of the historical data reflecting the current approach to DMSMS management. These methods work best for a system in sustainment. To develop a scenario for DMSMS issues expected during design or production, the DMT should consider the contractor's plans for modifications, information from manufacturers, the age of the technology in active electronic items, and relevant experience with similar systems.

A third approach divides historical data into categories. For example, historical data may be categorized by type of resolution and separate extrapolations may be made for each resolution type and then combined into a single value for each year. The potential advantage to this more detailed calculation is that it may provide SMEs with more information for making adjustments. If no adjustments are made, extrapolations by category may not improve the accuracy of the total annual estimate.

NAVAIR developed model discussed in Appendix G.2 and currently available on the DKSP, also has the capability to estimate resolution costs for electronic boxes based on historical averages. The problem with basing program/budget estimates solely on historical data, even after allowing for expert adjustments, is that program/budget decision makers may not find this approach convincing.

M.1.1.2 ESTIMATE BY TECHNOLOGY SEGMENT

Another technique in use today estimates total annual DMSMS resolution costs and DMSMS management costs (as discussed in Section 3.4.1) for the entire program/budget timeframe. This technique involves technology segments. Use of this approach benefits from contributions from the systems engineering team who has knowledge of system life and the difficulty of resolving issues. Linkages to the product support community also help. The first step in the technology segment approach is to segregate the equipment into technology segments with predictable life cycles. Examples of technology segments include analog to digital conversion, amplifiers, backplanes and chassis, and so forth. For each of these segments, the expected life cycle (or technology refreshment period) and the breakdown of DMSMS resolutions by type is estimated.[247] By allocating assemblies to each technology segment a projection of total annual DMSMS cost can be developed. The following bullets summarize the computations:

- Estimate the number of years in the life cycle for *each* technology segment.
- Based on historical data, use SMEs to estimate the *average fractions* of resolutions by type for the technology segment. These data should be estimated by the DMT on the basis of an extrapolation of historical data for the entire system.
- Identify assemblies with a high probability of obsolescence impact and determine their technology segment.

[247] Just three aggregate resolution types may be used—low cost, medium cost, and high cost.

- Derive CERs for monitoring and surveillance costs, engineering integration and kit development, kit procurement and installation, support product data updates, and management taking the distribution of resolutions into account.[248]
- Calculate the results of the CERs for each of the items with a high probability of obsolescence and sum over all items to obtain an estimate of total annual cost.

One drawback to this approach is that it can be time consuming. A second drawback is that there may be little existing data to utilize to derive the CERs. There may be potential simplifying assumptions but none are in general use.

M.1.1.3 ESTIMATE BY CASES

There are two building blocks for estimating program/budget resolution requirements based on cases:

- Costs and timing associated with known DMSMS issues. This building block pertains to already obsolete items that can no longer be procured and to items where a PDN or equivalent has been received.
- Costs and timing associated with potential, future DMSMS issues. This building block pertains to items where there is no known issue at the current time, but an issue could manifest itself at some point in the program/budget timeframe. In some cases, the issues may be anticipated on the basis of expected life as projected by predictive tools, vendor surveys, or other research. In other instances, the issues could be completely unanticipated.

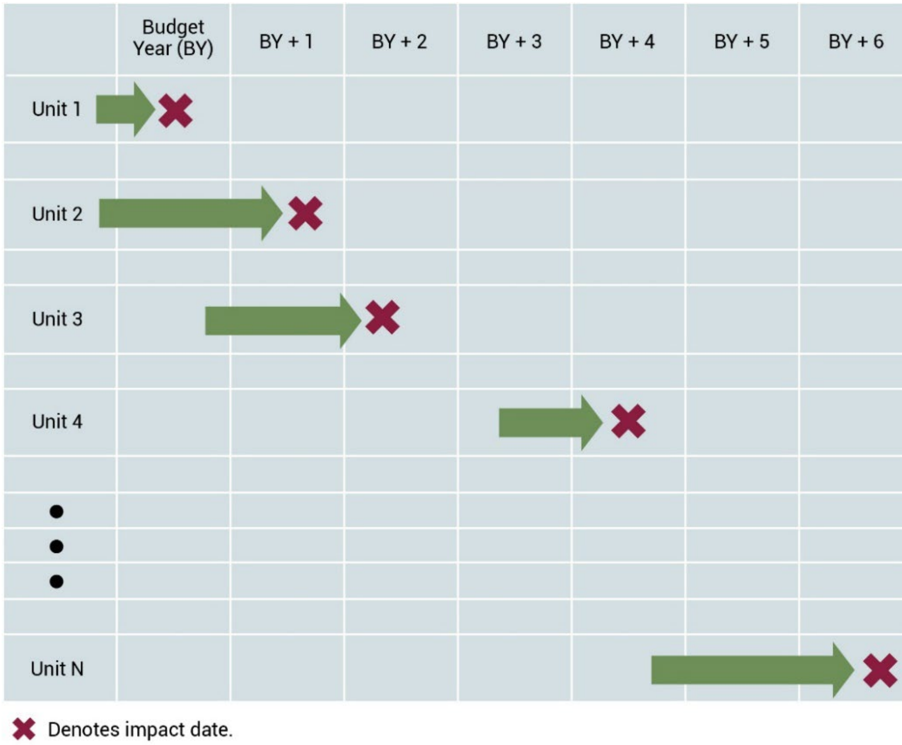
M.1.1.3.1 Estimating Program/Budget Requirements for Known, Current DMSMS Issues

The resolution-based health assessment technique (as described in Section 5.3.1 and Appendix K) is a best practice for making program/budget estimates for the first building block—resolutions for known, current DMSMS issues. Such an assessment determines the dates of impact (i.e., the point in time that a program office can no longer support the system) generally at the unit (e.g., box, WRA, LRU, software application) or sometimes assembly (SRA/LRU) level for the entire system. The impact date is a function of demand rate and stock on hand.

Figure 36 notionally depicts the results of a health assessment. The figure shows the expected DMSMS impact date as the point at which the implementation should be complete for various units in the system. The green arrows indicate when funds should be programmed/budgeted to resolve the issue before impact. Determining the appropriate lead time should consider technical content, non-recurring engineering, installation, and also take into account backlogged issues and workload capacity as well as administrative lead time.

[248] In theory, different CERs may be derived.

Figure 36. Notional Depiction of Impact Date and Timing of Funding Requirements



At any point in time, implementation of some resolutions may be underway. In Figure 36, this would apply to units 1 and 2. In the case of unit 3 for example, funding should be put in place in the budget year to avoid an impact 2 years after that. For unit 4, funds should be programmed for three years after the budget year.

The health assessment provides information regarding impact. Once that is determined, resolutions are evaluated in an AoA and the preferred resolution is selected. In many cases, the impact can be mitigated fairly easily for a short time until a redesign can be planned and funded. Resolution cost should be estimated in the normal way by SMEs as described in Section 6 (the *Analyze* step of DMSMS management).

There is a potential alternative approach within this class of cost estimating techniques that simplifies the calculations. The basis for this modified approach is the empirical observation that most DMSMS resolution costs are associated with redesigns. An analysis of the 2014 Department of Commerce survey introduced in Section 6.3 determined that based on 4,562 DMSMS cases, and 95% of the costs were associated with three redesign resolution types:

- Development of a new item or source,[249]
- Redesign—NHA, and
- Redesign—complex/system replacement.

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[249] This resolution type has been divided into development of a new source, design refreshment, and redevelop the item.

A similar examination of thousands of other cases from two different data sets indicated that 80% and 96% of the resolution costs were associated with redesign.

Using an approach focused on redesigns simplifies the calculations because it should significantly reduce the number of issues where individual cost estimates would be needed. Once the redesigns are identified and their cost estimated (see Section 6.3), budgets and programs could be constructed that apply funding with the appropriate lead time before impact. Every non-redesign resolution identified by the health assessment could be priced using an average cost factor, preferably tailored to the individual program office. For these simpler resolutions, a program/budget lead time of one year should be sufficient.

M.1.1.3.2 Estimating Program/Budget Requirements for Potential, Future DMSMS Issues

There is a great deal of uncertainty associated with the second building block—projecting the time when an item that is currently being produced and sold will no longer be available for purchase. While health assessments for non-obsolete items have value for targeted monitoring, their use for programming/budgeting is usually not practical. It may require a great deal of effort to project an end-of-sale date. That date may be hard to obtain and is often subject to large uncertainty, even in cases where the date is obtained via a vendor survey. In addition, the impact (as calculated in a health assessment) may be delayed by an unknown number of years as a result of a LON buy.

Utilizing technology refreshment planning (also known as design refresh planning) based on technology segments for estimating program/budget requirements for potential, future DMSMS issues is a best practice. As indicated in Section 4.6, the goal of technology refreshment is to resolve potential DMSMS issues before they materialize.[250] Because the DMSMS management community is not responsible for developing technology refreshment plans, this document does not describe methodological approaches. The DMSMS management community does provide input to the process (additional information is provided in Section 4.6.). For example, health assessments for non-obsolete items may have an impact on refreshment planning and therefore should be providers to the technology refreshment planners.

M.1.1.3.3 Combining the Building Blocks

It is a best practice to combine the programs/budgets for the building blocks described in the previous two sections. Any duplicate redesigns (e.g., one from technology refreshment planning and the other from known DMSMS items that can no longer be procured) should be eliminated. The combined values should be compared on a year-by-year basis with a historical extrapolation (as discussed earlier) and the larger of the two should be selected for the final program/budget. Regardless of which value is greater, the details behind the building blocks should be included in the budget justification.

It is usually a mistake to base programs/budgets solely on resolutions from known, currently obsolete items if program offices do not have a funded technology refreshment plan. In this situation, it is a best practice to compare the program/budget for the currently obsolete items to historical extrapolations on a

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[250] The University of Maryland's Center for Advanced Life-Cycle Engineering's Mitigation of Obsolescence Cost Analysis (MOCA) tools use technology segments to analyze a related problem. MOCA supports design refresh planning that optimizes either individual refreshment dates or (in a simplified application) periodic refreshment dates associated with the specific content and maintenance requirements of a system. A recent article on this subject provides a good list of references on this subject. See Peter Sandborn, "Design for Obsolescence Risk Management," *Procedia CIRP* 11 (2013): 15–22, https://doi.org/10.1016/j.procir.2013.07.073.

year-by-year basis, and select the larger of the two. The details behind the resolutions for currently obsolete items should be included in budget justification.

M.1.2 Determine DMSMS Resolution Programming and Budgeting Requirements

This section discusses the enabling best practice for circumstances where DMSMS issues may be funded with resources obtained outside of programming and budgeting for DMSMS resolutions by the program office. When this is the case, funding requirements discussed previously may be decreased accordingly.

Some DMSMS resolutions during sustainment will be financed[251] (either in part or in entirety) by the organizations that manage WCFs, assuming that those organizations have sufficient lead time to award contracts to implement the resolution.[252] (See Appendix M.3 for a discussion of some of these programs.) There are, however, uncertainties associated with this process:

- The process varies by service. There are periodic project calls with different criteria for the project to meet. There are also processes to submit projects out-of-cycle.
- Organizations that manage WCFs will of course only consider contributing to resolutions for items that they manage.
- There may be limitations on the amount of money available for projects. Consequently, a project proposal may be rejected, or only partially funded, on that basis.
- The WCF corpus can only be used to support projects that provide an F3 replacement. Deliberate increases in capability are not allowed. However there may be incidental improvement to capability as a result of using newer technology.
- WCF dollars cannot be used to pay for fielding the changes. The obsolete items will be replaced by attrition (i.e., when the higher level assembly cannot be repaired).
- There may be constraints on the extent of WCF resources available. For example, high-cost projects such as a redesign at a higher level of assembly may or may not be funded.
- The program office may be able to fund projects in conjunction with WCF projects. For example, the program office may fund costs associated with production, while WCFs would be used to finance costs associated with sustainment. More complex cost-sharing relationships may also be feasible. It is possible for joint funded or sequential projects. It is also possible to fund over several years.

Appendix M.4 lists other centralized, non-program office resources that may be used to resolve DMSMS issues. Generally, many projects compete for funding from these sources.

As was the case for DMSMS management operations, programming and budgeting for DMSMS resolutions may not be needed if a larger contract (e.g., a procurement contract, a modification contract, or a logistics support contract) is in place to fund them.[253] The program office should be aware of the level of funding allocated within the contract for DMSMS resolutions to ensure that there is alignment with the internal program office estimate. Separate programming and budgeting for resolutions applies only to

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[251] The term “finance” is used instead of “fund” when referring to WCFs. Since WCFs are required to break even by including all of their operating expenses in a cost recovery rate applied to all sales, WCFs technically do not fund anything. The cost of resolutions (among other things) is actually spread among all WCF customers in anticipation of future sales.

[252] Some programs are entirely contractor logistics support with no WCF involvement.

[253] This is often the case for non-class 1 changes. Class 1 changes imply significant impact to functional and physical interchangeability or supportability. There is often a change to F3 or interface.

DMSMS issues not funded within the contract. For resolutions not covered on contract,[254] the program office may need to modify the contract to implement these resolutions. Potentially, a separate contract may be used, depending on which course of action is preferable.

The program office must recognize that resolutions handled by the contractor generally apply only through the end of the contract period of performance[255] and the government needs to understand that another resolution may be needed before a new contract is negotiated to extend beyond the period of performance of the initial contract. During production, the contractor is responsible for delivering the units on contract, but programming and budgeting procurement appropriations may be necessary to implement a resolution before the next contract option is exercised. Depending on the timing, the resolution may be included in the funding for the follow-on contract. That resolution may be applied to already fielded units as the need arises. Even in sustainment with a PBL contract, programming and budgeting for DMSMS resolutions may need to consider programming and budgeting for the redesigns necessary to award the next PBL contract.

M.1.3 Consider the Appropriations Available

This enabling best practice involves taking the type of appropriation into account. As was described under programming and budgeting for DMSMS management operations, different appropriations are available to program offices as a function of where they are in the life cycle. During initial design and development, as well as design and development associated with modification, the non-recurring engineering and testing cost of DMSMS resolutions associated with the subsystems involved in the effort will normally be funded with the research, design, test, and evaluation (RDT&E) appropriation. Similarly, DMSMS issues associated with production, will normally be funded with one of the procurement appropriations.

The situation with fielded systems is more complicated, as follows:

- In some situations, when the system provides a service (e.g., airlift services), customers who pay for the service may be called upon to also transfer additional amounts of their own funds (normally an O&M appropriation) to the service provider for resolutions.
- A program office may build a POM and budget for a redesign resolution using RDT&E appropriations to develop and test the resolution. For immediate fielding, depending on the item cost, procurement or O&M funding would be used to procure the item. O&M appropriations are normally used to install it. This could be treated as an independent modification effort. For fielding by attrition, no DMSMS resolution funds would be needed for procurement and installation; they would be covered through customer funds.
- O&M funds may be used to fund the non-recurring engineering and testing for most low cost resolutions that do not involve redesign. There are different categories of O&M funding that may apply. For example, there is sustaining engineering funding for both hardware and software, as well as corresponding logistics related efforts.

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[254] For example, the DMSMS issue may apply to an item in a subsystem that is not being changed by a modification contract. Another theoretical example is one in which the contractor is required to fund a resolution that only applies until the end of the contract but the program office would rather fund a long-term resolution immediately and not wait until the period of performance has elapsed.
[255] There are examples of contractors making LON buys that go beyond the end of the contract if there is a business case for them to do so.

M.1.4 Establish a Dedicated POM/Budget Line

As an enabling best practice, program offices should establish dedicated POM/budget lines for funding DMSMS resolutions. All the reasons described in the fourth enabling best practice for DMSMS management operations (see Appendix G.4) apply here. In addition, the DMSMS management community should not perpetuate the myth that it cannot project DMSMS resolution costs well enough to have a POM/budget line item. Some form of the projection methodologies from Section 5.3.1 and Appendix M1.1 are used by many program offices. Of course, these methodologies only provide estimates and these estimates could be too high or too low. But there is no down side to either as long as there was no deliberate attempt to bias the estimate for some other purpose. If it happened that the estimate is too high, program office management will welcome extra funding to apply to some other unfunded requirement. If the estimate is too low, Appendix M.2 of this document covers some ideas for obtaining extra resources during budget execution.

If there is no POM/budget line for DMSMS resolutions, the DMT will have to seek funding on an ad hoc basis every time an issue arises. That leads to an erroneous impression that the DMSMS management community is a disruption to normal program office financial operations when the opposite is true. The proactive DMSMS management community forewarns program office management about problems before they cause disruptions.

Ad hoc funding is *never* a best practice; it's what you do when all else fails. Furthermore, an ad hoc process can negatively impact program office performance, schedule, and cost. An ad hoc environment is likely to be reactive, consequently, there will be an implementation delay as compared to having a dedicated POM/
budget line item to rely upon. Delays may occur in 1) determining what resolution should be pursued if it has not been considered earlier and 2) difficulty in identifying the funding necessary to implement the approved approach. These delays could increase cost because the window of opportunity to resolve them will be shorter. The delays could also contribute to disruptions to operations (e.g., reductions to mission capability, cannibalization) and/or schedule. Costs may also increase because trying to initiate modifications in a hurried way may suboptimize vendor selection, contracting strategy, and/or contract clauses as well as sacrifice economies of scale.

Although it may be necessary to treat an unanticipated DMSMS issue in an ad hoc way even when a formal programming and budgeting process was used, the frequency of obtaining ad hoc funding will be less with a dedicated POM/budget line item. In addition, obtaining funding in an ad hoc situation implies diverting resources from already funded activities. Those previously funded activities will generally be negatively affected. Lastly, ad hoc processes usually demand much more time and attention of people at all levels in the program office. This can lower morale or take time away from other important activities.

Having a POM/budget line item improves planning since it provides a basis for tradeoffs based on the funding profile available. As in the case of DMSMS management operations, a POM/budget line item gives visibility to the reality of obsolescence and the importance placed on addressing that obsolescence. It informs program office management that expenses must be incurred while at the same time illustrates that planning has been done for those expenses. It is also an opportunity to justify and defend the funds requested to all the organizations that review a program office's DMSMS resolution POM or budget. This is especially important when large DMSMS resolution funding requirements are expected.

Implementing DMSMS resolutions is not an optional activity because readiness, schedule, and cost impacts will occur otherwise. Showing the amount needed explicitly may serve to insulate this money from external and internal reductions. A POM/budget line item for DMSMS resolutions may be just internal to the program office or it may be displayed on external budget submissions. Visibility may help protect DMSMS-related funding; hiding it may have the opposite effect.

Naturally there should be a spend plan associated with the POM/budget line item for DMSMS resolutions unless it is part of a larger contract for design, development, production, or logistics support. As stated in Section 3.4.1, procedures for obtaining resources are Component dependent, and even within a single Component, those procedures may not be the same across all program offices. Regardless of Component, including DMSMS issue resolution requirements in the budgets of other activities, such as parts management, reliability and maintainability, or supportability activities, is often a successful tactic.

M.1.5 Prepare Programming and Budgeting Justification

Program offices should prepare persuasive programming and budgeting justification materials to support the need for funding for DMSMS resolutions as an enabling best practice. Justify resolution costs for known and anticipated issues separately since stronger justification can be established for currently obsolete items. If for some reason, the financial (or any other stakeholder) community questions the funding justification, it is important to discourage arbitrary reductions to the maximum extent possible by providing as much specific information as possible. Justification for anticipated issues will be based on the methodology used to estimate their cost.

The use of a quad chart mechanism (or something analogous to it) can be an effective way to justify programming and budgeting requests for DMSMS resolutions. Quad charts should be socialized in advance with all key stakeholders. The following information for a DMSMS issue and its recommended resolution should be conveyed:

- Provide pertinent general information on the obsolete item(s), e.g., part number, manufacturer, supplier if appropriate, expected demand, number on-hand, consumption rate, and so forth.
- Describe the issue, the impact that will occur if the issue is not resolved, and the expected date that the impact will begin to materialize.
- Describe the recommended approach for resolving the issue, any risks associated with the approach, and how those risks will be managed.
- Show the funding profile needed to resolve the issue over time, the tasks to be funded, and estimated completion dates.

Figure 37 is an illustrative, generic example of a quad chart.

Figure 37. Notional Quad Chart

Current Issue/Future Impact

- Company Y part number : : : is a modified version of Company Z part number : : :
- Company Z no longer manufactures this line and no assets are available
- The baseline : series has been superseded by the z series which appears to have design changes that make Company Y's modifications incompatible
- Any possible repairs would depend on the availability of the replacement parts, for which Company Y is dependent on Company Z to supply
- IMPACT Statement: Failure will cause the XXXX system to be unable to perform launch and recovery of all vehicles

General Information

- Systems: #
- CAGE: AAAAA
- APLs: 123456789
- P/N: 123-45-678

NSN (As of 04/05/2017)	Last Requisition	On Hand	QRTLY Demand	Surplus
NSN XXXX-XX-XXX-XXXX	03 Sept. 2012	0	0	0

Solution

- Short Term: N/A
- Long Term:
  - Develop "Fix as Fails engineering change proposal" for recommended replacement to the XXXX system to meet operational and performance requirements:
    - Develop installation drawing for integration of new motor
    - Initiate and submit engineering change proposal
    - Engineering change proposal will replace existing winches

Deliverables from Receipt of Funding

Task	Funding	Elapsed Time	Status
Engineering Research	$30K	60 Days	Unfunded
System Integration Impact Software Mods	$20K	120 Days	Unfunded
Testing Software Verification and Validation	$35K	150 Days	Unfunded
Initiate Engineering Change Proposal and Review	$10K	150 Days	Unfunded

M.1.6 Ensure Stakeholders Recognize the Importance of Funding Resolutions

Appendix G.4 covered this enabling best practice for programming and budgeting for DMSMS management operations. Some of the material applies to both management operations and resolutions and therefore is repeated here.

DMSMS management practitioners do not solely control the effectiveness and efficiency of DMSMS management-related activities in program offices. Everyone in a program office contributes. Programming and budgeting can only be successful if that is the case. Outreach to key stakeholders is the first essential step. While the need for outreach is mentioned elsewhere in this document, that material is organized by best practice. This section is organized by the stakeholder community interacting both inside and outside the program office. It summarizes the information that should be conveyed and how the stakeholder community can help with regard to DMSMS resolution-related programming and budgeting.

M.1.6.1 PROGRAM OFFICE MANAGEMENT

The PM is the ultimate decision maker. To a large extent, the technical aspects of the programming and budgeting request should be coordinated and supported by the chief engineer and the PSM.

Program office management needs to understand the value of separate programming and budgeting line items for DMSMS resolutions (for both known and anticipated DMSMS issues) in terms of their contributions to proactivity and efficient program office operations. Program office management should also understand that lead times should be built into DMSMS resolution fund requests. Resources may be needed (perhaps even a few years) before the issue is expected to impact the system because it takes time to develop and procure the necessary items. Finally, program office management should be aware that when unanticipated DMSMS issues occur, additional funding (not included in the budget)[256] could be needed during execution because program office management will be called upon to help identify potential sources of funding to resolve those previously unanticipated DMSMS issues.

M.1.6.2 CONTRACTING

The contracting community should recognize that new contracting actions could be required during budget execution to resolve previously unanticipated DMSMS issues. In some cases, especially for LON buys, these contracting actions for DMSMS resolutions must be exercised quickly. Contracting should also understand that to avoid a negative impact on the system, putting some resolutions on contract could be time sensitive. In the case of a LON buy, the window for final purchase may be very brief. In addition, the contracting community should explain what it needs from the DMSMS management community to satisfy the contracting community's requests.

Another key interface with the contracting community relates to the different ways that resolution funding may be implemented. The prime contractor/OEM may be contractually obligated, under a fixed price contract line item number (CLIN), to resolve all, some, or none of the DMSMS issues during development, production, or sustainment. This has an effect on how the total program and budget estimates are split between such fixed-price contract amounts and later contract modifications. For the fixed-price contract situations, the contractor resolution may only resolve the issue until the end of the contract, e.g., the contractor will buy additional items to resolve a DMSMS issue to satisfy demands up to the end of the contract period of performance.[257] The government should consider funding the portion of the costs that are beyond the contract end date. Otherwise the government can expect to incur redesign costs before a new contract can be signed or as part of the new contract. This could be complicated further if the government does not have appropriate technical data rights to accomplish the redesign.

M.1.6.3 FINANCIAL MANAGEMENT

Along with program office management stakeholders, the financial management community also must appreciate the importance of having separate line items for DMSMS resolution-related programming and budgeting. In addition, these stakeholders need an understanding of and degree of comfort with how DMSMS resolution-related funding requests are determined. They must be aware of and support the estimation of the funding required to resolve both known and anticipated issues. The unanticipated element is very important since it is nearly a certainty that such issues will occur but the specific details are not certain. The financial community must recognize the validity of the estimates for resolving

[256] Although the budget should contain funding for unanticipated issues, it may be the case that the requirements exceed the funding available.

[257] In one sense, a prime contractor should never develop a design for the government for which parts are not available for manufacturing, either LRIP or for all the options of the first production contract. That is not to say that there will not be any obsolescence. The prime contractor should stockpile a sufficient quantity of the obsolete items to meet the terms of these contracts (i.e., to produce prototypes, engineering design models, LRIP units, units for the first production contract, and initial spares for the units produced for the first production contract). That is not always the case in practice.

unanticipated DMSMS issues and not create barriers because of any uncertainty in the details because not resolving those issues could negatively impact cost, schedule, and readiness.

The financial management community is also a source of key information for DMSMS resolution-related programming and budgeting. They can provide information about the process, the types of appropriations that can be used for DMSMS activities, and help make the justifications for the funding as persuasive as possible. Financial management stakeholders should be aware that the cost of resolving unanticipated DMSMS issues could exceed the amount budgeted for that purpose. In that case, additional funding (not included in the budget) could be needed during execution. Since this community will have knowledge of budget execution rates, it also may be useful in identifying sources of funding for unanticipated issues that arise. Because there may be extensive approvals required for LON buys that exceed a certain quantity, the financial management community should know about the calculation of LON quantities and the fact that these quantities may be required to last well into the future. The financial management community can therefore help with the justification process. Finally, the financial management community should be aware of color of money repercussions due to the fact that resolving DMSMS issues may increase capability.

M.1.6.4 WCF ORGANIZATIONS

The organizations that manage WCFs also pay for certain resolutions during sustainment. In some cases, these efforts are driven by requests from the program office, but in other cases, the requests may have been generated in the WCF organizations themselves. These resolutions include, but are not limited to, LON buys. Two-way communications on all these issues are essential not only to ensure that everyone knows what is happening but also to enable alignment with program office modification efforts which are often not known by WCF organizations.

M.1.6.5 IPTs

This is a generic heading because every program office may have a different IPT structure. IPT stakeholders include those organizations that are concerned with both readiness and system development and modification. DMT interfaces with various IPTs should be made on those IPTs' own terms. For example, it is generally more effective for DMSMS SMEs to attend the meetings of other IPTs than to invite various IPTs to attend the program office's DMT meetings. The DMSMS management community should convey how it can help the various IPTs and then what the IPTs need to do to better enable that support. This could eventually lead to a situation where the various IPTs contact the DMT to provide key information.

The appropriate IPTs should be informed of the relationship between DMSMS management and readiness. The "readiness" IPT (or the IPT most concerned with the subject, whatever it is called) can help support DMSMS resolution programming and budgeting requests. Multiple IPTs usually support the program office's modification and development efforts. It is important for planned modifications to be considered in the development and AoA to enable the DMT to determine the length of time that a short-term resolution should cover based on existing plans and/or to ask about whether/how existing plans could be revised. Without such information, there could be inefficiencies or wasted effort on the part of the DMT. The DMT may be trying to come up with a resolution without knowing the appropriate time horizon. In theory, if communications are poor, the wrong LON quantity may be purchased.

DMSMS health assessments should be communicated to the appropriate IPTs as an input to their modification planning. The appropriate IPTs need to know about planned DMSMS resolutions because they may impact modification plans. Efforts should be made to improve receptivity to the DMSMS information. When unanticipated issues arise during budget execution, certain IPTs may be able to provide funding if the DMSMS resolution-related execution budget line was not sufficient to resolve the issue. There also may be a relationship between certain IPTs and the engineering authorities external to the program office that technically approves a DMSMS resolution.

M.1.6.6 ENGINEERING

This interface is important because technical approval of resolutions must be made by the appropriate engineering authority. The engineering authority may be in different organizations depending on how the service is organized—it may be at the HQ, field command, or program office level. The program office is of course always involved regardless of whether it is the technical decision maker. Depending on when the impact is projected for a DMSMS issue, technical approval may be preliminary. Nevertheless, the technical authority must be consulted to provide the best assessment of how the issue will be resolved to inform the resolution cost estimate, even if final approval has not been given.

M.2 CONSIDERATIONS FOR FUNDING DMSMS RESOLUTIONS IN THE YEAR OF EXECUTION

As stated in Section 7.1, reliance on obtaining funding for DMSMS issues in execution year is not a best practice. Despite this, financial issues may still arise during budget execution. This section discusses several budget execution considerations.

M.2.1 Potential Funding Sources during Budget Execution

During budget execution, unanticipated DMSMS issues may be discovered or the cost of implementing a resolution could be significantly higher than expected. As a result, the funds budgeted for DMSMS resolutions in the year of execution may be too low and it may become necessary to identify other sources of funding to resolve those issues quickly to prevent a specific impact (e.g., cost, schedule, and/or readiness) on the program office. The following are some potential approaches for obtaining additional resources given a high enough priority for initiating a resolution for the DMSMS issue during budget execution.

- Obtaining funds from other budget allocations. During the course of budget execution, unused funds may emerge. For a variety of reasons,[258] appropriated budgets may not be obligated for their intended purposes and unless obligated for some purpose, those funds will expire at the end of the budget execution year. This type of situation may be faced internal to a program office (e.g., budgets allocated to initial spares) or external to a program office (e.g., at a higher echelon of command such as the Program Executive Office or other organizations such as operating units). When that occurs, organizations often seek potential projects that can obligate those expiring funds (called sweep-up funds) just before the end of the fiscal year.[259]

  A centralized asset manager should be aware of *the* execution status of all aspects of the program office's budget. Likewise asset managers for organizations external to a program office will be aware of the execution status of its funds. If implementation plans for DMSMS issues are already prepared, technically approved, and can be quickly put on contract, then these efforts would compete well for sweep-up funds. If unobligated funding is found, there may be the opportunity to cost share using some of those funds to resolve a DMSMS issue. Operating forces

[258] For example, unexpected technical issue could delay the signing of follow-on contracts or contract negotiations and/or administrative lead time could be longer than planned.
[259] Some organizations do this both at midyear and at the end of the year.

using a system with a DMSMS issue may be willing to provide funding to resolve the issue if the program office cannot find another alternative. For example, budgets for replenishment spares held by operating sources could be considered.

- Leveraging FMS. DMSMS issues that affect U.S. systems will affect similar systems sold to other countries if they are using the same items. If the foreign buyer has paid for the resolution of DMSMS issues, then U.S. systems may be able to leverage that effort.
- Reallocating funds from ongoing projects where there is sufficient flexibility to slow the expenditure rate. The execution of system modifications or even other DMSMS resolutions may be able to be delayed without severe negative repercussions in the current budget execution year assuming that funding is restored in the following budget year when additional resources become available. There should be a process for adjusting spend plans rapidly if and when the need arises.

A key to success in overcoming budget execution shortfalls is outreach and communication. The DMT should be aware of calls for sweep-up fund projects, ongoing modification programs, potential funding sources, FMS, and centralized financial managers so it can act quickly when the need arises. Similarly, key points of contact in all these activities should be made aware of the uncertainties in DMSMS resolution budgets and recognize the roles they can play in minimizing the potential impacts of these uncertainties.

M.2.2 Contracting during Execution

There are two contracting-related considerations for funding DMSMS resolutions that may be of particular importance if a program is seeking to fund a DMSMS resolution during the budget execution year:

- Finding a contracting vehicle that is feasible to use. Finding an appropriate contract vehicle for DMSMS resolutions can sometimes be difficult. A contract must be in place with the organization that will implement the resolution (e.g., the organization performing the non-recurring engineering or the organization that will sell the items). This is often a problem when a system is in sustainment with only organic support for the obsolete item. In this situation, even if the program office has funds to develop a resolution, there may not be a readily available contract to use that money. If the item is supported by a WCF, the program office should attempt to initiate a WCF project to develop the resolution, including a LON buy. Otherwise, the program office should identify a usable contract vehicle or issue an RFP to create a new contract vehicle. The problem with the latter is that it will require significant lead time before a new contract can be put in place. This is especially challenging for a LON buy as there may only be a very limited amount of time to purchase the needed quantities.
- Having an appropriate funding appropriation to use on that contract. Restrictions exist on the use of all appropriations. In some cases, procurement funds are necessary to buy the new item; in others, RDT&E funding is generally required for non-recurring engineering and testing associated with redesign. O&M funding may be needed to pay for installation of the item. There will be knowledgeable people in the program office that can provide advice on this subject.

  When a system is in production, a program office may not have any or only very limited O&M funds. When a DMSMS issue occurs, production money can be used to develop a resolution, which would likely be applicable to units in production as well as fielded units. Installation of the item in fielded units requires O&M funds and is generally done by attrition. In rare cases where there is a need to install the new item in fielded units rapidly (i.e., not through attrition), there could be a problem because installation if O&M funds are not available to support rapid installation. A much more likely problem is the situation of funding a resolution that applies to both in-production and fielded units using a LON buy. It is difficult to justify the use of procurement appropriations to buy LON quantities of an item to meet the demand of the fielded units. There is no best practice for this situation. Programs must strongly justify the requirement and the impact of not procuring the full amount (i.e., to meet the item demand for production and fielded units) and then work with their leadership to obtain approval. Another approach is to work with organizations managing WCFs to finance the LON buy, when the item in question is managed by that WCF.

M.2.3 Executing LON Buys

There are two limitations that can result in suboptimal LON purchases.

- Limitations on being able to buy to the estimated requirement. According to 31 U.S.C. §1502 (a), the balance of an appropriation or fund, limited for obligation to a definite period, is available only for payment of expenses properly incurred during the period of availability or to complete contracts properly made within that period of availability and obligated consistent with §1501 of this title. The appropriation of funds is not available for expenditure for a period beyond the period otherwise authorized by law. In order to justify a LON purchase to include demand for the item beyond the expenditure period for the funds used to purchase those items, a “bona fide need” statement must be documented for the General Counsel’s office. That statement should explain the DMSMS issue and the risk posed to the system if the items to meet demand outside the expenditure period, as well as describe how and why the resolution option was determined.
- Limitation on the acquisition of excess supplies. 10 U.S.C. §2213 may also be an issue. That section of public law applies only to WCFs. It also provides a basis for exceptions to the limitation. The interpretation of these statutes varies throughout DoD. There have been situations in DoD where the quantity was limited to one year, two years, three years, the number of years remaining in a production contract, and as determined on a case-by-case basis. Some program offices routinely obtain exceptions and others do not. Program offices should work with their associated financial communities and potentially service DMSMS leads to establish a routine process for justifying their entire estimated requirement.[260]

M.3 LEVERAGING WCFs TO FUND DMSMS RESOLUTIONS

The Air Force and the Army each have comprehensive WCF programs to resolve DMSMS issues for WCF-managed items. The Navy has nothing equivalent. Under very limited circumstances, the Logistics Engineering Change Proposal program may be used to fund DMSMS resolutions. No further information has been provided. Program offices interested in learning more should refer to their principal point of contact for DMSMS matters.

The purpose of this appendix is to describe the extent to which the Air Force Working Capital Fund (AFWCF) and Army Working Capital Fund (AWCF) will finance[261] resolutions to DMSMS issues. Implementing or financing a resolution implies that the resolution has been determined, the non-recurring effort to develop and test the resolution to the problem has been funded and completed, and the replacement item/assembly can be obtained from the supply system.

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[260] One program office overcame the problem by adding the following words to its DMSMS resolution POM/budget line item: “Obsolescence above encompasses mitigation activities that protect the system and ensure a producible technical data package. This preserves an affordable future product cost with an acceptable production schedule. Examples of mitigation activities include component replacement parts, materials, qualification, alternative source/ parts qualification, and piece part/material bridge buys to support subsequent year’s production lots.”

[261] This document generally uses the term “finance” instead of “fund.” Since WCFs are required to break even by including all their operating expenses in a cost recovery rate applied to all sales, WCFs technically do not fund anything. The cost of resolutions (among other things) is actually spread among all WCF customers in anticipation of future sales.

M.3.1 Air Force Sustaining Engineering Program

M.3.1.1 NAME AND PURPOSE OF PRIMARY MECHANISM FOR USING THE WCF TO FINANCE A RESOLUTION TO A DMSMS ISSUE

- Consolidated Sustainment Activity Group–Supply (CSAG-S)/General Support Division (GSD) Sustaining Engineering Program.
  - Purpose. Solicit and finance projects that mitigate obsolescence of depot level reparables (DLRs) (as part of CSAG-S) and consumables managed by the AFWCF and consumables managed by the Defense Working Capital Fund (DWCF) where the Air Force is the cognizant engineering authority (as part of GSD); recover expenditures in the AFWCF cost recovery rate.[262]

Unless otherwise noted, the remainder of this section is primarily focused on the CSAG-S/GSD Systems Engineering Program, its call for projects, and the rules by which projects can be approved and financed.

M.3.1.2 SERVICE POLICY DOCUMENTS GOVERNING THE IMPLEMENTATION OF THE CSAG-S/GSD SUSTAINING ENGINEERING PROGRAM

- 448th Supply Chain Management Wing Instruction 63-118,
- Air Force Materiel Command (AFMC) Instruction (AFMCI) 20-105, DMSMS,
- Air Force Instruction (AFI) 23-101—Air Force Materiel Management, AFMC Supplement (Guidance Memorandum)—Improved Item Replacement Program (IIRP) verbiage, and
- AFI 65-601, Volume 1, Financial Management, Budget Guidance and Procedures, Paragraph 8.5.2.

M.3.1.3 TYPE OF OBSOLESCENCE-RELATED PROJECTS ALLOWED

- A project is allowable if its primary purpose is obsolescence mitigation for an allowable item and any product improvement that enhances capability is ***incidental***. SOWs and project narratives must clearly not intend to enhance capability because that effort then becomes a modification.
- Support documentation must include the following:
  - Proof of obsolescence indicating that an item can no longer be purchased (does not include functional or technological obsolescence) and
  - A determination of the date that the obsolescence will impact operational availability.
- In the case of a redesign, a project must develop an F3 interface replacement.[263] It usually is for a single new item to replace a single obsolete item. Obsolete items may be grouped together such that an obsolete assembly or subassembly is replaced by a new set of items if it is cost effective to do so. LRUs and SRUs must be budget code 8 (repairable) or budget code 9 (consumable) before a project can be funded by AFWCF dollars.
- Other projects include those to reverse engineer an item to gain complete TDPs so that competition can result in future buys and repairs.

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[262] Projects to improve reliability, availability, or maintainability; to correct safety of flight deficiencies; to develop repair procedures; to reestablish an organic repair capability following a redesign project; or to obtain needed technical data are also allowed. In addition, projects can maintain test program sets or units under test capability to isolate and resolve software discrepancy reports. Such non-DMSMS-related projects are not discussed further in this document.

[263] This is usually preferable from a program management perspective since it simplifies logistics in that there is no proliferation of the number of configurations to be supported.

- Another type of project could be one to re-establish repair capability as a result of a related sustaining engineering project as data is the deliverable and not equipment. That equipment is the responsibility of the program office or the organic depot itself.
- Cost sharing between appropriated and WCF dollars is not allowed with one exception.[264] The WCF cannot be used to supplement appropriated funds.
- It is also possible to use AFWCF resources to investigate an issue to determine a resolution. Such efforts are not associated with the sustaining engineering program. The results could lead to either a sustaining engineering project or a program office deciding to deliberately increase capability to correct the deficiency and use appropriated dollars.

M3.1.4 ALLOWABLE COSTS

- Non-recurring engineering costs for redesign or reengineering.
- Prototype design and fabrication.
- Testing at the item level (and at higher levels of assembly) to ensure the item's requirements are met.
- Software costs when the software is embedded in hardware that is being redesigned or reverse engineered.
- Reverse engineering to develop a TDP if it is not available.
- Purchase of technical data associated with a project's engineering efforts, and the rights to use that data. Other technical data can be purchased with non-sustaining engineering AFWCF funds.
- Associated changes to technical manuals.

M.3.1.5 EXCLUSIONS

- AFWCF funds cannot follow appropriated procurement or RDT&E funds.
- Studies that determine what to do cannot be supported through the sustaining engineering program, but they can be financed in the AFWCF using the Contract Services program.
- While initial spares are not funded by sustaining engineering, they may be purchased with AFWCF as a result of a requirement established elsewhere.
- New test or support equipment.
- Production or implementation of kit.
- Projects related to software only.
- System level testing.
- Development projects; project must be at Technology Readiness Level (TRL) 6 (demonstrated in a relevant environment) or higher.

M.3.1.6 TYPES OF DMSMS RESOLUTIONS THAT CAN BE FUNDED

- Approved part: Yes.
- LON buy: An LON buy cannot be executed through the project call, but it can be executed using the AFWCF (see Appendix M.3.3).

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[264] The sole exception to this is the case when it is not clear whether a deficiency is item related. A study to make a determination of whether the deficiency is item related must be made with appropriated dollars. If the study concludes that the deficiency is item related, then the AFWCF may be used to finance the resolution.

- Repair, refurbishment: Yes.
- Extension of production or support: Yes.
- Simple substitute: Yes.
- Complex substitute: Yes.
- Development of a new item or source: Yes.
- Redesign—NHA: Only if the NHA is managed by AFWCF, which means that it has been provisioned.
- Redesign—Complex or (sub)system replacement: Only if the subsystem is managed by AFWCF, which means that it has been provisioned.

M.3.1.7 PROJECT CALL PROCEDURES

- Issuer/Point of contact: Systems Engineering Program Office.
- Approval authority: AFMC.
- Frequency and timing: In-cycle data calls are issued December-March annually. If a need arises, projects may also be submitted out-of-cycle.
- Ranking criteria examples:
  - Whether the project is a continuation of a previous project,
  - Mission impact,
  - Severity of the impact,
  - Mission degradation date,
  - Mission item essentiality code,
  - Affected weapon systems,
  - Reliability, availability, maintainability impact,
  - ROI (to the Air Force as a whole), and
  - Impact on safety.

M.3.1.8 LIMITATIONS ON THE DOLLAR AMOUNT THAT THE WCF CAN FINANCE

- There is no explicit limitation.
- The total dollar value of all projects from FY16 to FY19 has been $370 million, $118 million, $118 million, and $241 million, respectively. Obsolescence mitigation projects represent approximately 75% of the total.

M.3.1.9 FUNDING FOR FIELDING NEW ITEMS

- Appropriated funds can be used for scheduled installations across operating units if fielding is considered urgent.
- Installation by attrition is a second option.
- The IIRP is a mechanism for using the AFWCF to finance some fielding of replacement items to correct deficiencies, replace obsolete assets, and/or introduce, through technology insertion, state-of-the-art components that are stocked, stored, and issued as assets of supply.

- There are no known funding limits. High priority candidate items for IIRP funding include those correcting a safety of flight issue, those providing a specialized mission capability, those whose fielding would lead to an ROI through improved reliability, and obsolete items (electronic as an example).
- In the case of obsolete items, the rationale is that by the time an attempt is made to purchase the redesigned item, it may be obsolete because residual stock of the original item could last longer than the market life of the replacement electronics. In that situation, the cost of the original redesign project would have been wasted because another redesign will be required.

M.3.1.10 REASONS A PROGRAM MIGHT NOT WANT TO TRY TO USE WCF RESOURCES ON AN ALLOWABLE PROJECT

- PM might not want a solution at the part level, but prefer a solution at the assembly level and potentially improve capability at the same time.

M.3.1.11 OTHER MECHANISMS FOR FINANCING A DMSMS RESOLUTION

- Outside of sustaining engineering, the AFWCF, as part of its normal supply operations, may execute a LON buy for either the DLRs or the consumables that it manages. Unless something significantly changes with the reliability or condemnation rate for a DLR, additional procurements are rarely needed. Even when one of those changes occurs, a DLR LON buy would not be required if it is possible to develop F3 replacements to obsolete components within the DLR or to make LON buys of the component itself. Furthermore, if there were issues at the component level, there may be no ability to buy the DLR itself. The AFWCF will execute a LON buy option for an item which will no longer be produced only when all other more economical and logistically acceptable alternatives to a material shortage or manufacturing discontinuance have been exhausted. While 10 U.S.C. Section 2213 limits the ability of WCFs to buy stock beyond two years of need, it also establishes a mechanism for exceptions to be granted within a WCF organization itself. The likelihood of approval is heavily dependent on whether the purchase will impact AFWCF cash flow since the sales to reimburse the AFWCF for the purchase will be several years in the future.
- LON buys on items managed by DLA are executed by DLA. They are usually the result of a discontinuance, counterfeit, or change notice and are processed within the AFWCF for identification of all Air Force-managed next higher assemblies that will be impacted and computation of total projected requirements through the life of the program.
- To some extent, the AFWCF uses CLS and PBL contracts to repair some of the items that it manages. Those contracts may have requirements to resolve certain DMSMS issues. The funding for such contracts is not part of the project call. It is however possible that those contracts are modified to perform a funded project.

M.3.2 Army Obsolescence Mitigation Program

M.3.2.1 NAME AND PURPOSE OF PRIMARY MECHANISM FOR USING THE WCF TO FINANCE A RESOLUTION TO A DMSMS ISSUE

- AWCF Obsolescence Mitigation Program.
- Purpose. Solicit and finance projects that mitigate obsolescence of DLRs and consumables managed by the AWCF;[265] recover expenditures in the AWCF cost recovery rate.

[265] There are three other programs included in the project: Operating and Support Cost Reduction (OSCR), Reliability Improvement Program (RIP), and Cost-Wise Readiness. Since they are not focused on DMSMS issues, they are not discussed further in this document.

Unless otherwise noted, the remainder of this paper is primarily focused on the AWCF Obsolescence Mitigation Program, its call for projects, and the rules by which projects may be approved and financed.

M.3.2.2 SERVICE POLICY DOCUMENTS GOVERNING THE IMPLEMENTATION OF THE AWCF OBSOLESCENCE MITIGATION PROGRAM

- U.S. Army Materiel Command (AMC) Memorandum, Subject: Supply Management, Army. AWCF Procedures of Submission of Secondary Item Obsolescence Requirements, October 1, 2020, updated annually.
- Annual Funds Release Execution Guidance.

M.3.2.3 TYPE OF OBSOLESCENCE-RELATED PROJECTS ALLOWED

- A project is allowable if its primary purpose is obsolescence mitigation for an AWCF-managed item and any product improvement that enhances capability is incidental. Support documentation must include the following:
  - Proof of obsolescence indicating that an item can no longer be purchased (does not include functional or technological obsolescence) and
  - A determination of the date that the obsolescence will impact operational availability.
- In the case of a redesign, a project must develop an F3, interface replacement.[266] It usually is for a single new item to replace a single obsolete item. Obsolete items may be grouped together such that an obsolete assembly or subassembly is replaced by a new set of items if it is cost effective to do so.
- A project whose primary purpose is product improvement to enhance capability would not be funded by the AWCF. However, if a single project includes both obsolescence mitigation and deliberate product improvement, a shared cost arrangement can be negotiated (assuming that an equitable way of splitting the cost has been agreed upon and there are separate CLINs).[267]

M.3.2.4 ALLOWABLE COSTS

- Non-recurring engineering costs for redesign or reengineering,
- Prototype development,
- Testing at the item level (and at higher levels of assembly) to ensure the item's requirements are met,
- Software costs when the software is embedded in hardware,
- Reverse engineering to develop a TDP if it is not available, and
- Purchase of technical data related to the project and the rights to use that data.

M.3.2.5 EXCLUSIONS

- Initial spares when needed are normally funded by the PM with appropriated funds.
- Production or implementation of kits.
- Projects related to software only.

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[266] This is usually preferable from a program management perspective since it simplifies logistics in that there is no proliferation of the number of configurations to be supported.
[267] In some cases, it is difficult to make the distinction. There have been instances where the AWCF financed hardware changes and appropriated dollars paid for software changes.

- Studies that determine what to do are not part of the project call. However, such studies can be funded with AWCF logistics operations money.
- System level testing.
- Development projects; project must be at TRL 6 (demonstrated in a relevant environment) or higher.
- New test equipment unless the old test equipment were AWCF managed.
- While changes to technical manuals and revisions to provisioning data are funded with appropriated resources, there are no programming and budgeting implications to the program office. Such changes are centrally funded with non-program office appropriated funds.
- Projects unique to special operations since they involve no AWCF parts.

M.3.2.6 TYPES OF DMSMS RESOLUTIONS THAT CAN BE FUNDED

- Approved Part: Yes.
- LON buy: An LON buy cannot be executed through the project call, but it can be executed using the AWCF (see Section L.3.11).
- Repair, refurbishment: Yes.
- Extension of production or support: Yes.
- Simple substitute: Yes.
- Complex substitute: Yes.
- Development of a new item or source: Yes.
- Redesign—NHA: Only if the NHA is managed by AWCF, which means that it has been provisioned.
- Redesign—Complex or (sub)system replacement: Only if the subsystem is managed by AWCF, which means that it has been provisioned.

M.3.2.7 PROJECT CALL PROCEDURES

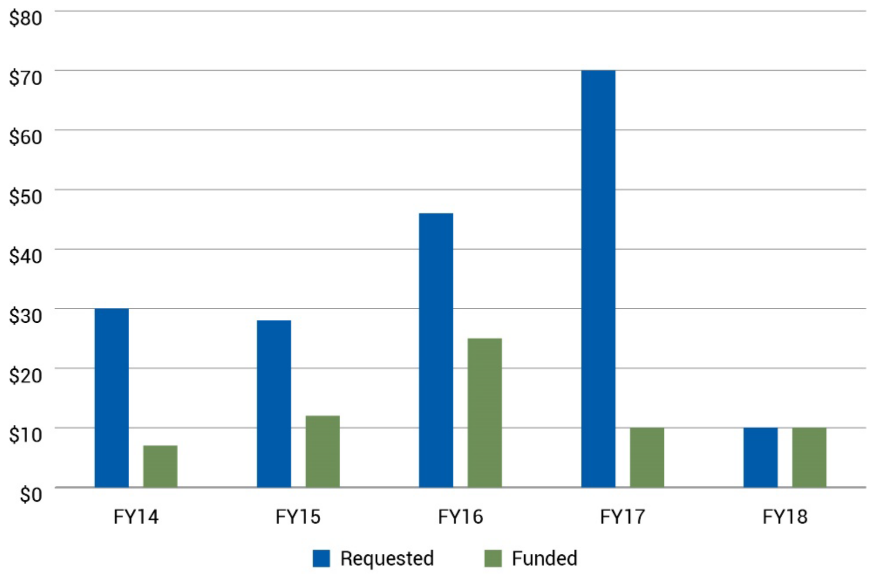
- Issuer/Point of contact: Army's Aviation and Missiles Command (AMCOM), Communications and Electronics Command (CECOM), and Tank and Automotive Command (TACOM).
- Approval authority: AMC.
- Frequency and timing: Data calls issued typically in April and November. If a need arises, projects may also be submitted out-of-cycle.
- Ranking criteria examples:
  - Amount of time until no items are available because of obsolescence,
  - Amount of reliability improvement that would be attained,
  - Stakeholder priority,
  - ROI (to the Army as a whole),
  - Technical risk and merit,
  - Impact on safety, and

– Impact on the Integrated Product Support (IPS) elements.[268]

M.3.2.8 LIMITATIONS ON THE TOTAL DOLLAR AMOUNT THAT THE WCF CAN FINANCE

- Two and one-half percent of predicted AWCF sales allocated by systems command (AMCOM, CECOM, and TACOM).
- From 2008 through 2010,[269] AMCOM was not allocated sufficient AWCF funds to meet its obsolescence mitigation requirements. From 2011 through 2018, AMCOM has not spent all its allocation.[270] The average funding spent on obsolescence mitigation from 2008 through 2018 is $31.78 million per year with approximately $15.93 million spent on other supportability improvement projects.
- Since FY14, with the exception of FY18, CECOM has not been allocated sufficient AWCF funds to meet its obsolescence mitigation requirements. During that time period, CECOM only submitted AWCF projects that were obsolescence related. Figure 44 shows data call requests made by CECOM Integrated Logistics Support Command and the corresponding amount funded by AMC by fiscal year.

Figure 38. CECOM Requests and Funding for AWCF DMSMS-Related Projects



Note: Dollar amounts are in millions of dollars.

- Figure 39 shows TACOM requirements and funding for AWCF projects. Data was not available to differentiate DMSMS issue-related projects from other types of projects. All requirements from FY14 through FY17 were not funded. In FY18, requirements were fully funded and some additional resources were provided to deal with emergent problems.

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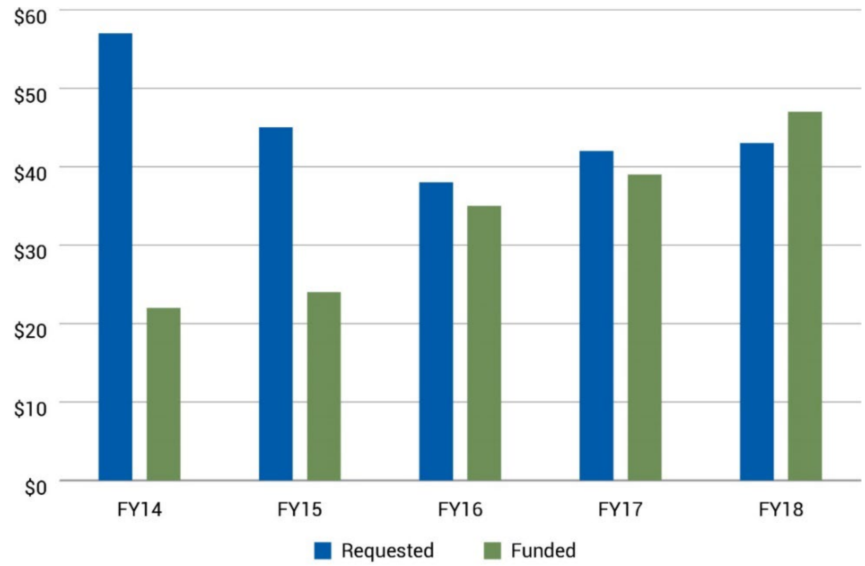
[268] DAU, IPS Elements Guidebook, July 2019.

[269] In 2010 AMCOM had urgent obsolescence mitigation needs and was granted extra allocation from AMC.

[270] Because 2013 was a sequestration year, no "new starts" were approved by AMC. Only ongoing projects were funded in 2013.

Figure 39. TACOM Requests and Funding for AWCF Projects



Note: Dollar amounts are in millions of dollars.

M.3.2.9 FUNDING FOR FIELDING NEW ITEMS

- Appropriated funds can be used for scheduled installations across operating units if fielding is considered urgent.
- Otherwise, installation by attrition.

M.3.2.10 REASONS A PROGRAM MIGHT NOT WANT TO TRY TO USE WCF RESOURCES ON AN ALLOWABLE PROJECT

- PM might not want a solution at the part level, but prefer a solution at the assembly level and potentially improve capability at the same time.

M.3.2.11 OTHER MECHANISMS FOR FINANCING A DMSMS RESOLUTION

- While a LON buy cannot be executed through the project call, the AWCF could finance a LON buy for items that it manages as part of its normal supply functions. The decision would be made by the item manager along with his/her organization. Perhaps the more difficult aspect of this is the determination of whether a LON buy is the most cost effective resolution over the life cycle of the system. The AWCF will execute a LON buy option for an item which will no longer be produced only when all other more economical and logistically acceptable alternatives to a material shortage or manufacturing discontinuance have been exhausted. Such an action is unusual for depot-level reparables themselves since DMSMS issues would normally be associated with the components used for repair and would be mitigated at that level. Furthermore, many of the components used for repair are DLA managed and LON buys would be funded by the DWCF (see below). When the AWCF does identify a LON as the preferred resolution, 10 U.S.C. § 2213 limits the ability of WCFs to buy stock beyond two years of need. However Section 2213 also establishes a mechanism for exceptions to be granted within a WCF organization itself. The likelihood of approval is heavily dependent on whether the purchase will impact AWCF cash flow since the sales to reimburse the AWCF for the purchase will be several years in the future.
- It is unlikely that the AWCF would be used to supplement an inadequate DLA-funded LON buy for a DLA-managed item for which the Army is the technical authority. In such a situation, the Army is likely to try to use senior level influence to persuade DLA to buy additional items.

- To some extent, the AWCF uses CLS and PBL contracts to repair some of the items that it manages. Those contracts may have requirements to resolve certain DMSMS issues. The funding for such contracts is not part of the project call. It is however possible that those contracts are modified to perform a funded project.

The Army has three other WCF programs that theoretically could also be used to resolve a DMSMS issue. Each program has different project acceptance criteria:[271]

- The OSCR program is designed to "save the field money" by reducing secondary item acquisition costs, extending the life of the item, and reducing the number of events (removals or repairs) and the cost per event. OSCR promotes life-cycle cost savings and avoidance in the field by redesigning, prototyping, and testing spare parts for fielded systems. OSCR projects involve an individual item or assembly of items, prototype, or test. The program will not fund production or implementation of kits, nor will it fund studies. Eligibility for the program requires a validated economic analysis.
- The RIP is a continuous process to look for opportunities to decrease demand, improve operations, and improve reliability. Projects must provide immediate help to the soldier and must show an ROI. This program will not fund production and studies.
- The Product Improvement Pilot program provides funding for product improvements such as improving reliability and maintainability, extending useful life, enhancing safety, and lowering maintenance costs. This program cannot be used to significantly change the performance envelope of an end item, and individual item costs may not exceed $1 million.

M.3.3 WCFs and LON Buys

There are circumstances where WCFs finance LON buys for the items they manage. Because Service WCFs generally manage more expensive reparable items, LON buys are usually not the most cost-effective resolution to DMSMS issues and are often not feasible. That is one reason why the programs described earlier in this appendix were established. On the other hand, the DLA-operated DWCF manages less expensive consumable items where LON buys are not unusual.

Therefore, the purpose of this section of the appendix is to describe how DLA uses the DWCF to finance resolutions to DMSMS issues. This appendix also provides best practices that the Services should follow to optimize DLA support in obtaining such DWCF assistance. Answers are provided to the following questions:

1. What is the process by which the DWCF will finance a LON buy[272] (either in whole or in part)?
2. How much of the actual cost to make the LON buy or implement some other resolution will the DWCF finance?

DLA defines and distinguishes between diminishing manufacturing sources (DMS) and obsolescence in its own unique way. When an item can no longer be procured (i.e., it is non-procurable), it is declared by DLA as obsolete. An item is coded DMS by DLA when a PDN or equivalent has been received and there remains some opportunity to buy the item. A PDN ideally precedes DLA's definition of obsolescence, providing warning of part production termination, but not always.

The first section of this appendix primarily focuses on the single DLA office responsible for all LON buy processes across all DLA supply chains. It is located in the DLA Land and Maritime DMSMS Office (DMSMS Office). The next section gives a brief description of other processes for accomplishing a LON

[271] For more information, an organization should contact its manager for each of the programs.
[272] DLA normally uses the term Life-of-Type Buy.

buy or mitigating obsolescence in some other way. Mechanisms to revisit LON buy assumptions are addressed in the third section. Finally, the fourth section provides advice to the DMSMS management community on navigating all of these DLA processes.

M.3.3.1 PRIMARY DLA LON BUY PROCESSES

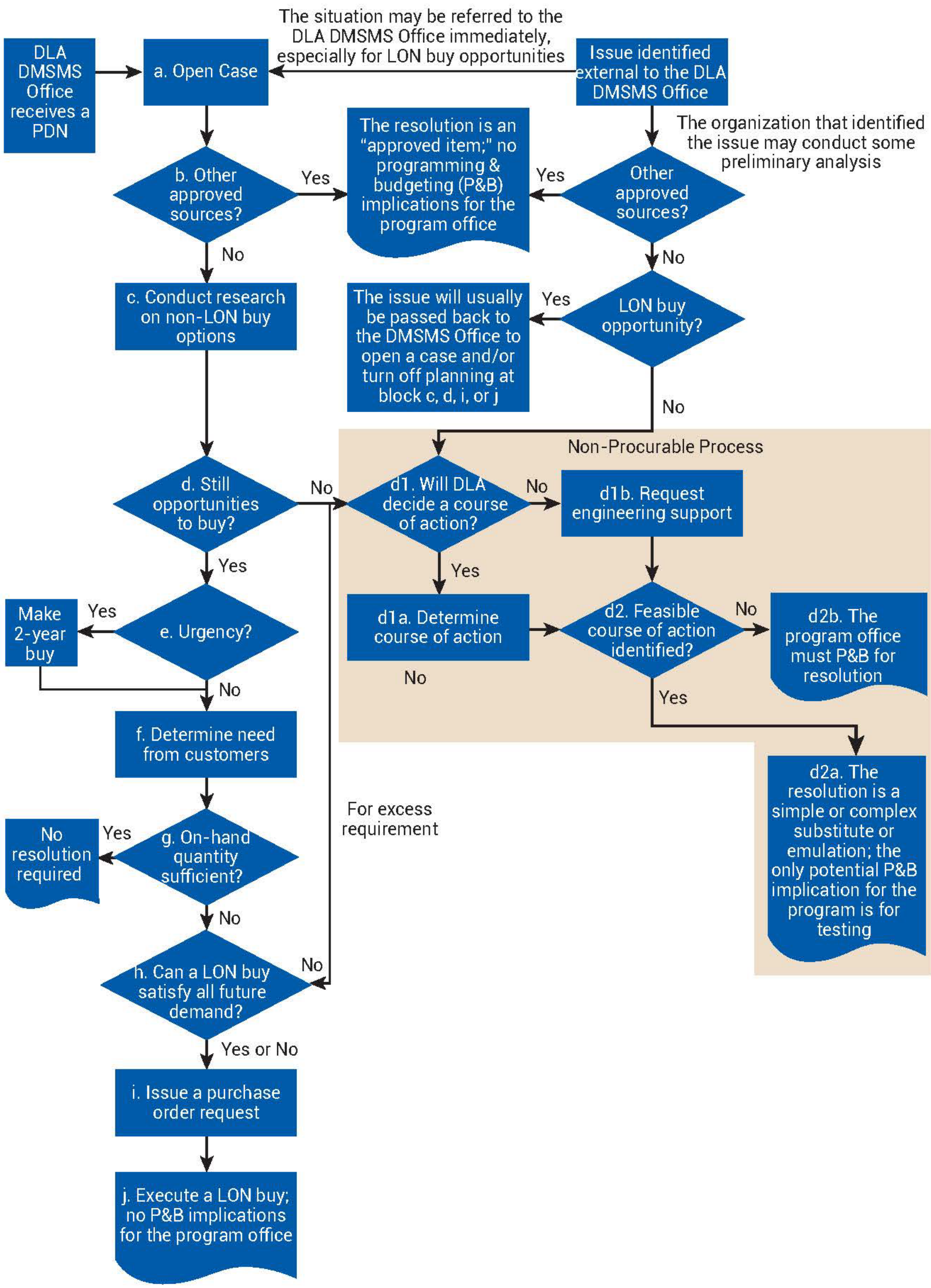
The DMSMS Office deals exclusively with DMS items and it is the most likely organization to pursue a LON buy. Figure 40 depicts the DMSMS Office's processes that can result in either a LON buy or the issuance/funding of a request for engineering support for non-procurable (obsolete) items. Both the technical engineering support process and the logistics requirements function of executing a LON buy are conducted, in part, external to the DMSMS Office. The letters shown in Figure 40 represent labels used to reference different parts of the figure.

From the perspective of a program office trying to program and budget to resolve DMSMS issues,[273] a specific DMSMS situation or case[274] may lead to five potential outcomes:

- The resolution is an existing "approved item," with no programming and budgeting implications on the affected program offices.
- The resolution is a "simple substitute," a "complex substitute," or "a new item or source" specifically through emulation. There may be no programming and budgeting implications on the affected program offices or there could conceivably be some testing cost implications.
- The resolution is an "LON buy," with no programming and budgeting implications on the affected program offices.
- No resolution is required.
- None of the above resolutions was feasible. An affected program office will need to develop and fund its own resolution.

[273] An operating unit's perspective is that it will have to buy parts to maintain its equipment. It is possible that the price paid for parts will change or the reliability of parts is increased and therefore fewer will need to be purchased. Programming and budgeting implications of this are out of scope for this document.
[274] DLA's definition of a case is different from the concept of a case within the context of a case management system as discussed in this document.

Figure 40. Primary DLA DMSMS-Related Processes



The following are brief descriptions of the principal blocks in the process depicted in Figure 40. The letters depicted below correspond to the letter labels in the principal Figure 40 boxes. It will be useful to refer back to Figure 40 to locate the box being discussed.

a. Open case.

This step happens very quickly. The DMSMS Office resolution process is usually initiated when it receives a PDN or equivalent thereof either from the GIDEP or directly from industry. The process may also be initiated upon notification along with evidence of the discontinuation (e.g., EOL notice from the manufacturer or an email from the manufacturer), from other sources. Possible sources include a program office,[275] another Service entity (e.g., a depot), or some other DLA organization (e.g., from a product specialist or material manager as a result of a no bid to an attempted order or direct notification from a Service). A DLA case (or cases) will be opened on item(s) that DLA manages (i.e., on a stock listed item with an NSN). A case may be opened at other points in the overall process as indicated in Appendix M.3.3.2.

b. Other approved sources?

After opening a case, the first consideration is whether there are any already identified approved sources. If there are, and those sources are willing to produce the item in question, the case is closed and DLA databases are updated accordingly. The resolution is an "approved item;" there are no DMSMS programming and budgeting implications on the affected program offices.

c. Conduct research on non-LON buy options.

This step may take a few days to complete if no approved options are found. The DMSMS Office codes all of the items associated with the PDN as DMS. No DLA entity other than the DMSMS Office can change the DMS code for an item. When the code is set, DLA planning is stopped, no automatic requests to purchase the item can be issued, and DLA's process for identifying excess inventory no longer considers that item. In addition, the technical side of the DMSMS Office researches each of the DLA-managed items in a PDN to identify potential replacement items, new sources, complex substitutes, and/or the possibility of emulation, but that research is not immediately acted upon. The technical side of the DMSMS Office forwards the information to the logistics side of the DMSMS Office to investigate the viability of a LON buy and to issue a request for engineering support as needed.

The next decision in the flowchart splits the process into two major branches, depending on whether or not there still are opportunities to buy an item after a PDN has been issued. While there normally are opportunities to buy an item after a PDN or equivalent has been received, DLA may not have received the notice in a timely manner and the period of time where the item could be purchased may have expired. When there are no opportunities to buy, DLA initiates its non-procurable item process where engineering support is sought from the appropriate Service engineering authority to determine another item or source. When there are opportunities to buy, DLA's LON buy process is continued. The following paragraphs describe both branches after the "still opportunities to buy" decision block. The non-procurable process is discussed first since the requests for engineering support could occur in the other branch.

d. Still opportunities to buy?

The first step in determining the viability of a LON buy is determining whether the original source is still willing to fulfill orders.

If there ARE NO opportunities to buy:

1) Will DLA decide a course of action?

The DMSMS Office usually is not involved in this branch of Figure 40. This branch is for DLA-defined obsolete or otherwise non-procurable items and would normally be led by the material planners or product specialists as discussed in Appendix M.3.3.2. The branch is however described in this section because the DMSMS Office often utilizes the same processes where there is a LON opportunity since the LON buy would not be DLA's resolution preference if another item or source can be approved for use instead of the DMS item.

DODI 4140.69[276] establishes the criteria whereby DLA must obtain approval from the appropriate engineering support activity (ESA) for the use of a replacement item or another supplier. The criteria are based on Federal Logistics Information System (FLIS) data elements for criticality and weapon system essentiality. DLA is the

[275] Program offices and other service organizations have the ability to initiate a case if they have access to DLA's shared data warehouse gateway. This is rare and probably not a best practice because direct contact with the DMSMS Office will begin more quickly if that office creates the case.

[276] DoDI 4140.69, "Engineering Support Instructions for Items Supplied by Defense Logistics Agency (DLA)," September 30, 2016.

decision-making authority if the criticality code is blank or it indicates the item does not have a nuclear hardened feature or any other critical feature such as tolerance, fit restriction, or application (a value of X) and the essentiality code indicates that the failure of the part will not render the end item inoperable. Otherwise the approval needs to come from the ESA. Even when DLA is the decision-making authority, it may still request ESA support to determine the appropriate action, typically a replacement item or source. This usually occurs when DLA believes that the item is used on weapon systems even though the FLIS record indicates otherwise.

a) If Yes, DLA Determines Action.

If DLA does not request engineering support, it determines the course of action to be taken using, in part, the information collected in the previous research step. This effort often involves both the DMSMS Office, the material manager, and the product specialist.

b) If No, DLA Requests Engineering Support.

If DLA is not the one to decide upon the course of action, it initiates a request for engineering support with the creation of DLA Form 339 incorporating the research results from c) above. After being reviewed within DLA, the form is sent to the appropriate Service ESA(s) by the designated DLA ESA focal point. Typically the 339 (and any subsequent revisions) may request approval of replacement item or a new source of supply, identification of a replacement item or new source, or use of a waiver/deviation associated with replacement item or source. The information discovered in the previous research step is included in the request.

The required Service response time may be as low as 15 days for situations urgently impacting readiness. Otherwise the response time requirement will vary between 30 to 90 days based on engineering support performance-based agreements (PBAs) between DLA and the Services.[277]

The DWCF pays for the non-recurring engineering efforts performed by the Service ESA on a fixed price basis as established in the PBA. What is paid may be different than the actual expenses incurred by the Service ESA. 339s may be revised in complex situations, but no additional funds are provided to cover any additional work related to such a revision. In some instances the funding provided for Service ESA non-recurring engineering efforts will completely pay for the implementation of the resolution, but in many cases it will not.

DLA generally does not increase the amount paid to the ESA to perform testing because it asserts that in the determination of the resolution, the Service ESA should have already been assured that the resolution is technically acceptable. The only testing that DLA funds (outside of the 339 process) is a first article test (FAT) or a production lot test (PLT). Such tests would be requested by the Service ESA and paid to the performing organization (i.e., a contractor or a government laboratory) if it is put in the purchase order that DLA issues. Since the purpose of these tests is to ensure that the contractor can and does furnish a product that conforms to all specifications, DLA should have a TDP that contains those specifications so that it can judge the test results.[278] When there is no TDP, DLA occasionally may ask for a FAT or a PLT, but in such cases, the contractor can simply assert that the test was successful with providing DLA the technical data needed to verify the result.

2) Feasible course of action identified?

a) If yes, Resolution is simple or complex substitute or emulation.

The only potential programming and budgeting implication for the program office is testing. DLA databases are updated accordingly.

b) If no, Program office must program and budget for resolution.

If no replacement item or source has been determined by the ESA or by DLA, then the users must determine and fund the resolution.

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[277] In some instances, iterations between DLA and the ESA extend the time for this process to six months.

[278] This implies that the acquisition management suffix code is "G'" indicating that the government has unlimited rights to the technical data and the data package is complete. Valid acquisition method codes are "1" which implies suitable for competitive acquisition, or "2" which is suitable for competitive acquisition for the first time.

If there ARE opportunities to buy:

e. Urgency?

If a LON buy is feasible, the logistics side of the DMSMS Office next makes a determination of urgency. For high-demand items where the demand is forecastable (as indicated by an AAC of D[279]), the DMSMS Office usually recommends that a buy (not officially designated as a LON buy) be initiated for typically a two-year quantity based on historical demand as experienced by DLA. Such a purchase is unusual because high-demand items do not typically become obsolete.

f. Determine need from customers.

Regardless of whether an urgent buy occurred, the DMSMS Office sends out an "alert" about the DMS situation to customer focal points associated with the weapon systems linked to the item in question. The alert indicates that a PDN has been received and requests that information on the life-time demand for the item be provided back to the DMSMS Office within 30 days or less if the EOL date is less than 30 days away. The DMSMS Office requests monthly demand estimates for as long as the end item is expected to be in service.

When the logistics side of the DMSMS Office has received demand requirements from the customer focal points representing the weapons systems associated with the item, it will compare, in consultation with the DLA material planner and demand planner for that item, those demand requirements to historical demand. It will also perform its own research on how long the end item is expected to remain in service. If the demand requirements from the customer focal points are not consistent[280] with DLA's historical demand or represent a high cost, the logistics side of the DMSMS Office will request further explanation, justification, and tangible evidence (e.g., purchase records) for the quantity of the item required from the customer focal points. Future production needs are not an acceptable justification because DLA provides items for sustainment only. If the demand cannot be justified to DLA's satisfaction, DLA will use its own calculations made jointly by the DMSMS Office, the material planner, the demand planner, and the product specialist. In general, DLA forecasts approximately 60% of the items it manages. About 68% of those forecasts are close to actual demand on average. However, DLA internal data indicates their demand history is usually closer to actual demand than what the Services state their future requirement estimates will be. Statistically, collaborative input on future requirements provides a better forecast about 25% of the time.

If there are no current customer requirements,[281] no backorders, and no current demands, the logistics side of the DMSMS Office is likely to recommend no further action regarding the item at that time.

If there is any controversy, the decision on the LON buy quantity is made by a senior DLA decision maker.

g. On-hand quantity sufficient?

This decision is a simple test of whether there is sufficient on-hand inventory to meet all future requirements for the item. If that is the case, no resolution or further action is required. If the answer is no, the LON buy is executed.

h. Can a LON buy satisfy all future demand?

An LON buy is executed to satisfy the requirement. There are however situations where the combination of on-hand stock and the maximum amount feasible to purchase will not satisfy all future needs. When that occurs, the maximum LON buy is executed and the remainder of the requirement is satisfied by the non-procurable process discussed above.

i. Issue a purchase request.

This step normally takes one–three days. The logistics side of the DMSMS Office recommends a certain quantity LON buy of the item to the appropriate DLA material planner responsible for the item. Sometimes, the DMSMS

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279 AAC D is defined as follows. Issue, transfer, or shipment is not subject to specialized controls other than those imposed by the Integrated Materiel Manager/Service supply policy. 1) The item is centrally managed, stocked, and issued. 2) Requisitions must contain the fund citation required to acquire the item. Requisitions will be submitted in accordance with Integrated Materiel Manager/Service requisitioning procedures.

280 Reasons for inconsistency include situations where customers buy the item commercially (bypassing DLA), cannibalization, and the items being bought commercially by a commercial support provider even though the Services are required to submit a Demand History Accounting when a materiel requirement for a DLA-managed part is satisfied outside the normal supply process.

281 DLA will also try to locate customers by examining previous orders if there was no response to the alert.

Office may relinquish control of the process and have the material planner execute this step.[282] Recommendations are prioritized on the basis of the EOL date. The material planners or their supervisors (for higher dollar level buys) are the ones who approve a LON buy. When approved, the material manager issues a purchase request and sends it to the DLA buyer.[283] Since the determination of how many to buy is usually done jointly, the quantity requirement for the purchase normally does not deviate from what was originally determined. In some instances, when the material planner has not been involved, there may be a purchase quantity adjustment if the material planner has some additional specific knowledge about the item. In other instances, the Services have interacted directly with the material planner to change the size of the buy if there is a disagreement about the quantity.[284]

There are legal restrictions to the amount purchased as discussed in Section 7.2. Although 31 U.S.C. §1502 does not apply, 10 U.S.C. §2213 explicitly restricts the quantity of an item that can be purchased by a stock fund to two years of supply. In the case of a DMSMS item, there are national security reasons for allowing an exception—there is a validated future demand and the item will not be available for purchase in the future. The head of DLA's Contracting Agency can make such a determination and is asked to do so when the quantity exceeds two years of supply.

j. Execute the LON buy.

This step can take anywhere from 30–90 days or longer depending on the circumstances for the item being purchased. The DLA buyer orders the LON buy quantity from the OEM and pays for the purchased items using funds from the DLA DWCF. The LON buy quantity is then available through the DLA supply systems. The logistics side of the DMSMS Office will continue to leave the case open for that item until the LON buy stock for that item is delivered. There are no programming and budgeting implication for the program office as long as the quantity purchased by DLA is sufficient to meet the demand requirements of the program office and all other known DLA customers for that item.

M.3.3.2 OTHER PROCESSES

When another organization in DLA (normally the material manager and/or the product specialist) discovers a DMS or obsolescence situation first, a number of things could happen:

- For a DMSMS situation, the information could be passed immediately to the DMSMS Office and the process occurs exactly as depicted in Figure 40. In some instances, some of the beginning steps of the Figure 40 process could be conducted outside of the DMSMS Office and then it is turned over to the DMSMS Office and the remainder of the Figure 40 process proceeds. The point at which the turnover occurs varies.
- Sometimes for a DMSMS situation, the entire Figure 40 process is conducted outside of the DMSMS Office. Normally, when this happens, there is something time sensitive about the situation, e.g., a very short time until the item can no longer be purchased. Ultimately, the DMSMS Office should be informed to update the data elements in FLIS to turn off planning and exempt the item from being considered in excess inventory reporting. No case is opened.
- Regardless of whether the DMSMS Office is or is not involved, the branch of Figure 40 associated with no opportunity to buy an item (Appendixes M.3.3.1.d1 and M.3.3.1.d2) would always be followed. In the aviation supply chain, a 339 is sometimes not issued because of the length of time it may take to obtain a final response. A pilot program has been established to form a "sourcing team" of very experienced people to conduct in-depth market research and to negotiate with the source of the item and the ESA to determine a resolution.
- For an item that is truly obsolete (non-procurable and a PDN was not received), the DMSMS Office is usually not involved and no case is opened.

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[282] DLA material planners reside within the DLA supply chains; therefore, if an item is unique to a particular supply chain, the recommendation for a LON buy from the logistics side of the DMSMS Office will go to the appropriate DLA material planners in that supply chain. For example, if the item in question is aviation-unique, the recommendation for a LON buy will go to a material manager in the Aviation supply chain. Of note, the Land and Maritime supply chains are the only supply chains that have material managers with special DMSMS expertise. Those material planners manage a certain set of items associated with a particular federal supply class, as well as work with demand planners.

[283] The buyer is responsible for acquisition, the product specialist is responsible for the technical quality of the items delivered.

[284] The usually occurs outside of the Land and Maritime supply chain.

M.3.3.3 REVISITING THE LON DECISION

No one at DLA routinely monitors the stock level of items for which a LON buy was executed, i.e. to determine, over time, whether the demand assumptions used to size the LON buy were too low. If DLA's inventory becomes exhausted and there is no longer an ability to purchase the item, then the process in Figure 40 for no opportunities to buy (Appendixes M.3.3.1.d1 and M.3.3.1.d2) is again followed.

There are rare instances where additional demand becomes known and it is possible to expand the size of the original LON buy if the purchased quantity has not been fully delivered. For example, sometimes a back order will occur for a DMS item. When this happens, the material planner should contact the logistics side of the DMSMS Office. If the timeframe for making LON buy purchases of the item in question is still open, then the LON process would continue. If the timeframe for making LON buy purchases of the item has actually ended,[285] then this should trigger the no opportunity to buy process.

M.3.3.4 DMSMS MANAGEMENT TAKE-AWAYS

Several key take-aways emerge for the DMSMS management community:

- Program offices, whether proactive or reactive, identify DMSMS issues on a continuing basis; some of these issues impact DLA-managed items. When it appears that a LON buy is a cost-effective resolution, program offices should contact both the DLA DMSMS Office and the cognizant material planner to expedite the LON buy process.
- The DMSMS Office relies, in part, on the user community, to determine LON buy demand quantities. It generally reaches out to specific Service identified points of contact to obtain that information. The Services should ensure that their internal communication processes rapidly provide well-prepared demand inputs from all concerned users.
- Service consumption of DLA-managed items may differ from DLA sales because some items are purchased commercially. The Services should be in a position to provide sufficient, compelling justification for the demand requirements for the item in question, as well as what the impacts would be if the LON buy purchase were not approved and executed. Services therefore should ensure that thorough records are kept to be able to persuasively justify future support requirements.
- DLA will not include future production requirements in determining a LON buy quantity. Program offices should program and budget for LON buys associated with production.
- DLA might not agree with Service LON buy requirements. Affected program offices, in an integrated manner at least at the Service level, should monitor the LON buy process to understand how many DLA was willing to purchase as compared to the total requirements for all customers of that item. Senior Service representatives may be able to reverse the situation by communicating directly with DLA senior managers.
- With the exception of a FAT or a PLT, the DWCF will not fund any testing when a replacement item or a new source is the resolution to be implemented beyond the amount of money on a 339 request. Program offices should program and budget for any additional testing necessary.
- Even when the LON buy quantity matches that indicated by the sum of all associated weapon systems' demand requirements for that item, the stock of that item in the supply system is available on a first-come, first-served basis. Any registered user can purchase the item.[286] For this reason, and because the assumptions used to determine the LON buy quantity may be incorrect, a program office that has demand for the item, should monitor the stock levels closely.

[285] DLA checks whether additional procurement is feasible after the EOL date has expired.

[286] One exception exists and that pertains to FMS programs that are users of the item for which a LON buy was implemented. FMS programs can identify their demand requirements for the item at the time that the case is being worked and then the FMS programs fund and take possession of their portion of the LON buy quantity purchased at the time that they are delivered.

M.4 OTHER RESOURCES THAT MAY BE AVAILABLE TO FINANCE DMSMS RESOLUTIONS

With the exception of the first initiative shown below, this appendix lists several external funding sources at the DoD and the service levels.[287] These funding sources represent other potential resource options for DMSMS resolutions.[288] Most of these funding sources have a periodic project solicitation, but some do not. Projects may or may not be accepted off cycle. In some cases, the solicitation is directed at government program offices; in other cases, the solicitation is directed at industry. The focus areas for the project solicitations are defined by the funding initiatives themselves, on the basis of their understanding of DoD needs. Although a program office with DMSMS issues can communicate its needs to the funding initiatives, the proposed DMSMS resolution must be aligned with the mission, requirements, restrictions, and goals of the funding initiatives in order to obtain funding. Key initiatives follow.

M.4.1 DoD's VE Program

There are no separate resources associated with DoD's VE Program. VE provides a systematic approach to analyze the functions of systems, equipment, facilities, services, and supplies to ensure they achieve essential functions at the lowest life-cycle cost, consistent with required performance, reliability, quality, and safety.[289] Typically, the implementation of the VE process increases performance, reliability, quality, safety, durability, effectiveness, or other desirable characteristics. VE has been used to mitigate DMSMS issues from two perspectives: funding and methodological.[290]

From a funding perspective, a value engineering incentive (VEI) clause is included in most supply/service contracts when the contract price exceeds $150,000. A value engineering change proposal (VECP) is a proposal submitted to the government by the contractor in accordance with the VEI clause. A VECP proposes a change to the contract that, if accepted and implemented, provides an eventual, overall cost savings to the government with a substantial share of that savings contributing to the contractor's profit. It provides a vehicle to reduce acquisition and operating costs, while increasing the contractor's rate of return. Typically, the contractor pays the non-recurring costs associated with the VECP and is reimbursed from the savings. To ensure that savings can be shared, the VECP must meet two primary requirements:

- It must require a change to the current contract under which it is submitted.
- It must provide an overall cost savings to the government after being accepted and implemented. (A VECP could result in increased unit cost but reduced O&S cost. Thus, there would be an overall savings to DoD.)

The key takeaway associated with the funding perspective is that the contractor has a profit-based incentive to resolve obsolescence issues earlier. Without this incentive, proactive issue identification may not occur and, consequently, resolutions may be more expensive. These concepts could be applied to a LON buy if the contractor would use its own resources to buy items and then sell them back to the

[287] Air Force, Army, and Navy WCF initiatives are discussed in Appendix M.3.
[288] DMSMS management practitioners should also be aware of congressionally established programs that are not included in the DoD Presidential budget, for example, the Industrial Base Innovation Fund, the Rapid Innovation Fund, and the Defense Rapid Innovation Program. Such congressional programs are not discussed in this document.
[289] Office of Management and Budget, Circular A-131, Value Engineering, January 2013, available at https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/circulars/A131/a131-122013.pdf.
[290] See SD-24, *Value Engineering: A Guidebook of Best Practices and Tools*, June 2011 (available by entering SD-24 in the "Document ID" via the ASSIST Quick Search webpage at https://quicksearch.dla.mil/qsSearch.aspx), Chapter 8.

government when needed. This could be especially valuable if the government were not able to obtain the necessary resources in a timely manner.[291]

From a methodological perspective, the VE process can augment the *Analyze* step in DMSMS risk management, as illustrated in the following example:

> *Obsolescence issues emerged for the Theater High Altitude Air Defense missile. The issues involved multiple subcontractors and various components. The major and minor redesign efforts recommended to address the obsolescence problems would have resulted in high costs and negative schedule impacts for the program office. The DMT used VE to evaluate each redesign proposal and determine if other mitigation efforts could be employed to overcome the obsolescence issues. A VECP was implemented to mitigate the obsolescence and minimize redesign cost without adverse schedule impacts. The total three-year cost avoidance by being proactive was calculated to be $21.2 million.*

M.4.2 DoD and Service ManTech Program

The ManTech program is codified in Title 10 §2521 of the U.S.C. as a requirement for each Military Service and Component.[292] This is DoD's primary program for investing in next-generation manufacturing processes, materials, or technologies, but it also has the mission for the "development and application of advanced manufacturing technologies and processes that will reduce the acquisition and supportability costs of defense weapon systems and reduce manufacturing and repair cycle times across the life cycles of such systems."[293]

Thus, DMSMS resolutions that require producibility improvements or a new manufacturing capability can seek funding through the ManTech program, particularly if repair cycle time and support costs can be reduced. The DoD ManTech program is a joint service R&D program with appropriations in OSD, Army, Navy, Air Force, and DLA. Each Military Department or agency programs its investments separately, but plans jointly through the Joint Defense Manufacturing Technology Panel. Annual solicitations from OSD and each Military Department or agency are released, and all proposals must contain clear transition paths and have Military Department support from the transition target PM.

M.4.3 Defense Production Act Title III Program

This program's mission is "designed to create, maintain, protect, expand, or restore domestic industrial base capabilities."[294] Production capabilities that would otherwise be inadequate are transformed to support the material requirements of defense programs in a timely and affordable manner. Title III focuses on materials and items that could be used across a broad spectrum of defense systems. The capabilities of defense systems depend upon the availability of materials and technologies.

The program can respond to material shortages using unique authorities that apply to three focus areas:

- "Sustain[ing] Critical Production,"

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[291] When a PDN is anticipated but has not been released, it may be possible to adapt this approach to critical items that are expensive to redesign and test. Specific arrangements to do this would have to be negotiated in advance with the program office, the contracting officer, and industry.
[292] For more information, see Defense Innovation Marketplace, "DoD Manufacturing Technology (ManTech) Program," accessed April 7, 2020, https://defenseinnovationmarketplace.dtic.mil/business-opportunities/mantech-program/.
[293] Ibid.
[294] For more information, see DoD Office of Industrial Policy, "Defense Production Act (DPA) Title III," accessed April 7, 2020, https://www.businessdefense.gov/Programs/DPA-Title-III/.

- "Commercializing R&D Investments," and
- "Scal[ing] Emerging Technologies."[295]

Title III authorities incentivize the creation, expansion, or preservation of domestic manufacturing capabilities for technologies, items, and materials needed to meet national security requirements.[296] The goal is not the production of materials or items themselves, but the creation or expansion of the industrial capacity to produce these items and materials. Title III mechanisms can include the following:

- Grants,
- Purchases and purchase commitments (not commonly used),
- Installation of production equipment,
- Development of substitutes (most commonly used via R&D contracts), or
- Loans and loan guarantees (not used since 1992 by memorandum of understanding with the DoD General Counsel).

M.4.4 Industrial Base Analysis and Sustainment (IBAS) Projects

The IBAS program is part of DoD's efforts to fortify the industrial base, particularly with regard to DoD's supply chain. To that end, the focus of the program is to "enable investments to close gaps in defense manufacturing capabilities and create and sustain reliable sources that are critical to the Department's focus on readiness and lethality."[297] IBAS projects are intended to support "last resort" efforts when it would prove costly, difficult, or perhaps even impossible to restore the capability, skill, or manufacturing process to produce a required defense system or item within a defense system. Industrial base risk is used to evaluate projects "using a framework of risk assessment methodologies and tools, such as fragility and criticality risk criteria."[298,299]

M.4.5 Foreign Comparative Testing (FCT) Program

The FCT program's mission is to test high-TRL items and technologies from foreign allies to determine whether the items could satisfy U.S. military requirements or address mission-area shortcomings and could do so more quickly and economically than would otherwise be possible.[300] The program has resulted in "substantial savings by avoiding R&D costs, lowering procurement costs, reducing risk for major acquisition programs, and accelerating the fielding of equipment critical to the readiness and safety of U.S. operating forces."[301] Sponsoring organizations within the Department identify foreign items for

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[295] Ibid.
[296] Ibid.
[297] DoD Office of Industrial Policy, "IBAS Overview," accessed April 6, 2020, https://www.businessdefense.gov/IBAS/Overview/.
[298] DoD Office of Industrial Policy, "IBAS Opportunities," accessed April 6, 2020, https://www.businessdefense.gov/IBAS/Opportunities/.
[299] The fragility and criticality criteria are used to prioritize the capabilities and sectors of the industrial base on which to focus its efforts. The criticality portion of the assessment considers factors such as 1) the degree to which there is a commercial market for the capability; 2) the extent to which any specialized skills, equipment, or facilities are required or related to the capability; 3) the existence or necessity of defense-specific requirements; 4) the existence of facility and equipment requirements; 5) the impact given the time it would take to restore the capability once lost; and 6) consideration of any alternatives. The fragility portion of the assessment looks at 1) the financial stability of the current source for the capability, 2) DoD business versus business from other customers for the current source for the capability, 3) other sources that exist within the market sector, and 4) the existence of a dependency on a foreign source for the capability. DoD Industrial Policy, "Assessments," https://www.businessdefense.gov/Industrial-Assessments/Assessments/, accessed April 6, 2020.
[300] FCT Program," OSD CTO Foreign Comparative Testing, https://ac.cto.mil/pe/fct/, accessed April 6, 2020.
[301] Ibid.

inclusion in the program.[302] Through this program, “the OSD Comparative Technology Office funds testing and evaluation; the Services fund all procurements that result from a successful test.”[303] DMSMS resolutions that have foreign involvement can use this program to qualify technology or items for procurement.

M.4.6 DLA’s Reverse Engineering Program

DLA’s reverse engineering program is designed to lower the price that DLA pays for an item and to reduce the cost that DLA customers incur. According to a DLA Land and Maritime website,[304] “Reverse Engineering is a process used to gather required data to adequately determine how an item is manufactured. This process involves a variety of engineering disciplines to evaluate structural, dimensional, and functional properties of a component or technology. This allows DLA to better understand a system's form, fit, and function. DLA parts are examined and analyzed to determine how they are manufactured for the development of a complete TDP[305] to make the item more competitive and provide better value to the warfighter.”[306]

Reverse engineering projects are usually identified by the DLA program office based on an analyses of sources and sales; program offices are generally not involved. Projects are typically associated with sole source or hard to obtain items where competition is more likely to lead to a reduction in the purchase price of such items. The reverse engineering itself is often performed by in-house DLA engineers.

There are however instances where one of the DLA reverse engineering office establishes an agreement with an ESA to perform reverse engineering. When that occurs, there can be an opportunity for the ESA to suggest reverse engineering candidates based on obsolescence. As a result, there have been DWCF reverse engineering projects approved to mitigate an obsolescence issue.

While there have been situations where reverse engineering projects have been undertaken for obsolete items, DLA’s reverse engineering program is not designed to provide wide ranging support to the DMSMS management community, especially not directly to program offices. In special circumstances, it can provide limited obsolescence mitigation support to ESAs.

M.4.7 DLA’s Sustaining Engineering Program

A sustaining engineering program will generally result in a design refreshment or redevelopment of the item. Sustaining engineering proposals are evaluated when received. Explanatory material for the program states that projects should generate an ROI of 10:1 to DLA (at a minimum) and are expected to deliver other positive impacts. Although this ROI is calculated as a ratio, the definition of the term ROI is different from the typical economic one. The denominator is the DWCF investment only.[307] The numerator

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302 Ibid.
303 Ibid.
304 DLA, Land and Maritime, accessed April 7, 2020, http://www.dla.mil/LandandMaritime/Offers/Services /TechnicalSupport/ValueMgtDiv.aspx.
305 The TDP created by reverse engineering may evolve over time to enable companies to compete.
306 DLA, Land and Maritime, accessed April 7, 2020, http://www.dla.mil/LandandMaritime/Offers/Services /TechnicalSupport/ValueMgtDiv.aspx.
307 The sustaining engineering program may be willing to split the funding needed for the project with the Service whose weapons system program proposed the project to achieve the 10:1 ratio on DLA DWCF investments.

includes life-cycle reduction in DWCF outlays[308] (which is not DWCF life-cycle savings). The numerator may include other life-cycle savings for the weapon system at the discretion of the sustaining engineering program. Considerations for savings for the numerator of the ratio for an obsolescence resolution project include:

- Reductions to DWCF outlays for the new item because of smaller demand, lower unit price, improved reliability, or maintainability. Projects are not limited to F3 replacements and may provide more than incidental improved performance as a result of new technology.
- The amount that DWCF would pay for the existing or obsolete item may increase as availability decreases.
- Cost that DLA would incur associated with extra testing that may be required to ensure that the supply for the existing or obsolete item is not counterfeit.
- Additional cost as a result of cannibalization to obtain the existing or obsolete item becoming more frequent.
- Cost associated with sidelining an expensive, depreciating end item (i.e., a weapon system or platform) due to its material condition (i.e., critical item unavailable due to obsolescence).

Beyond ROI, the sustaining engineering office also evaluates project proposals in terms of other positive impacts such as improving operational readiness, reducing lead time (e.g., administrative and/or production lead time), decreasing the number of field and depot maintenance actions necessary, and improving the competitive position of the government with regard to the item by ensuring availability of the technical data with the appropriate rights to be able to add sources of supply, if desired.

The sustaining engineering program office works with the weapon system program office that submits a proposal for consideration. If necessary, it will help the weapon system program office improve and revise a proposal to improve the likelihood of its approval. For those project proposals that are deemed “good candidates,” the sustaining engineering program office will develop a sustaining engineering project approval document. A sustaining engineering board will be scheduled and held to decide whether the proposed project is worthy of funding within the sustaining engineering program. If this is the case, then the sustaining engineering program office will develop a service agreement between DLA and the weapon system program office regarding the project. With the service agreement in place, the sustaining engineering program office will also ensure that there are DWCF funds available to support the proposed project and execute the steps necessary to transfer the funds to the weapon systems program office.

After the weapon systems program office has received the funds, it is responsible for implementing the project. The weapon systems program office submits progress reports throughout the course of the project to process any of its invoices against the funds provided.

While it has never been used to resolve an obsolescence problem, the descriptive literature for the program indicates that such an application is feasible. The nature of obsolescence issues are such that a sustaining engineering project is unlikely to be approved; nevertheless program offices should not dismiss this potential resolution path. There is no downside for exploring possibilities.

[308] Outlay reduction is measured by a decrease in the price that the DWCF pays for the item and/or a reduction in demand as compared to what would have been the case had the item not been replaced (typically as a result of improved reliability of the replacement item over the original item).

M.4.8 Aviation Component Improvement Program (AvCIP)

AvCIP applies to the Navy and Air Force. Within the NAVAIR, AvCIP deals with common and unique avionics on in-production and fielded systems. It can fund non-recurring engineering activities such as redesign or modification, prototype development, T&E, integration, and technical documentation in partnership with the Naval Supply Systems Command for repairable items and with DLA for consumable items. To qualify for funding, a project must address a critical near-term issue concerning reliability, maintainability, or DMSMS; must result in cost avoidance by being proactive; and must achieve significant gains in warfighting capability or readiness.[309] (No evidence exists to indicate that AvCIP will be used by the Air Force for a DMSMS issue.)

[309] For more information, contact the NAVAIR AvCIP program manager.

Appendix N. Abbreviations

AAC	Acquisition Advice Code
AD-DSL	Aerospace Defense Declarable Substance List
AEC	Allowance Equipage Code
AFI	Air Force Instruction
AFMC	Air Force Materiel Command
AFMCI	Air Force Materiel Command Instruction
AFWCF	Air Force Working Capital Fund
AMC	U.S. Army Materiel Command
AMCOM	Aviation and Missiles Command
AME	Advanced Microcircuit Emulation
AMSC	Acquisition Method Suffix Code
AoA	analysis of alternatives
APL	Allowance Parts List
ARCI	Accountable/Responsible/Consulted/Informed
AS	acquisition strategy
ASD(S)	Assistant Secretary of Defense for Sustainment
ASIC	application-specific integrated circuit
ASR	Alternative Systems Review
ASSIST	Acquisition Streamlining and Standardization Information System
AvCIP	Aviation Component Improvement Program
AWCF	Army Working Capital Fund
BCA	business case analysis
BOA	Back Orders Avoided
BOM	bill of materials
BY	Budget Year
C.F.R.	Code of Federal Regulations
CAGE	Commercial and Government Entity
CCA	circuit card assembly
CCB	configuration control board
CDR	Critical Design Review
CDRL	Contract Data Requirements List
CECOM	Communications and Electronics Command
CER	cost estimating relationship

CLIN	contract line item number
CLS	contractor logistics support
CM	configuration management
CMRMP	Chemical and Material Risk Management Program
COG	Cognizance (code)
COTS	commercial off-the-shelf
CSAG-S	Consolidated Sustainment Activity Group–Supply
DAG	Defense Acquisition Guidebook
DASD(IP)	Deputy Assistant Secretary of Defense for Industrial Policy
DAU	Defense Acquisition University
DAWIA	Defense Acquisition Workforce Improvement Act
DBS	Defense Business Systems
DFARS	Defense Federal Acquisition Regulation Supplement
DHA	Defense Health Agency
DI	developmental item
DID	data item description
DKSP	DMSMS Knowledge Sharing Portal
DLA	Defense Logistics Agency
DLR	depot level reparable
DMAIC	define, measure, analyze, improve, control
DMP	DMSMS management plan
DMS	diminishing manufacturing sources
DMSMS	Diminishing Manufacturing Sources and Material Shortages
DMT	DMSMS management team
DoD	Department of Defense
DoDI	Department of Defense Instruction
DoDM	Department of Defense Manual
DPA	Defense Production Act
DSIA	days of supply impact avoided
DWCF	Defense Working Capital Fund
ECP	engineering change proposal
EEE	electrical, electronic, and electromechanical
EMD	Engineering & Manufacturing Development
EOL	end of life
ESA	engineering support activity
ESD	electrostatic discharge
F3	form/fit/function

FAR	Federal Acquisition Regulation
FAT	first article test
FCT	Foreign Comparative Testing
FIIN	Find Item or Index Number
FLIS	Federal Logistics Information System
FMS	foreign military sales
FOC	Full Operational Capability
FY	fiscal year
GEM	Generalized Emulation of Microcircuits
GIDEP	Government Industry Data Exchange Program
GOTS	government off-the-shelf
GSD	General Support Division
HMTL	Hazardous Material Target List
HQ	Headquarters
IAEG	International Aerospace Environmental Group
IAW	in accordance with
IBAS	Industrial Base Analysis and Sustainment
ICA	Industrial Capability Assessment
IIRP	Improved Item Replacement Program
ILA	independent logistics assessment
IMP	integrated master plan
IMS	integrated master schedule
IOC	Initial Operational Capability
IP	intellectual property
IPS	Integrated Product Support
IPT	integrated product team
LCC	life-cycle cost
LCSP	Life-Cycle Sustainment Plan
LON	life-of-need
LRIP	low rate initial production
LRU	line replaceable unit
LSS	Lean Six Sigma
M&P	Manpower & Personnel
ManTech	Manufacturing Technology
MaSME	materials and structural, mechanical, and electrical
MCA	Major Capability Acquisition
MDA	Missile Defense Agency

MDD	Materiel Development Decision
MICAP	mission capable
MilSpec	military specification
MIL-STD	Military Standard
MOCA	Mitigation of Obsolescence Cost Analysis
MTA	Middle Tier of Acquisition
NAS	National Aerospace Standard
NASA	National Aeronautics and Space Administration
NAVAIR	Naval Air Systems Command
NDAA	National Defense Authorization Act
NDI	non-developmental item
NHA	next higher assembly
NMCS	non-mission capable supply
NPV	net present value
NSN	national stock number
O&M	operations and maintenance
O&S	operating and support
OASD(L&MR)	Office of the Assistant Secretary of Defense for Logistics and Materiel Readiness
OCM	original component manufacturer
ODASD(SE)	Office of the Deputy Assistant Secretary of Defense for Systems Engineering
OEM	original equipment manufacturer
OSCR	Operating and Support Cost Reduction
OSD	Office of the Secretary of Defense
OT&E	operational test and evaluation
P&B	programming & budgeting
Pb	lead
PBA	performance-based agreement
PBL	performance-based logistics
PDC	priority designator code
PDN	product discontinuance notice
PDR	Preliminary Design Review
PEO	Program Executive Officer
PESHE	programmatic environment, safety, and occupation health evaluation
PLT	production lot test
PM	program office manager
PMR	Provisioning Master Record
POM	Program Objective Memorandum

PPA	physical product audit
PRR	Production Readiness Review
PSM	product support manager
PSS	product support strategy
QML	Qualified Manufacturers List
QMS	Quality Management System
QPL	Qualified Products List
R&D	research and development
RDD	required delivery date
RDT&E	research, design, test, and evaluation
REACH	Registration, Evaluation, Authorisation, and Restriction of Chemicals
RFP	request for proposal
RIC	Repairable Identification Code
RIP	Reliability Improvement Program
RNVC	Reference Number Variation Code
RoHS	Restriction of Hazardous Substances
ROI	return on investment
RRAC	Regulatory Risk Analysis and Communication
SCM	strategic and critical materials
SCRM	supply chain risk management
SD	Standardization-related Document
SDD	System Development and Demonstration
SEP	Systems Engineering Plan
SETR	systems engineering technical review
SFR	System Functional Review
SME	subject matter expert
SOW	statement of work
SPC	Special Procedures Code
SRA	shop replaceable assembly
SRR	Systems Requirements Review
SRU	shop replaceable unit
SWA	Software Acquisition
T&E	test and evaluation
TACOM	Tank and Automotive Command
TBD	to be determined
TDP	technical data package
THAAD	Terminal High Altitude Area Defense
TRL	Technology Readiness Level

U.S.C.	United States Code
UCA	Urgent Capability Acquisition
UDR	Urgent Data Request
USD(A&S)	Under Secretary of Defense for Acquisition and Sustainment
USD(R&E)	Under Secretary of Defense for Research and Engineering
VE	value engineering
VECP	value engineering change proposal
VEI	value engineering incentive
VHDL	VHSIC Hardware Description Language
VHSIC	Very High-Speed Integrated Circuit
VSM	value stream map
WCF	working capital fund
WRA	weapon replaceable assembly

Appendix O. References

10 U.S.C. § 1701–1765 (Subchapters I–V).

10 U.S.C. § 2213, Limitation on Acquisition of Excess Supplies.

10 U.S.C. § 2320, Rights in Technical Data.

10 U.S.C. § 2533b, "Requirement to Buy Strategic Materials Critical to National Security from American Sources; Exceptions."

28 U.S.C. § 1498, Patent and Copyright Cases.

31 U.S.C. § 1502, Balances Available.

50 U.S.C. § 98, Strategic and Critical Materials Stockpiling Act.

48 C.F.R. § 252.227-7013, Rights in Technical Data—Noncommercial Items.

48 C.F.R. § 252.227-7017, Identification and Assertion of Use, Release, or Disclosure Restrictions.

48 C.F.R. § 252.227-7027, Deferred Ordering of Technical Data or Computer Software.

48 C.F.R. § 252.227-7037, Validation of Restrictive Markings on Technical Data.

48 C.F.R. § 227.7108, Contractor Data Repositories.

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