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Diminishing Manufacturing Sources and Material Shortages

A Guidebook of Best Practices and Tools for Implementing a DMSMS Management Program

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Foreword

This guidebook on Diminishing Manufacturing Sources and Material Shortages (DMSMS) is a compilation of the best practices from across the Department of Defense for managing the risk of obsolescence for electronic, electrical, and mechanical parts. In addition, it identifies various tools that may be useful for analyzing and tracking the effectiveness of DMSMS programs.

We recommend that the program manager use this guidebook as a desktop reference to quickly pinpoint key actions required to manage DMSMS issues and address concerns. Additional information can be found at the DMSMS Knowledge Sharing Portal (www.dmsms.org).

If you have any questions or comments about this document, please contact the Defense Standardization Program Office at 8725 John J. Kingman Road, Stop 5100, Fort Belvoir, VA 22060-6220, or e-mail DSPO@dla.mil.

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Introduction

Diminishing Manufacturing Sources and Material Shortages (DMSMS), the loss of sources of items or material, surfaces when a source announces the actual or impending discontinuation of a product, or when procurements fail because of product unavailability. DMSMS may endanger the life-cycle support and viability of the weapon system or equipment.

Compared with the commercial electronics sector, the Department of Defense (DoD) is a minor consumer of electrical and electronic devices. While the electronic device industry abandons low-demand, older technology products, DoD seeks to prolong the life of weapon systems. These conflicting trends cause DMSMS problems as repair parts or materials disappear before the end of the weapon system life cycle. While electronics are most likely to be discontinued, obsolescence of nonelectronic and commercial off-the-shelf (COTS) items also poses a significant problem to weapon systems. In short, DMSMS is a threat to system supportability.

Solving DMSMS is complex, data intensive, and expensive. You, the program manager (PM), have only two approaches to solving DMSMS in a system: reactive (you address DMSMS problems after they surface) and proactive (you identify and take steps to mitigate impending DMSMS problems). DoD policy prescribes the proactive approach.

An effective DMSMS program does the following:

- Ensures that all parts and material to produce or repair the system or equipment are available
- Reduces, or controls, total ownership cost (TOC)
- Minimizes total life-cycle systems management (TLCSM) cost
- Eliminates, or at least minimizes, reactive DMSMS actions
- Evaluates design alternatives
- Provides for risk mitigation as it applies to DMSMS
- Evaluates more than one approach to resolve DMSMS issues
- Collects metrics to monitor program effectiveness.

To achieve an effective DMSMS program, you should consider adopting the common practices and tools described in this guidebook. These practices and tools were drawn from various

DoD organizations that have successful DMSMS programs. This guidebook is not limited to any particular type or class of manufacturing sources or material shortages.

The purpose of this guidebook is fourfold:

- Define a proactive DMSMS management process that a PM can use to build an effective DMSMS program
- Define DMSMS support metrics to measure the effectiveness of a proactive DMSMS program
- Promote cost-effective supply chain management integrity through DMSMS problem solution at the lowest (cost, time, functional) level
- Promote the exercise of best practices throughout the DMSMS management cycle.

Basis for DMSMS Mitigation

DoD Directive 5000.01, "The Defense Acquisition System," addresses both TLCSM and performance-based life-cycle product support (PBL) in the weapon system life cycle and requires a focus on sustainment early in the life cycle. Both TLSCM and PBL relate to DMSMS mitigation:

- TLCSM deals with obsolescence as one of the cost drivers in the system life cycle. More specifically, TLCSM is the implementation, management, and oversight, by the PM, of all activities associated with the acquisition, development, production, fielding, sustainment, and disposal of a DoD weapon system across its life cycle. It empowers you, as the life-cycle manager, with full accountability and responsibility for system acquisition and follow-on sustainment.
- PBL is the preferred sustainment strategy for weapon system product support. It employs the purchase of support as an integrated, affordable performance package designed to optimize system readiness.

The relationship between DMSMS, TLCSM, and PBL was emphasized by the Deputy Under Secretary of Defense for Logistics and Materiel Readiness in a March 2007 memorandum, "Life Cycle Sustainment Outcome Metrics." That memorandum described 14 life-cycle sustainment (LCS) enablers that "when appropriately addressed, positively impact the Material Readiness LCS outcomes." PBL is enabler number one, and DMSMS is number nine.

The DoD Acquisition, Technology and Logistics enterprise is concerned with creating reliable and cost-effective industrial capabilities sufficient to meet strategic objectives and with implementing improved governance and decision processes. These aspirations relate directly to DMSMS efforts. An efficient, proactive DMSMS management process is critical to providing more effective, affordable, and operational systems by identifying and mitigating DMSMS issues that affect their availability and supportability. This DMSMS management is in line with TLCSM and PBL tenets.

TLCSM Tenets

TLCSM increases the significance of design for system reliability, availability, maintainability, manufacturability, and supportability. The inherent objective of TLCSM is to enhance the warfighter's capability through the improved system operational effectiveness (SOE) of new and fielded weapon systems. SOE is a composite of performance, availability, process efficiency, and total ownership cost. You can best achieve the objectives of the SOE concept by influencing early design and architecture. The warfighter's capabilities are maintained by focusing on system design for operational effectiveness and proactive DMSMS initiatives.

Reliability, reduced logistics footprint, and reduced system TOC are most effectively achieved when you include them as drivers from the very beginning of a program, starting with the definition of required capabilities. Reliability, maintainability, supportability, and producibility are components that affect availability. The primary objective of "design for system supportability" is to positively affect and reduce the requirements for the various elements of logistics support during the system operations and maintenance phase. One aspect of successfully accomplishing this is by continually addressing DMSMS issues.

PBL Tenets

PBL offers an effective way to deal with obsolescence throughout the life of a product. Unlike traditional approaches to modernizing legacy systems, PBL holistically manages the support of weapon systems, assemblies, subassemblies, and components. As the point of responsibility for meeting performance requirements shifts to the product support integrator (PSI) under the PM, PBL provides a powerful tool for mitigating obsolescence and making continuous modernization a reality for current weapon systems, assemblies, subassemblies, and components (where a PBL application is feasible).

PBL clearly fulfills the need for continuous modernization and obsolescence mitigation. With PBL, the PM, rather than purchasing parts or products, purchases performance via an integrated product support package. You can do this through a long-term contract with a commercial entity or through a memorandum of agreement or understanding with an organic support source. Whether through a contract or some other vehicle, the focus is on establishing performance guarantees that ensure effective system support.

For programs that adopt a PBL strategy, you should have commercial providers (via contract instruments) maintain a proactive DMSMS program. Ideally, PBL contracts are long term (5 to 15 years) and require the provider to manage many aspects of product support through the life cycle. The properly structured PBL strategy will include an incentive for the provider to be proactive and manage DMSMS and obsolescence to achieve the required performance outcomes. Long-term PBL contracts lower provider risk and allow for DMSMS mitigation efforts such as life-of-type (LOT) buys, long-term contracts with prime contractors, long-term contracts between primes and subcontractors, and return on investment for redesigns.

The PBL provider has the financial incentive to continuously improve performance, because of its bottom-line impact:

- Optimized supply support reduces inventory investment and yields higher margins.
- Increased reliability of systems and subsystems (and fewer failures or returns) reduces transportation, labor, and spare parts costs.
- Adoption of open system design increases the use of plug-and-play components that can be renewed or replaced quickly.
- Continuous modernization extends the system's useful life.
- Continuously refreshed technologies increase the residual value of the systems, subsystems, components, and repair parts.

To implement an effective PBL strategy, you should be familiar with two key documents:

- *Performance Based Logistics: A Program Manager's Product Support Guide*, published by the Defense Acquisition University (DAU) in March 2005
- *Designing and Assessing Supportability in DoD Weapon Systems: A Guide to Increased Reliability and Reduced Logistics Footprint*, published by the Office of the Secretary of Defense (OSD) in October 2003.

DMSMS Program Guidance

DMSMS Program Levels

DMSMS is a risk to the life-cycle support and operational availability of weapon systems. Effective DMSMS management requires proactive solution of obsolescence problems before they adversely affect system availability or TOC. Managing DMSMS risks follows a standard sequence:

- *Identify.* Identify "problem" parts in the line replaceable units (LRUs) that are, or will be in the foreseeable future, obsolete. In a big weapon system, identifying problem parts is a monumental task. Identifying DMSMS problems early and solving them (the next three steps in the process) is the essence of a proactive program.
- *Assess.* Considering the population of problem parts, determine and prioritize the LRUs most at risk for current and future DMSMS impacts.
- *Analyze.* Research the problem parts in the high-priority LRUs first and, for each LRU, develop an optimum set of DMSMS solutions.
- *Implement.* Budget, fund, contract for, schedule, and execute the solutions for the high-priority LRUs and then for the lower-priority LRUs.

Developing solutions for a few obsolete parts isn't too hard. However, implementing an effective proactive DMSMS management program on a system such as the E-3 Sentry is daunting and expensive.

Common sense dictates that the level of DMSMS management practice cannot possibly be the same for every weapon system program. Therefore, DoD recognizes a spectrum of four DMSMS levels of intensity. Each level represents a set of practices to mitigate the effect of DMSMS. The levels are defined as follows:

- Level 1—practices (largely reactive) sufficient to resolve known obsolescence problems
- Level 2—practices (more proactive) sufficient to mitigate the risk of future obsolete items
- Level 3—proactive practices sufficient to mitigate the risk of obsolescence when there is a high-probability opportunity to enhance supportability or reduce TOC (these proactive activities may require additional program funding)
- Level 4—proactive practices implemented during the conceptual design of a new system and continued through its production and fielding.

Table 1 identifies the set of practices for each intensity level; each higher level includes the practices of all lower levels.

Table 1. DMSMS Mitigation Practices for Each Intensity Level

Intensity Level 1	Intensity Level 2	Intensity Level 3	Intensity Level 4
DMSMS program established and funded	All Level 1 practices implemented	All Level 2 practices implemented	All Level 3 practices implemented
DMT formed	BOM processed through a predictive tool	DMSMS life-cycle costs and cost avoidance estimates developed	Technology road mapping used
DMT trained in ◆ DMSMS fundamentals and ◆ DMSMS for executives	Results of predictive tool output analyzed	DMT trained in ◆ DMSMS essentials, ◆ DMSMS case studies, and ◆ advanced DMSMS	System upgrades planned
DMSMS program plan written and approved	DMSMS solution data-base established		Technology transparency attained
Complete BOM developed with periodic reviews planned to keep it current	Budget established to fund future obsolescence solutions	Funding shortfall and impact identified and communicated to decision makers	Accessibility realized for alternate source development (VHDL, emulation, MEPs)
Solutions to near-term obsolescence problems implemented	Website established	For legacy systems, DMSMS tasking and data requirements included in applicable contracts	
For new acquisitions, DMSMS tasking and data byproducts inserted in the development, production, or support contracts	Method established to prioritize LRUs/WRAs for DMSMS risk	Circuit design guidelines established	
		Technology assessment and insertion under way	
		DMSMS metrics established[a]	
		Electronic data interchange used	

Notes: BOM = bill of materials, DMT = DMSMS management team, LRU = line replaceable unit, MEP = Manufacturing Extension Partnership, VHDL = VHSIC (Very High Speed Integrated Circuit) Hardware Description Language, WRA = weapons replaceable assembly.

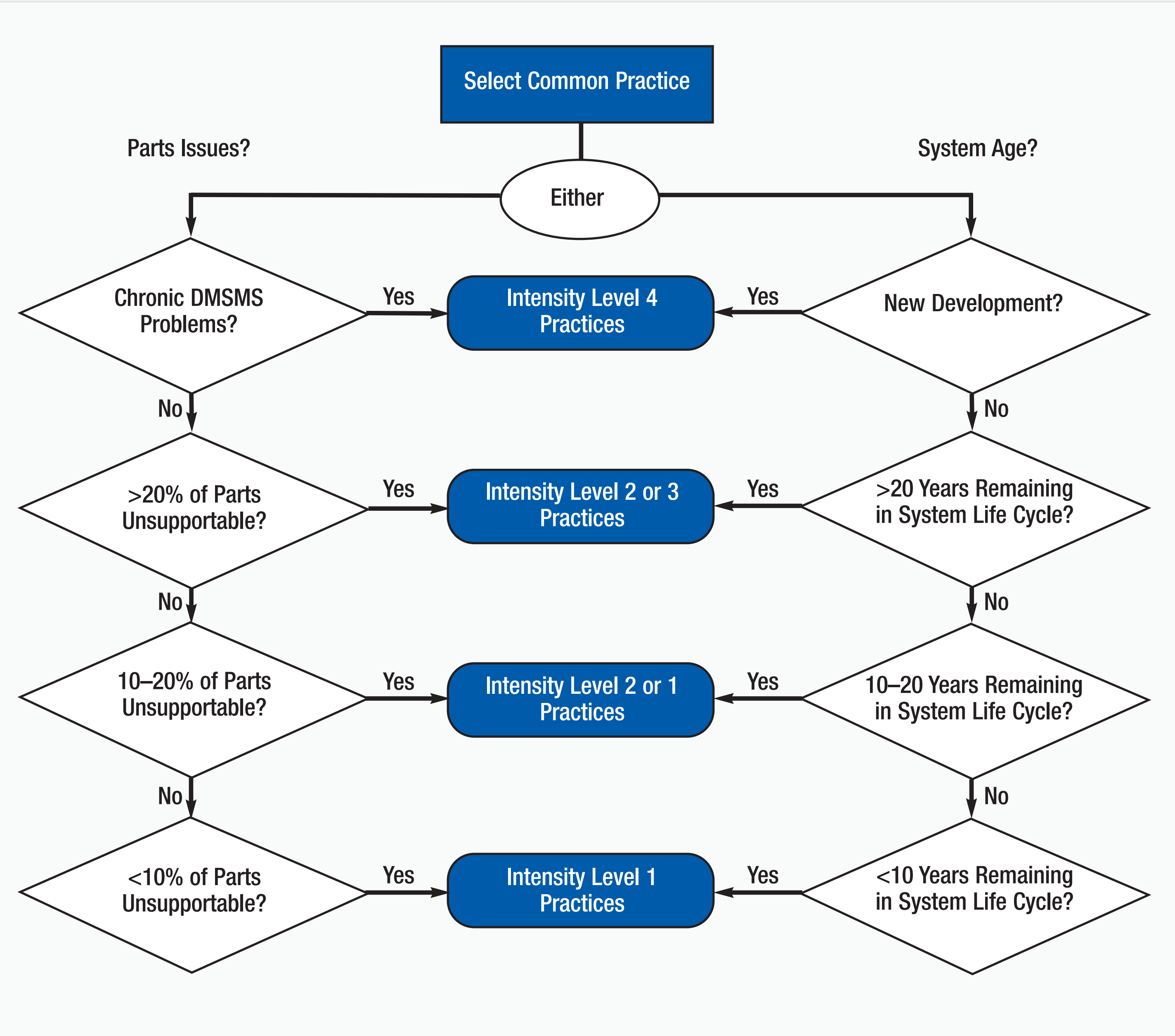
[a] Metrics include number of cases, number of solutions implemented, life-cycle costs, and cost avoidance.

Selecting DMSMS Mitigation Practices for Your Program

Consideration and selection of DMSMS management practices may follow a "trigger" event that convinces the PM that something needs to be done about obsolescence. An example trigger is a no-bid on spare circuit cards because of obsolete microcircuits or concerns from DMSMS-induced depot maintenance delays.

The logic of Figure 1 will help you select an appropriate intensity level for your program.

Figure 1. Logic for Selecting Intensity Level



You also should consider the complexity of the program, available resources, management philosophy, and acquisition life-cycle phase. For example, a program entering the technology development phase may be able to plan for the incorporation of Level 3 practices in the request for proposals for the system development and demonstration phase. However, a program in the operations and support phase may not be able to afford to convert all the drawings into an Electronic Data Interchange format.

Over time, you may be able to increase the intensity level of your DMSMS mitigation practices to increase cost avoidance and further reduce the risk of obsolescence.

The Customer's Perspective on Level of Practice

The customer's—government program office's—perspective on DMSMS management is usually "How do I protect myself?" Although cost is a valid consideration, your focus should be on instituting proper planning mechanisms to address future DMSMS problems. Current DoD DMSMS management efforts range from no program awareness of DMSMS to proactive DMSMS programs. The proactive programs generally use Level 1 and Level 2 DMSMS mitigation practices, focusing on resolving DMSMS problems. For the most part, these programs are under the purview of the logistics team with little or no program management support. To implement Level 3 and Level 4 practices, successful organizations will have to reach beyond DMSMS damage control and focus time, energy, and resources on implementing a fully proactive approach to minimize, if not eliminate, future DMSMS problems. Although the cost of implementing such a program will be high, the cost of failing to do so will likely be far higher. In short, the customer will have much better support, at lower cost, if it has a proactive DMSMS program to monitor the health of new systems (e.g., technology refresh/insertion) and to identify any part availability issues early in the acquisition process.

The Supplier's Perspective on Level of Practice

The supplier's—contractor's—perspective on DMSMS management represents a dichotomy: "How do I do the right thing (add overhead cost) and maintain a competitive edge (lower overhead cost)?" The primary objectives of any commercial entity are to keep costs down and increase profits, but implementing Level 4 DMSMS practices requires the supplier to expend time and manpower resources. Convincing the supplier to expend those resources requires helping the supplier's senior management to recognize the conditions under which DMSMS avoidance management is good business. For example, applying DMSMS avoidance techniques to products makes them more attractive to buyers by reducing projected TOC. This lowered TOC may be beneficial to the supplier when the product has a high-margin, high-volume sales potential. In a competitive environment, it will enhance the probability of winning. Even under sole-source conditions, using DMSMS avoidance techniques is a defensive strategy against future competition. In general, having an effective DMSMS program may pave the way for increased sales and profits on other DoD contracts.

Implications of Level of Practice for Source Selection

The customer is concerned with the initial acquisition cost and TOC. In contrast, the supplier generally is not concerned with TOC, because it does not need to deal with the long-term storage and warehousing costs associated with post-deployment sustainment. However, the supplier is concerned with the perception of higher acquisition cost introduced by DMSMS avoidance costs. This means that projected TOC—based in part on costs incurred to implement proactive DMSMS management in the beginning and on DMSMS costs avoided in the future—should be an evaluation factor in the source selection process. This factor will provide an incentive for the seller to spend money up front in development and production. In turn, this consideration ensures both long-term savings and supportability of the equipment. This approach will require both the customer and the supplier to accept the basic annual investment costs (software, support, travel, website) of implementing Level 3 DMSMS mitigation practices and to recognize that implementing these practices during the life cycle should lower the projected and actual TOC. In other words, the inclusion of DMSMS avoidance practices comes at a cost, but that cost is offset by

- increased sales for the supplier,
- decreased TOC for the customer, and
- possibly increased revenue from PBL award-fee targets on supply or availability performance.

DMSMS Resources

Many policy documents, training courses, and other sources of information are available on the DMSMS discipline. In addition, some locations (Tinker Air Force Base, OK, and Warner-Robins Air Force Base, GA, to name two) have resident subject matter experts in DMSMS.

Appendix A lists key documents applicable to the DMSMS discipline. One particular document with which you should be familiar is MIL-STD-3018, "Parts Management," which provides for the implementation of an effective parts management program on DoD acquisitions. Parts management is a design strategy that seeks to reduce the number of unique or specialized parts used in a system in order to enhance standardization, reliability, maintainability, and supportability. This strategy also minimizes parts obsolescence due to DMSMS. MIL-STD-3018 requires a parts management plan describing procedures for obsolescence management; those procedures must include proactive obsolescence forecasting for applicable part types and plans for reacting to and resolving obsolescence issues. In other words, the parts management plan provides the process for the initial screening, for DMSMS issues, of parts to be used in the design or modification of a system. DMSMS risk mitigation is one facet of the larger process of parts management.

If you are new to the DMSMS discipline, you should consider taking advantage of courses available through DAU:

- LOG 102, "Sustainment Management Fundamentals"
- LOG 204, "Configuration Management"
- LOG 235, "Performance Based Logistics"
- CLL 201, "DMSMS Fundamentals" (continuous learning module)
- CLL 202, "DMSMS for Executives" (continuous learning module)
- CLL 203, "DMSMS Essentials" (continuous learning module)
- CLL 204, "DMSMS Case Studies" (continuous learning module)
- CLL 205, "DMSMS for Technical Professionals" (continuous learning module).

Classroom versions of the DAU continuous learning modules are available through the DoD DMSMS Working Group.

In addition to the courses, DAU maintains a Logistics Community of Practice for sharing information about DMSMS, obsolescence, and continuous modernization and a Systems Engineering Community of Practice for sharing information about open systems, COTS items, and evolutionary acquisition.

Several web-based resources contain useful links to information on DMSMS management as well as to useful tools. One example is the DMSMS Knowledge Sharing Portal (DKSP), established by the Defense Standardization Program Office (DSPO). You can access the DKSP and get help in proactively managing your DMSMS problems using its tools, services, and data. Although the DKSP is still a work in progress, DSPO has made great strides in setting up the website and populating it with relevant DMSMS information, links, training, and other information. Portions of the site allow unrestricted access, while other portions are password protected. The restricted sections of the site require you to be a Government-Industry Data Exchange Program (GIDEP) user (see how to register for GIDEP at www.gidep.org). The DKSP can be accessed by government and contractor personnel as authorized. Information on how to access the restricted portions is available at the site. Visit this website for more information: www.dmsms.org/.

Attending the annual DMSMS conference is a "must" for anyone working in this discipline, particularly if you are new to DMSMS management.

Appendix B lists other important DMSMS-related web-based resources.

Keys to a Successful DMSMS Management Program

For a DMSMS program to be successful, several elements must be in place:

- Management support ("buy-in" or commitment)
- DMSMS management team (DMT)
- Predictive tools
- Accurate bills of materials (BOMs)
- Financial resources.

Support from Management

Management buy-in (commitment) is crucial to a successful DMSMS program. The interest of senior leaders will ensure that the various supporting disciplines (engineering, logistics, management, contracting) will work with the DMSMS program. One method for securing the necessary commitment from managers of both the customer (program office) and the supplier is to ensure that clear contractual language delineates roles and responsibilities.

Another aspect of management involvement deals with the organizational level at which DMSMS should be managed. Efficiencies can be realized by monitoring DMSMS at the highest level of commonality. That means common items (those not unique to a system) should be managed at the DoD level in order to leverage volume, which in turn will lower unit cost and potentially extend the life cycle. This will also reduce redundancies in finding and fixing problems for like items. In contrast, identifying problem parts and finding supply solutions at any lower level (for example, depot or program) is likely to be less effective.

DMSMS Management Team

A program can best attain DMSMS objectives by establishing a DMT. The DMT's composition will depend on the program situation and could include any combination of disciplines—managers, engineers, technicians, logisticians, and other skill types—and organizations, including support contractors, original equipment manufacturers (OEMs), prime contractors, and other government organizations such as the Defense Supply Center Columbus (DSCC) or Defense MicroElectronics Activity. The DMT should develop a written plan for and guide the DMSMS program. The team will need to be supported with adequate resources to ensure success.

Predictive Tools

The primary goal of a DMSMS program is to find and document problems in Problem Part Reports (PPRs) and then to solve those problems. Good predictive tools can help you achieve that goal. Most predictive tools perform the same core function: monitor the status of electronic components in the BOM and forecast their obsolescence. Each tool has a set of loading criteria and formats, output report formats, and other information that can be gleaned from the loaded BOM. The DMT should perform a review and work together to select the tool that is right for their program based on needs and cost.

Bill of Material

The BOM is the indispensible data resource that enables proactive DMSMS management. Without it, impact analysis, component analysis, prediction of discontinuance, and other DMSMS-related activities would not be possible. A BOM is a list of parts (electronic, electrical, mechanical, and so on) needed to produce a system or assembly. An indentured BOM shows the relationship (generally in a top-down breakout format) of components to board, to box, and to system. A flat-file BOM lists parts without indenturing relationships. One of the first tasks of the DMT is to obtain the BOMs (probably from the integrating OEM), develop them from available data, or negotiate for access to contractor-owned technical data packages, technical manuals (illustrated parts breakdowns), and engineering change proposals (ECPs).

Ideally, the BOM should be in an editable electronic open-standards-based format. As part of the contract data requirements, you should consider requiring compliance with DI-SESS-81656, "Data Item Description, Source Data for Forecasting Diminishing Manufacturing Sources and Material Shortages."

The DMT can make a good start on proactive DMSMS management if it can at least obtain or create a minimal BOM that reflects the active devices. With this limited BOM, the DMT can load a predictive tool, identify the status of components, and perform some basic analysis. As it gets better at managing DMSMS problems, the DMT will realize that any redesign or new system acquisition should include the BOM, along with the new boards or systems. It may be prudent to require the procurement of some type of BOM data on any new system acquisition.

Due to competition or proprietary issues, OEMs are often reluctant to release a BOM for COTS products, but, through a PBL contract, many OEMs have shared their COTS BOMs to support government obsolescence management. (Appendix C describes some best practices for obsolescence management of COTS products.)

If COTS BOMs are available, you can periodically survey the OEM to obtain updated information about the status and projected life of the product. Data from these surveys need to factor in the OEM's internal DMSMS program and reliability of data provided by the vendor. In PBL contracts, BOMs are not generally required to be maintained by the DMT, because obsolescence management is delegated to the PBL provider. Nevertheless, DoD must be protected in case the provider ends its support of the weapon system or goes out of the business. These contingencies should be covered in contract exit clauses and criteria that require the contractor to provide all technical data necessary to either compete the product support or establish organic capability. An excellent example is the V-22 AE1107 Engine Technical Data license. In this instance, if the contractor raises the price per engine hour over the established formula, it must turn over a complete technical data package to the government. Similarly, the PBL contract for the Auxiliary Power Unit/Total Logistics System has an exit clause that establishes an exit Integrated Product Team (IPT) and ensures that the government receives all data necessary to reestablish full product support capability.

In a non-PBL environment, the OEM should be asked to consider providing access to the BOM well in advance of announcing an end-of-production/end-of-support/end-of-life date. This notification may come at a price. During acquisition and production, the OEM should be required to provide a list of obsolete, or soon to be obsolete, devices. Although this latter approach is reactive, it will at least enable the program to verify that the parts are in fact obsolete or in danger of becoming obsolete.

Budgeting for DMSMS

Funding must be available early in the development of a program—when the design is most cost-effective to influence—to ensure that the DMSMS program can proactively mitigate DMSMS problems. Developing a time-phased DMSMS budget is intuitive. For an initial DMSMS program, you can use a spreadsheet to delineate annual personnel costs (both government and contractor support) to build a DMT and to cover travel, training, and any predictive or data tool costs.

As the DMSMS program becomes established, you should include the ongoing costs for the resources required in establishing the initial program. You must add to that the cost of implementing the obsolescence solutions submitted by the DMT. An effective DMT will detail the cost to implement a specific solution, which will aid not only in budget preparation, but also in Program Objective Memorandum (POM) budget justification. The cost may be distributed over several years and will be affected by administrative lead-time (ALT) and production lead-time (PLT).

You may want to establish a quick-response budget (QRB) early in the program to enable rapid funding of low-cost DMSMS solutions. The QRB will minimize TOC and the DMSMS impact on operational readiness. A QRB may be especially important until the DMSMS program can institute Level 3 and Level 4 DMSMS mitigation practices. Below is an example of a QRB contract clause:

> To expedite the mitigation process and ensure best value, contractor will formally request an $80,000 budget from customer to fund a contractor-managed DMSMS QRB. Contractor shall use the QRB to purchase low-cost DMSMS mitigation inventories (i.e., not to exceed $4,000 per DMSMS case) when QRB funding is needed to provide best value. Contractor shall provide customer with a full accounting for all QRB dollars spent on a quarterly basis.

Another reason for the QRB is that more complex and time-consuming solutions are not normally implemented in the first few years of the program. The timely funding and planning of a DMSMS management program will significantly reduce the need for emergency projects related to the sustainment and producibility of military weapons, systems, and commodities.

DMSMS Program Elements

DMSMS programs typically have three elements: infrastructure, operations, and support. These elements must be well defined, integrated, and exercised.

Infrastructure

This element refers to the set of enabling resources and capabilities for the DMSMS program. Initially, the DMT will need to select a program integrating agent (PIA) to collect identified problems and keep the problem solution process moving. The DMT typically has three choices for the PIA: the prime contractor, a support contractor, or internal resources.

The DMT, with the involvement of the PIA, should develop a DMSMS Management Plan (DMP) for its program. The DMP should, among other things, state the program objectives, define program elements, define DMT roles and responsibilities, describe program resources, and specify DMT procedures. The plan also should address the approach the DMT will use to measure the progress and output of the program. Metrics selected must include any standardized metrics as mandated by DoD, the components, or other higher-level reporting requirements. An automated DMP generator—called Plan Builder—has been developed to assist programs with creating high-quality DMPs. Plan Builder ensures that the latest policy and guidance is included in the DMPs. It also enables program offices to customize their DMPs to meet specific program needs. It is available at www.dmsms.org/PlanBuilder.

The DMT will need to choose a DMSMS predictive software tool to forecast the obsolescence of the electronic parts in the BOM. Many predictive tools are available; they are listed and described in the DKSP (www.dmsms.org/PartSearchTools/). Each one is different in terms of the user interface, loading of data into the software, and interval of refreshing the data. The DMT should compare the features and cost of all candidates and should make sure that the people who will be using the tool (often a key role of the PIA) need to be comfortable with the choice. Before deciding on a predictive tool, the DMT should have demonstrations of the candidate tools and their process outputs. The program must then purchase the tool (on a contract or a subscription basis). Remember that a specific tool, alone, will not solve all DMSMS problems. Engineering analysis and judgment are still key factors in addressing DMSMS issues, coupled with the tool's output.

In addition to a predictive tool, the DMT will need tools to access data sources to identify problems and pursue solutions. Table 2 lists some of the tools available from the government.

A more comprehensive list, being developed by the DMSMS Working Group Common Use Tool Committee, can be found at www.dmsms.org/, along with a detailed description of each tool.

Table 2. Tools Linking to Potential Data Sources

Tool	OPR	Fee?	Usage
ASSIST	DSPO	No	Specifications and standards
CDMD-OA	NAVSEA (DETPAC)	No	Configuration status accounting of systems and equipment
D200C	AFMC	No	LRU and SRU failure data
EMALL	DLA	No	Item of supply information and ordering (DLA Item Catalog)
GIDEP Notices	GIDEP	No	Historical and new discontinuance notices
JEDMICS	AFMC	No	Engineering drawing file system
MEDALS	DLA	No	Engineering drawing location and revision
Microcircuit Query	DSCC	No	Manufacturer part number to standard microcircuit drawings
PC Link	DLA	No	Access to service databases
REMIS	AFMC	No	Reliability data
SDW	DLA Headquarters	No	Discontinuation notices
Sunset Supply Base	NAVSEA	Yes	COTS piece part solutions with OEMs
WebFLIS	DLA	No	Federal total item record
WebLink	DLA	No	Web-based version of PCLink

Notes: AFMC = Air Force Materiel Command, ASSIST = Acquisition Streamlining and Standardization Information System, CDMD-OA = Configuration Data Managers Database–Open Architecture, D200C = Recoverable Item Requirements Computation System (Air Force), DLA = Defense Logistics Agency, DSCC = Defense Supply Center Columbus, GIDEP = Government-Industry Data Exchange Program, JEDMICS = Joint Engineering Data Management Information and Control System, LRU = line replaceable unit, MEDALS = Military Engineering Data Asset Location System, NAVSEA = Naval Sea Systems Command, OPR = Office of Primary Responsibility, REMIS = Reliability Engineering Management Information System, SDW = Shared Data Warehouse, SRU = shop replaceable unit, WebFLIS = Federal Logistics Information System Web Inquiry, WebLink = Web Logistics Information Network.

The DMT will need a database to capture and organize its work, because a complex program will require the concurrent investigation of hundreds of DMSMS problems under way at multiple locations. An effective database will generate useful technical and management control reports. The DMT can develop its own database or adapt one from another DMSMS program. (For the rare program with only a few DMSMS problems, a spreadsheet may be sufficient.)

The DMT will need to adopt or develop a method for prioritizing the DMSMS issues that need to be resolved. This is crucial for a complex platform like a weapon system, which typically has many systems, each with multiple LRUs (boxes), which in turn have many more shop replaceable units (SRUs) (boards). Below are selected example criteria for prioritizing LRUs for DMSMS impacts:

- Window of opportunity: Is it a time interval when components are available for a potential lifetime buy?
- Operational impact: When will the weapon system be affected (in terms of losing SRUs or LRUs) by the DMSMS issue?
- Funding: When, where, and how will money be available to address the DMSMS issue?

After selecting a prioritization method, the DMT must collect the input data required by the method, apply the data to the list of systems, and rank order the systems in order of criticality. This method will also require the use of platform data (such as relative obsolescence and mission essentiality of the LRUs). Therefore, the approach must be based on easily available (yet meaningful) input data.

Collecting the configuration data and loading the predictive software tool is a continual process. The DMT must identify the configuration data sources, such as technical orders and engineering parts lists. The team may need to convert paper data to a data file of indentured BOMs to load into the predictive software tool (by the tool contractor or the DMT). After this data load, the real magnitude of the current and future DMSMS problem on the platform will begin to surface. The DMT is now ready to start "operations" and to investigate the obsolete parts and apply the prioritization method to determine the most critical system or LRU.

Operations

The operations element involves managing the DMSMS program according to the DMP. Below are some important things for the DMT to know:

- Processing the initial and subsequent batches of PPRs will be a new workload and a challenge for the DMT. Motivating the team's involvement is crucial and requires strong endorsement by senior management.
- Administering the decision-making process requires trained professionals. After the initial research (based on the predictive tool and the other data sources), the operations profes-

sionals will release a batch of PPRs (in accordance with the priority list) to the DMT members for their review and recommendations. Normally, the PPRs will then go to DSCC first (for electronic parts), then to contractors, logistics centers, and the owning IPT. Essentially, the DMT will "grow" a solution. The DMT, or PIA, will need to check that the PPRs are being worked and not languishing in someone's inbox.

- Understanding the costs of DMSMS management and measuring the success of a DMSMS program call for the development of program metrics. This requires a PM to document recommended and approved solutions and monitor implementation. Generating and reviewing PPRs generates an ever-growing list of recommendations that require follow-up action. For example, if there are obsolescence problems on 14 circuit cards in a given LRU, there would be a mix of recommendations (each a miniproject) for substitute part validations, multiyear buys, and part emulations. The organization that "owns" the circuit cards must keep track of these proposed miniprojects and submit them into the budget process at the next cycle. Often, when a program finds a solution that works (LOT buy, redesign, bridge buy, or other solution), it tends to lock onto that solution and use it to address all DMSMS issues. However, there is usually no one best solution. Therefore, an important part of the program metrics is the solution type and cost to implement, which must be tracked to measure success and identify trends. This information also can be useful for establishing internal benchmarks and performance goals for PBL providers.
- Synthesizing individual solutions into a recommendation for an entire LRU or subsystem requires close examination of the facts. For example, should the solution be to find seven substitute parts and one emulation or would it be better to redesign the circuit card assembly? Assessing obsolescence problems and developing solutions require a total system engineering approach. The DMSMS operations element must include a means of condensing the myriad individual recommendations into a succinct report (sometimes called a DMSMS Engineering Requirements Plan) for a given LRU that facilitates understanding, tracking, and action.

For an organization located at several dispersed sites, a DMT liaison at each site can help prevent unnecessary processing delays. Timeliness in processing PPRs, getting the crucial data, and following up on budgeting actions are major concerns for the DMT. If the PPRs go to an organization with no active DMT member, the chance of process breakdown is quite high. Therefore, this liaison process should be addressed in planning and contracting. Keeping the process moving is crucial, because windows of opportunity for lower-cost solutions (e.g., last-time buys) may be very short.

Support

The support element of the DMSMS program includes tasks such as training, reporting, and analyses. The DMP must assign specific support tasks to the various DMT members (and in the contract for the PIA, as applicable).

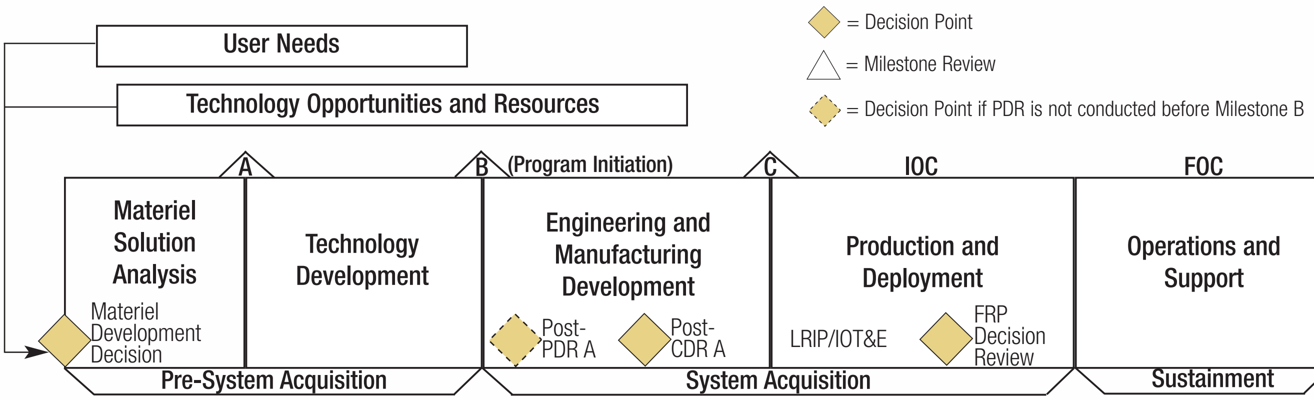
Below are some examples of support tasks:

- Execute DMSMS action items
- Refresh the prioritization list with new data at planned intervals
- Prepare themes, agendas, arrangements, and minutes for DMT meetings
- Participate in periodic DMT teleconferences, as required
- Train DMT members to use the DMSMS data tools
- Develop a descriptive presentation of the DMSMS program
- Prepare and deliver program management reviews for senior leaders
- Generate and post monthly metrics on PPR processing and DMT output
- Analyze the cost and operational effectiveness of the program
- Represent the DMSMS program at defense industry forums
- Collect part consumption and failure data
- Prepare POM justification for solution projects.

Potential Solution Approaches to DMSMS Problems

The practical solutions for a DMSMS problem depend on where the item, or supported system, is in its life cycle. (Figure 2 shows the phases of the DoD acquisition life cycle.) However, if a single item supports several systems that are at different points in their life cycle, you will need to do a much more intense analysis of alternative solutions and of their costs and benefits. Table 3 lists risk mitigation action types, by category, and indicates the life-cycle phase in which they are most commonly applied. You can use the action types listed as a starting point for identifying potential solutions to your DMSMS problem. Appendix D defines the terms used in the table, and Appendix E contains a table that you can use when considering alternative solutions to a specific DMSMS problem.

Figure 2. The DoD Acquisition Life Cycle



Source: DoD Instruction 5000.02, "Operation of the Defense Acquisition System," December 2008, p. 12.

Notes: CDR = critical design review, FOC = full operational capability, FRP = full-rate production, IOC = initial operational capability, IOT&E = initial operational test and evaluation, LRIP = low-rate initial production, PDR = preliminary design review.

Table 3. Alternative Risk Mitigation Actions, by Life-Cycle Phase

Action category	Action type	Life-cycle phase		
		Pre-system acquisition	System acquisition	Sustainment
DMSMS project	Existing source (stock)		X	X
	Reclamation		X	X
	Alternative source		X	X
	Existing substitute		X	X
	Commercial item or NDI substitution	X		
	After-market manufacturing (reverse engineering)			X
	Emulation			X
	Modification or redesign	X	X	X
Acquisition and design strategy	Performance-based requirement	X	X	
	Continuous modernization		X	X
	System upgrade and SLEP			X
	Technology refresh		X	X
Acquisition strategy	Breakout		X	
	Bridge buy		X	X
	Contractor-maintained inventory		X	X
	Contractor requirement or availability guarantee		X	X
	DPAS			X
	DLA War Stopper List		X	X
	Early-life-cycle parts procurement		X	X
	Government/organic fabrication facility		X	X
	JMPAB		X	X
	LOT buy		X	X
	Modernization through spares	X	X	X
	Performance-based life-cycle product support		X	X
	Early warning database			X
Design strategy	Design for obsolescence			X
	Design technique	X		
	Open systems architecture	X	X	
	Redefined requirement	X	X	X

Notes: DLA = Defense Logistics Agency, DPAS = Defense Priorities and Allocations System, JMPAB = Joint Materiel Priorities and Allocation Board, LOT = life-of-type, NDI = nondevelopmental item, SLEP = Service Life Extension Program.

Planned continuous modernization is an important component of any support strategy and is aided by the use of COTS items and nondevelopmental items (NDIs), ECPs and value engineering change proposals (VECPs), open systems architecture (OSA), PBL, and microcircuit emulation programs. These strategies are described below.

COTS Items and Nondevelopmental Items

The Government Electronics and Information Technology Association, in collaboration with DSPO, has developed minimum requirements for COTS/NDI integrated circuits and semiconductors and designated them as Aerospace Qualified Electronic Components (AQEC). AQEC suppliers include about 15 semiconductor manufacturers and avionics developers whose primary purpose is to enhance usage of COTS items throughout DoD.

AQEC documents establish guidelines for producing "modified COTS" parts—somewhere between military specification and pure commercial. AQEC suppliers are required to provide products for 5 years or more or to provide information on how to obtain the part if the life cycle is shorter. The AQEC designation also provides DoD better knowledge of the parts being used across all weapon systems as well as efficiencies of volume buying.

COTS/NDI solutions have many benefits:

- COTS/NDI solutions have a broader commercial base than build-to-order software and hardware products.
- COTS/NDI solutions cost less to acquire and support than military specification equipment.
- Industry, rather than the government, typically funds research and development of COTS items and NDIs.
- Compared with traditional military acquisitions, COTS/NDIs have much shorter time-to-market cycles.
- Shorter cycle times result in continuous and rapid improvements in technological capabilities—unlike build-to-order designs.

Engineering Change Proposals/Value Engineering Change Proposals

The ECP process is often a cost obsolescence mitigation solution and can be slow. Responsibility for identifying and mitigating obsolescence risk remains with the government. On the other hand, the VECP process uses a simple, flexible, and structured set of tools, techniques, and procedures. The VECP process has several advantages:

- Develops innovative solutions to DMSMS problems that provide collateral benefits such as reduced cost, increased quality, and improved performance
- Puts those solutions in place rapidly

- Provides businesses with a strong profit-based incentive for using their skilled engineering workforce to mitigate DoD DMSMS issues as part of a successful joint industry/DoD business relationship
- Rewards contractors for investing in DMSMS solution options by providing them with a mechanism to share in the savings generated
- Allows DoD to spread nonrecurring engineering costs over time, making them far easier to fund.

The use of PBL does not obviate the need for value engineering because VECPs change the business case by providing the proper incentives for the contractor to adopt an approach more beneficial to DoD in the long term. For each DMSMS solution option, there is evidence of significant benefits that can be achieved with the use of value engineering. (For more information, see *A Partnership between Value Engineering and the Diminishing Manufacturing Sources and Material Shortages Community to Reduce Ownership Costs*, published by the Institute for Defense Analyses in September 2008.)

When reviewing and approving related ECPs or VECPs, the DMT must be sure that it fully understands the cost impacts and potential savings over the expected life cycle.

Open Systems Architecture

The objective of an OSA is to improve weapon system affordability and sustainment by reducing the effects of anomalies such as out-of-production parts, technology obsolescence, and single-source suppliers. Being locked into proprietary technology or relying on a single source over the life of a system can be detrimental to the warfighter's mission. Spiral development can also help to alleviate obsolescence concerns.

When a PBL contract is used, you should ensure that it stipulates turnover of all configuration management data to the government, as well as when that should occur. The product support integrator can help carry this out. The PSI is an entity performing as a formally bound agent (contract, memorandum of agreement, memorandum of understanding) charged with integrating all sources of support, public and private, defined within the scope of the performance-based logistics agreements to achieve the documented outcomes. PBL support arrangements give significant latitude to the PSI to manage technology refreshment. The PSI is responsible for performance outcomes and is incentivized to maintain currency with state-of-the-art technology, maximize the use of COTS items, and generally use readily available items to avoid the high cost of DMSMS over the life of the system. Proactively addressing DMSMS concerns throughout the entire life of the program will help ensure effective life-cycle support and reduce adverse impacts on readiness or mission capability. (Appendix F contains examples of contract language that has proven useful in implementing DMSMS programs.)

Performance-Based Life-Cycle Product Support

PBL is a new way of doing business. Unlike traditional approaches to modernizing current systems, PBL holistically manages sustainability and availability of systems. PBL facilitates continuous modernization because the support integrator and providers bear the risk and cost of obsolescence.

Microcircuit Emulation Programs

Using an innovative approach of combining government-sponsored technology development with industry production capacity, DSCC, the Defense Logistics Agency, and the Sarnoff Corporation of Princeton, NJ, have developed two highly effective microcircuit production programs to ensure the availability of replacement parts for as long as the need exists:

- The Generalized Emulation of Microcircuits program focuses on supporting earlier digital logic families (54H, 54L, 54XX, 54LS, 10K ECL), small static random access and read-only memories, and some interface functions.
- The Advanced Microcircuit Emulation (AME) program focuses on supporting advanced digital logic families (54F, 54AS, 54FCT, 10H ECL); the AME program also has application-specific integrated circuit capabilities ranging from 10,000 to 200,000 gates and advanced reverse engineering. AME can support all but the most advanced commercially available technology and has a development road map to enhance its capabilities. Systems under development now can be fielded using AME's technology, thus avoiding obsolescence concerns altogether. At the very least, AME could be an integral part of a weapon system program's long-term support strategy for advanced microcircuit technologies.

Measuring DMSMS Program Effectiveness

Periodically, you should measure the effectiveness, or health, of your DMSMS program. The purpose is to answer this question: How proactive is the DMSMS program? One approach is to use a self-assessment guide to determine the intensity level of the DMSMS program's mitigation practices. You may also want to incorporate a red–yellow–green rating scheme:

- "Red"—none of the criteria factors are completely (or effectively) addressed
- "Yellow"—a deficiency exists in at least one, but not all, of the criteria factors
- "Green"—all of the criteria factors are favorably or positively addressed.

The results of your assessment can help you plan the direction of your DMSMS program. Fundamentally, the DMSMS level of intensity must be appropriate for the system. A major weapon system program may be "Green" for Level 1, but it may receive a "Red" rating if the program warrants a Level 3 DMSMS effort.

Each OSD agency/office and service component may elect to establish additional metrics for DMSMS program tracking and accountability, such as the following:

- Items received (alerts, cases, and end items) for review
- Number of items solved to defined solutions
- Shared data warehouse solutions
- DMSMS dollar value of savings.

The following subsections contain some guidance about general approaches to assessing program cost, schedule, and performance (or supportability).

Cost

Cost Trades Analysis

Once a PM selects a solution to a DMSMS problem, you need to estimate the implementation cost. Figure 3 is a sample worksheet. You then need to determine the cost of resolving obsolescence problems if a proactive DMSMS program is not implemented; in other words, you need to estimate the TOC if no mitigation techniques are implemented, requiring the program to react to supportability problems as they occur. Cost trades analyses are important for developing a business case that validates the implementation of a particular solution to mitigate the impact of obsolescence.

DMSMS Program Self-Assessment Guide

Intensity Level 1

- ☐ DMSMS program established and funded
- ☐ DMT formed
- ☐ DMT trained
- ☐ • DMSMS fundamentals
- ☐ • DMSMS for executives
- ☐ DMSMS program plan written and approved
- ☐ Complete BOM developed with periodic reviews planned to keep it current
- ☐ Solutions to near-term obsolescence problems implemented
- ☐ For new acquisitions, DMSMS tasking and data byproducts inserted in the development, production, or support contracts

Intensity Level 2

- ☐ All Level 1 practices implemented
- ☐ BOM processed through a predictive tool
- ☐ Results of predictive tool output analyzed
- ☐ DMSMS solution database established
- ☐ Budget established to fund future obsolescence solutions
- ☐ Website established
- ☐ Method established to prioritize line replaceable units/weapons replaceable assemblies for DMSMS risk

Intensity Level 3

- ☐ All Level 2 practices implemented
- ☐ DMSMS life-cycle costs and cost avoidance estimates developed
- ☐ DMT trained
- ☐ • DMSMS essentials
- ☐ • DMSMS case studies
- ☐ • Advanced DMSMS
- ☐ Funding shortfall and impact identified and communicated to decision makers
- ☐ For legacy systems, DMSMS tasking and data requirements included in applicable contracts
- ☐ Circuit design guidelines established
- ☐ Technology assessment and insertion under way
- ☐ DMSMS metrics tied to program life cycle
- ☐ • Number of cases (problem parts)
- ☐ • Number of solutions implemented
- ☐ • Life-cycle costs
- ☐ • Cost avoidance
- ☐ Electronic data interchange used

Intensity Level 4

- ☐ All Level 3 practices implemented
- ☐ Technology road mapping used
- ☐ System upgrades planned
- ☐ Technology transparency attained
- ☐ Accessibility realized for alternate source development

Figure 3. Sample Worksheet for Estimating Costs of Alternative Source Solutions

ROM Cost Estimate

Alternative Source

Requirements ________ × Unit Cost _______ = __________
Nonrecurring Engineering = __________
Prototype Development = __________
Tech Data Development/Compilation = __________
Qualification = __________
Part Testing (Form, Fit, and Function) = __________
System Testing = __________
Documentation Revision = __________
Warehousing and Disbursement = __________

DMSMS Analysis Labor:

Engineer Man-Hours ________ × Rate _______ = __________
Analyst Man-Hours ________ × Rate _______ = __________
Other Man-Hours ________ × Rate _______ = __________
Solution Total = __________

Cost Avoidance Analysis

Recall that the rationale for a proactive DMSMS management program is that "finding solutions early will save money." Any claimed cost avoidance, or savings, cannot be realized by merely identifying a solution. The solution must actually be implemented for true avoidance or savings to result. Data have been published on the expected average costs for each of eight common nonrecurring engineering (NRE) DMSMS solution types. Table 4 shows the average NRE cost values for the various solution types. For 2007 and beyond, you should apply DoD escalation factors to these values.

Table 4. NRE Cost Metrics (2006)

Solution	Average cost ($)
Existing stock	0
Reclamation	2,000
Alternate	7,000
Substitution	21,000
After-market	54,000
Emulation	78,000
Redesign—minor	127,000
Redesign—major	469,000

Note: These cost values are obsolete. Since they were developed in the 1997–1999 time frame, their updates have been limited to applying escalation factors to the original values. These values should not be used for budgetary purposes, because they do not include the effects of changes to material and chemical technology, environmental restrictions, manufacturing processes, raw materials costs, or the overall business market. They also do not include data on hybrids, application-specific integrated circuits, or replacement of two or more unique boards with one common board. If possible, cost values should be based on values proposed by the prime contractor. Those same values should be used in estimating the cost of solutions associated with individual PPRs or solutions documented in DMSMS Engineering Requirements Plans. (NRE cost metrics will be updated in 2010.)

The values in Table 4 do not include system-level qualification testing, software testing, and certification testing for safety of flight or flight test costs. You should add these costs into the analysis based on the unique aspects of your specific systems. In addition, you should incorporate any solutions specific to the program office, such as a LOT buy, into the analysis. This means that programs should keep track of actual solution costs and should use these values only as a default.

The average costs are used to analyze cost avoidance, defined as the average cost of the selected solution minus the average cost of the next most technically feasible solution. (For example, when an alternate solution was selected, there may not have been a substitute available; the after-market would be the next technically viable option.) A redesign may resolve DMSMS problems for more than one component at once. Cases have been documented where as many as five obsolete part problems were solved with one board or SRU redesign.

This cost avoidance method ranks each solution from lowest cost to highest cost. Cost avoidance is determined by subtracting the average cost of a solution derived proactively from the next most feasible average cost solution (assumed to result from taking no action or a reactive DMSMS program).

Below are example cost avoidances for different solutions:

- If a device can be emulated, a cost avoidance of $49,000 is realized ($127,000 − $78,000), because it prevents a minor redesign.
- If an alternate device is available, a cost avoidance of $47,000 is realized ($54,000 − $7,000).

As the DMSMS program generates a growing list of solutions, the DMT should capture data on the actual costs of each solution. It can then compute the total cost avoidance of the current set of solutions and can keep a running track of cost avoidance as shown in Table 5.

Business Case Analysis

A business case analysis (BCA) quantifies the economic value of the DMSMS program in terms of measures such as return on investment and breakeven point (BEP). Two analysts could look at the same data and generate different outcomes if they use different assumptions or modeling methods. Therefore, the BCA assumptions and method used must be succinctly and fully disclosed.

Whatever BCA method is used, it must generate a cost stream for each alternative under consideration. For a DMSMS management program, the alternatives are the reactive approach and the proactive approach.

Table 5. Sample Cost Avoidance for Set of DMSMS Program Solutions

Solution type	Solution status	PPR count	Cost avoidance estimate ($)
Emulation	Unfunded	11	0
Firmware	Firmware solution in work	2	60,000
	Unfunded	7	0
NHA redesign	Unfunded	10	0
Part redesign	Engineering solution complete	5	2,700,000
	Engineering solution in work	2	1,100,000
	Unfunded	1	0
Substitution	Engineering solution complete	1	55,000
	Engineering solution in work	2	94,000
	Unfunded	120	0
Multiyear buy	MYB complete (with PPRs)	54	1,800,000
	MYB complete (no PPRs)	500	17,000,000
	MYB on order	8	0
	MYB partially received	10	340,000
	MYB protected at DSCC	6	200,000
	Other	1	0
	Unfunded	298	0
No support impact	Approved alternate available	71	200,000
	Part no longer used	17	0
	Part still available	239	720,000
	Sufficient quantity on hand	206	620,000
Reclamation	Reclaimed parts on hand	1	0
	Reclamation in work	1	0
	Unfunded	2	0
Transfer of assets	Transfer complete	9	27,000
	Transfer pending	17	0
Total cost avoidance			24,916,000

Notes: MYB = multiyear buy, NHA = next higher assembly, PPR = Problem Part Report.

The following scenarios describe the two approaches:

- *Reactive approach*. DMSMS problems go unnoticed until a repair part such as an integrated circuit is needed. If that part becomes obsolete and unavailable, the SRU quickly receives focused attention from the responsible IPT. The cost and complexity of the resultant corrective action then depends on the severity of obsolescence in the SRU. To model this scenario across an entire LRU or weapon system and to generate a cost stream for it, you must estimate and mathematically relate three items:
  - Number of SRU problems each year caused by obsolete unavailable parts
  - Distribution of degree of obsolescence present in those SRUs
  - Solution costs for those SRUs associated with the varying degrees of obsolescence.

  You can then estimate the cost, by year, of a reactive approach to DMSMS management.

- *Proactive approach*. The DMT identifies problem parts in the platform configuration and takes steps to develop and implement solutions before the problems can affect the system support posture and operational availability). To model this scenario, you must relate the following three items mathematically:
  - Historical mix of solution types (substitute part, emulation)
  - Number of obsolescence problems estimated to be solved each year
  - Cost data for each type of solution.

  You can then estimate the cost, by year, of a proactive approach to DMSMS management.

One principal output of the BCA is the BEP, which shows the payback period of an alternative. It is found from a plot of the cumulative yearly benefit less the cumulative yearly operations cost, computed over the years of interest. The benefit for each year is the difference between the costs of the reactive approach and the costs of the proactive approach. The BEP—the point at which the plot crosses the x-axis, as shown in Figure 4—signifies that the cumulative investment in the proactive approach equals the cumulative benefit derived from that investment. At this point, the extra costs of the proactive program are offset and savings begin to

Figure 4. Sample Plot Showing Breakeven Point ($ million)

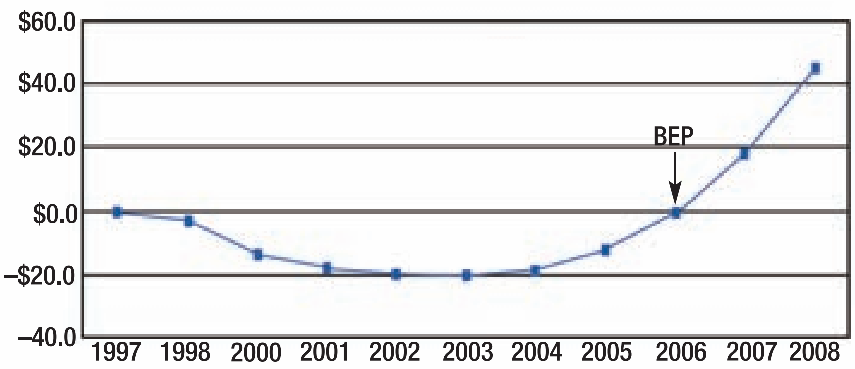


Table 6. Sample Economic Analysis Summary (10-Year Study)

Item	Reactive ($M)	Proactive ($M)	Notes
Cost DMSMS program costs DMSMS solution costs Total	 NA 180 180	 30 65 95	
Benefit		115	$180M – $65M
Breakeven point		End of 2006	From a plot
Benefit-to-cost ratio		3.8	$115M ÷ $30M
Return on investment		2.8	($115M – $30M) ÷ $30M
Net value		85	$180M – $95M

accrue. In addition to the BEP plot, a typical BCA would include a table of econometric values. Table 6 is an example.

In summary, a proactive approach to DMSMS management yields the best return for the warfighter. Not only does a proactive approach minimize costs over the long run, but, because it addresses obsolescence early, it provides higher levels of readiness to the warfighter. In contrast, a reactive approach may place the warfighter and his mission in jeopardy, because he may not be able to use his weapon, or equipment, until a suitable replacement part or system is found.

Funding Impact versus Time

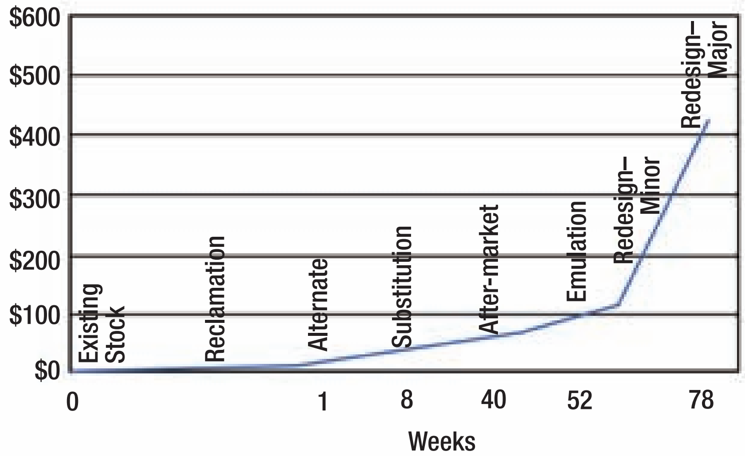
To implement the selected solution, you will need to secure funding. If funding is not available, you should petition the system program director (SPD) or system support manager (SSM) for the necessary funding. The SPD or SSM must work with the program element monitor (PEM) to include DMSMS requirements in the Future Years Defense Program, taking into consideration the program phase and the year money is required. If the funding aspect is not pursued, then an "unfunded liability" exists that exacerbates the obsolescence problem in the future. You can influence the budgeting process if you have data demonstrating the costs of a DMSMS plan and the potential cost avoided. Specifically, you need metrics that demonstrate the true costs and benefits of DMSMS management.

Schedule

The costs and typical times to solve DMSMS problems can be plotted. Figure 5 is an example. As you would expect, the time required to solve a problem increases as the complexity of the solution increases. In other words,

Timeline determination = solution timeline (includes ALT + PLT + funding timeline).

Figure 5. NRE Cost and Time to Resolve by Solution Type ($ thousand)



Performance

Operations Impact Analysis

Operations impact analysis (OIA) predicts the effects of obsolescence on operational readiness. The OIA answers this question: "If we do nothing about DMSMS, what happens to the inventory of LRU (box or weapons replaceable assembly) and SRU (board or shop replaceable assembly) spares—and, ultimately, the weapon system?" From a proactive view, the SRU that will become obsolete first is the one that should be examined first.

The OIA is sensitive to the following complex data sets:

- Forecasts of platform operating hours
- LRU and SRU failure and condemnation rates
- Obsolescence trend of the system components (if the rate of obsolescence is high, repair parts likely will not be available for the LRUs and SRUs that fail)
- Number of spares of each type of LRU and SRU in the system (with minimum spares, obsolescence-induced shortages could trigger an operations impact sooner).

An OIA approach requires making some simplifying assumptions. We assume that, without intervention, every year more failed SRUs would not get repaired because the failed parts are obsolete, not procurable, and not in the repair parts stock. If the depot cannot repair the SRUs, we would have a problem. We may also assume that some obsolete parts can be reclaimed from a pool of nonreparable SRU carcasses. Because of reclamation problems, the yield of pool parts from this pool will be less than 100 percent. Eventually, the SRU spares pool will become exhausted, causing the effective loss of an LRU spare when used to supply a spare of the needed SRU. The model is sensitive to operational hours and failure rates, as mentioned before.

As your DMT implements solutions for your obsolete part types, the OIA must be changed to model them. For example, if you make a multiyear buy of an obsolete part, that part is carried (in the model) as "available" and would not contribute to the depletion of the SRU spares population. You can use this information to measure the effect of your implementations on operational supportability.

The output of the OIA is a matrix showing the drawdown of the population of SRU or LRU spares, as described above. Table 7 is a sample output of an OIA at the LRU level. The color in each cell indicates the spares posture and the number indicates the number of spares available. For example, for the control unit, "G 1" in 2011 means that one spare is available. For 2012, the table shows "Y 0," because the OIA predicts a drawdown of one spare (in 2011) leaving zero spares available for use in repair. For the VHF radio, the table shows "Y 0" (no spares) for 2009 and 2010, but changes to "R −1" for 2011, when the model indicates a drawdown from 0 to −1, which represents a shortage of one item. Clearly, the year in which a given LRU turns "Red" represents a dire circumstance for the program unless a work-around solution is found. Thus, the OIA can provide the early warning needed to prioritize LRUs with serious DMSMS problems and to begin planning for a technology refresh or modernization.

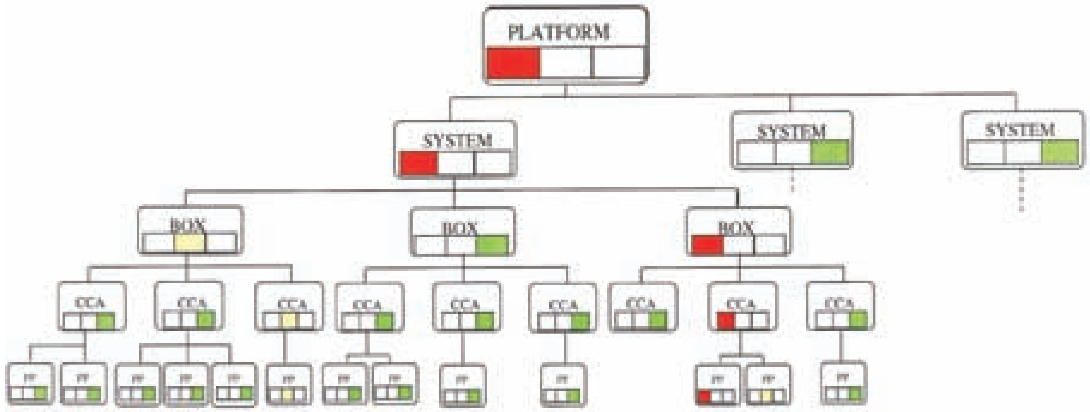
Table 7. Sample OIA Output

LRU name	Initial quantity LRU spares	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Control unit	3	G 3	G 2	G 1	Y 0	R –2	R –4	R –6	R –8	R –11	R –15	R –19
UHF radio	5	G 5	G 5	G 5	G 5	G 4	G 4	G 4	G 3	G 3	G 3	G 2
VHF radio	2	Y 0	Y 0	R –1	R –1	R –2	R –3	R –3	R –4	R –4	R –5	R –6
Electronic assembly	2	G 2	G 2	G 1	G 1	G 1	G 1	Y 0	Y 0	Y 0	Y 0	R –1
Power supply	3	Y 0	R –2	R –5	R –8	R –11	R –15	R –18	R –21	R –25	R –29	R –33

Platform Readiness Status

Platform readiness status is based on which systems are needed by the operator (tank commander, pilot, ship captain) to successfully complete the mission. Like other aspects of the DMSMS program, platform readiness status can be depicted by applying the red–yellow–green coding scheme to each indentured box, component, or part below it. Figure 6 is an example.

Figure 6. Sample Model for Depicting Platform Readiness Status



Notes: CCA = circuit card assembly, PP = piece parts.

Performance Measures

Table 8 lists many useful performance measures that are available to characterize the effectiveness and output of your DMSMS management program. It may take some time to accumulate the data and develop the capability to produce the more advanced measures listed in the table.

Design Interface Criteria

The Department of the Navy has published evaluation criteria in *Independent Logistics Assessment Handbook* (NAVSO P-3692) that you may find useful when developing assessment criteria for your DMSMS program. Appendix G contains a table excerpted from that document.)

DMSMS Progress Indicator

ARINC, Inc., has developed a method to track DMSMS progress. The most important metric is mission success; mission capability should never be at risk due to inadequate obsolescence management. In general, performance can be measured as the ratio of good events to total events. In the field of reliability engineering, inherent availability (Ai) is measured by the ratio of uptime to total time:

$$Ai = Uptime \div (Uptime + Downtime).$$

Success in DMSMS management is generally seen in terms of the effect on system availability. Parts availability is itself not measured in terms of uptime or downtime, although parts availability contributes to system availability as computed above. Operational availability (Ao) considers parts availability as part of the equation as mean logistics delay time (MLDT):

$$Ao = Uptime \div [(Uptime + Downtime) + MLDT].$$

Table 8. Typical Internal Performance Monitoring for a Proactive DMSMS Management Program

Source	Data to be examined	Purpose
Predictive tool	Monthly count of piece parts across the entire platform, by DMSMS color code[a]	Characterize system health
	Monthly count of parts, SRUs, and LRUs, by color code, in each system	
DMT database	Cumulative number of PPRs	Determine DMT productivity
	Cumulative generation of LRU assessments	
	Count of PPRs at various DMT locations showing age of PPRs at each location	Determine DMT process effectiveness
	Breakout by solution type and status categories	Characterize DMSMS in the configuration
	Breakout of multiyear buys by status (e.g., on order or received)	
	Count of "no impact" conclusions	
	Count of funded versus unfunded solutions	
	Breakout of unfunded solutions, by age and type	
	Estimate of proactive solution benefits of established solutions	Compute cost avoidance
Other sources	Econometric comparison of proactive and reactive approach cases	Determine business case metrics
	Projected DMSMS-induced depletion of LRU and SRU spares	Analyze operational impacts

[a] "Green" = two or more viable manufacturers, "yellow" = only one viable manufacturer, "red" = no manufacturers (the part is obsolete), "blue" the manufacturing sources for the part are not known.

DMSMS progress can be measured using two equations, one addressing the macro level (assembly or box level) and the other, the micro level (piece part level). In both cases, progress is measured by calculating a ratio that establishes a baseline and then monitoring the ratio as it changes over time. Naturally, the ratio would have to be rebaselined when system configurations change and the number of total events either decrease or increase. For both equations, a progress indicator (PI) of 1.0 indicates that the program has no problems, while a PI of 0 implies obsolescence has not been evaluated.

At the assembly level (AL), PI can simply be stated as

$$PI_{AL} = \text{Assemblies with no obsolescence issues} \div \text{Total number of assemblies}.$$

Assemblies with no obsolescence issues imply that the item has been evaluated and will not cause an impact because either no DMSMS issues exist for the item or the issues have been solved (sufficient spares are available, the item was redesigned, technology insertions are planned). Assemblies with the lowest PI should be evaluated first.

At the piece part level (PL), PI can be stated as

$$PI_{PL} = (G + Y1) \div (G + Y1 + Y2 + R + B),$$

where

G = parts that show no current or future obsolescence or have more than one source of supply

Y1 = parts that have only one source of supply and a funded solution has been implemented (or identified)

Y2 = parts that have only one source of supply and no solution has been implemented or identified or no monitoring program has been established

R = parts that are obsolete or discontinued with no solution identified

B = parts that are unknown (not identified by a predictive tool or on BOM).

Additional observations are as follows:

- If you have no BOMs, the PI will be 0.
- If the predictive tool reports greens as reds, the PI will be lowered.
- If the predictive tool reports reds as greens, the PI will be increased.
- As problems are solved, the PI will be increased.

In summary, you can use both equations as progress indicators by collecting program data, performing the calculation, recording the results, and repeating these steps monthly. The bottom line still remains: the best metric is mission success.

Summary

This guidebook describes the best proactive DMSMS practices used across DoD for managing the risk of obsolescence. You should now have some insight into these key areas:

- Development and integration of TLCSM and PBL tenets to support DMSMS efforts
- Understanding of the levels of DMSMS involvement
- Approach to building a proactive DMSMS program
- Benefits of proactive versus reactive approaches to DMSMS management
- Awareness of applicable reference documents that provide DMSMS policy and guidance
- Awareness of some of the DMSMS tools and services available
- Awareness of tools for tracking the status and effectiveness of a DMSMS program
- Awareness of the DMSMS Knowledge Sharing Portal and the helpful resources provided.

The main point to be taken from this guidebook is that you need to proactively address DMSMS issues. Doing nothing is not an option. No two programs are alike. However, much can be gained from the prior work of others. The intent of this guide is to help make this action much easier for you.

Appendix A. DMSMS-Related Documents

Air Force Materiel Command, DMSMS Program, *Case Resolution Guide*, May 1999.

Code of Federal Regulations, Title 15, Part 700, "Defense Priorities and Allocation System," August 1998.

Defense Acquisition University, *Performance Based Logistics: A Program Manager's Product Support Guide*, March 2005.

Defense MicroElectronics Activity, *Program Manager's Handbook: Common Practices to Mitigate the Risk of Obsolescence*, May 2000, available at http://www.dmea.osd.mil/docs/acquisition_guidelines.pdf.

Defense MicroElectronics Activity, *Resolution Cost Metrics for Diminishing Manufacturing Sources and Material Shortages*, May 1999.

Defense Standardization Program, *Performance Specification Guide*, SD-15, June 1995.

Department of Defense, MIL-STD-3018, "Parts Management," October 2007.

Department of the Navy, *Independent Logistics Assessment Handbook*, NAVSO P-3692, September 2006.

Deputy Under Secretary of Defense for Logistics and Materiel Readiness, Memorandum, "Life Cycle Sustainment Outcome Metrics," March 2007.

Federal Aviation Administration, *FAA COTS Risk Mitigation Guide: Practical Methods for Effective COTS Acquisition and Life Cycle Support*, July 2003.

Institute for Defense Analyses, *A Partnership between Value Engineering and the Diminishing Manufacturing Sources and Material Shortages Community to Reduce Ownership Costs*, September 2008.

Office of the Secretary of Defense, *Designing and Assessing Supportability in DoD Weapon Systems: A Guide to Increased Reliability and Reduced Logistics Footprint*, October 2003.

Appendix B. Web-Based Resources

Air Force Materiel Command DMSMS Program

http://www.ml.afrl.af.mil/dmsms/default.html

Includes information on AFMC DMSMS-related activities and links to DoD and industry websites

Army Materiel Command, Logistics Support Activity, Systems Planning and Requirements Software

https://www.logsa.army.mil/lec/syspars

Includes a DMSMS management plan generator (also known as "Plan Builder")

Defense Acquisition University

https://acc.dau.mil

Includes links to the Logistics Community of Practice (which addresses DMSMS, obsolescence, and continuous modernization) and the Systems Engineering Community of Practice (which addresses open systems, commercial off-the-shelf, and evolutionary acquisition)

Defense Acquisition University, Integrated Framework Chart

https://acc.dau.mil/IFC/

Links to the Integrated Defense Acquisition, Technology and Logistics Life Cycle Management System Chart

Defense Logistics Agency

http://www.dla.mil/

Provides comprehensive, best practice technological support to the DoD/DLA logistics business community

Defense Logistics Information Service

http://www.dlis.dla.mil/

Contains the following tools:

- DESEX (Defense Supply Expert)
- DRMS (Defense Reutilization Marketing Service)
- JTAV (Joint Total Asset Visibility)
- DLA Status (Defense Logistics Agency Status)
- EMALL (Electronic Mall)
- DAMES (DAASC Automated Message Exchange)
- Web REQ (Web REQuisition)
- DSS (Distribution Standard System)
- GTN (Global Transportation Network)
- ITV (Radio Frequency In-Transit Visibility)
- Web VLIPS (Web Visual Logistics Information Processing System)

Defense MicroElectronics Activity

http://www.dmea.osd.mil/

Contains information on technologically correct and economically viable solutions to microelectronic obsolescence

Defense Supply Center Columbus

http://www.dscc.dla.mil/

Contains DMSMS information on electronic components

Defense Supply Center Columbus, Generalized Emulation of Microcircuits Program

http://www.dscc.dla.mil/programs/gem/

Contains information on form, fit, and function replacement for unavailable microcircuits using current design and processing technologies

DMSMS Knowledge Sharing Portal

www.dmsms.org

Exists to encourage communication, education, and cooperation in achieving solutions to DMSMS challenges

Government-Industry Data Exchange Program

http://www.gidep.org

Enables sharing of technical information essential during research, design, development, production, and operational phases of the life cycle of systems, facilities, and equipment

Government-Industry Data Exchange Program, Shared Data Warehouse

http://www.gidep.org

Enables rapid and economical identification, dissemination, and processing of DMSMS-affected part numbers and national stock numbers

Naval Sea Systems Command, Corona Division, Sunset Supply Base

http://www.dmsms.org/SSB

Services as a bridge between government programs and manufacturers, and includes recommended approaches to mitigating obsolescence risk

Naval Sea Systems Command, Crane Division, DMS Technology Center

https://portal.navfac.navy.mil/portal/page/portal/navfac/navfac_ww_pp/navfac_ncc_pp

Provides in-depth information on DMSMS management and solutions

Naval Supply Systems Command, Navy Logistics Productivity R&D

https://www.navsup.navy.mil/navsup

Contains general information about the Navy's policy, guidance, and tools for commercial off-the-shelf items

Appendix C. Best Practices for Obsolescence Management of COTS Products

Using COTS items has several benefits, including reducing or eliminating the risks typical of custom-developed systems. However, COTS solutions present a unique set of challenges that are specific to the commercial market and the COTS products it offers. For example, the rapid turnover of COTS products creates unique obsolescence-induced supportability issues, as does the as-is nature of COTS product configurations, which often do not completely meet rigid military requirements. This appendix describes practices developed by the Federal Aviation Administration (FAA) and the Office of Naval Research (ONR) for acquiring and supporting COTS-based systems.

Federal Aviation Administration Practices

The FAA, through its Acquisition Management System, has fielded numerous COTS-based systems into the National Airspace System since 1996. The FAA has documented its practices in *FAA COTS Risk Mitigation Guide: Practical Methods for Effective COTS Acquisition and Life Cycle Support*. The standardized approach described in the guide features the application of the system engineering process of programmatic risk management. The guide is designed to provide any activity with a standard method for acquiring and supporting COTS products. It describes commonly experienced government and industry lessons-learned or risk factors associated with the use of COTS products, and it identifies risk mitigation strategies that can effectively limit the impact of the risks. The guide also provides an in-depth "what, why, how, and when" discussion of each mitigation strategy relative to system engineering processes and acquisition life-cycle phases.

The guide's appendixes contain additional useful information:

- References
- COTS obsolescence and technology evolution planning
- Relationship of COTS mitigation strategies to a work breakdown structure
- Obsolescence risk analysis
- Technical performance factors to assist with the development of COTS-related functional/performance specifications (for example, open system standards conformance)
- Nontechnical selection factors to provide for optimization of product selection based on nontechnical criteria such as product maturity.

The strategies developed by FAA can be applied by any organization. Such a risk mitigation approach can accelerate the transition of acquisition and user personnel from rigid custom-oriented approaches to more flexible market-oriented approaches, dictated by the growing number of COTS-based system acquisitions.

Office of Naval Research Practices

ONR created the Best Manufacturing Practices (BMP) program to help businesses identify, research, and promote exceptional manufacturing practices, methods, and procedures. Its objective is to empower defense and commercial customers to operate at a higher level of efficiency and effectiveness. To achieve this end, the BMP program has three core components:

- Best practices surveys, which are conducted to identify, validate, and document best practices and to encourage government, industry, and academia to share information and implement the practices
- Systems engineering, which is facilitated by the Program Manager's WorkStation, a suite of electronic tools that provide risk management, engineering support, and failure analysis through integrated problem solving
- Web technologies, offered through the Collaborative Work Environment, which provide users with an integrated digital environment to access and process a common set of documents in a geographically dispersed environment.

The program highlights innovative COTS products and techniques that provide resolutions to specific problems. Its main goal is to save manpower, time, and money. Below are some examples of best practices from the ONR BMP website.

ELECTRONIC PART OBSOLESCENCE FORECASTING

The Center for Advanced Life Cycle Engineering (CALCE) at the University of Maryland has developed two methods for predicting part obsolescence. The two methods address current limitations in the capability to forecast future obsolescence dates and provide quantitative confidence limits when predicting future obsolescence. The two methods are as follows:

- *Electronic Part Obsolescence Forecasting.* This method, developed by the CALCE Electronic Products and Systems Center (EPSC), uses data-mining-based algorithms to forecast electronic part obsolescence. In the basic EPSC method, sales data for an electronic part are fit to a curve. The attributes of the curve fit are plotted, and trend equations are created that can be used for predicting the life-cycle curve of future versions of the part type. This approach, in conjunction with the life-cycle curve forecasting approach, substantially increases the predictive capabilities of obsolescence forecasting.
- *Mitigation of Obsolescence Cost Analysis (MOCA).* MOCA provides a stochastic solution for design refresh planning—a system design strategy that sets a target point along the procurement timeline for revising a design to eliminate obsolete parts. MOCA uses a detailed cost analysis model based on production projections, maintenance requirements, and parts obsolescence forecasts. MOCA determines the number of refresh activities (redesigns) that will optimize the system sustainment costs, and it predicts the dates for these activities. The most mature MOCA method, known as the Technology Sustainment MOCA, provides planning data that support refreshing the design in its current configuration. An enhanced MOCA version, known as the Technology Insertion MOCA, will add decision networks to account for other design factors besides obsolescence, making it possible to characterize key elements, such as performance and reliability that influence design. Besides determining optimum refresh design dates, it also may show how the design might be improved.

AEGIS COTS TECHNOLOGY FAMILY ANALYSIS AND SELECTION TOOL

The Aegis COTS Technology Family Analysis and Selection Tool (ACTFAST)—developed by Lockheed Martin Naval Electronics and Surveillance Systems–Surface Systems (NE&SS-SS)—is an all-encompassing tool for dealing with the complexities in today's COTS acquisition environment. ACTFAST leverages the entire program community for risk mitigation and optimal system design. This relatively new tool and the accompanying process assess total life-cycle concerns in the COTS equipment selection process. ACTFAST addresses four acquisition focus areas: technical/performance; program management (development, production, operations, support, training); total relative cost; and road maps (multiple baselines, viability, market/technology trends). The tool, which requires a relatively minimum amount of information to start, supports a three-phased IPT approach consisting of technology identification, vendor selection, and end-product choice. Using the IPT approach, tailored questions lead to discriminatory categories that, in turn, require data collection. The acquisition data collected are then refined, weighed, and assessed by the IPT prior to making a selection. The IPT consists of representatives from the Navy Fleet; the program office; production engineering, manufacturing, sourcing, and lifetime support operations; industry; and the appropriate laboratories.

COMMERCIAL PARTS PROCESS

ITT Aerospace/Communications Division (A/CD) established a process for the procurement of commercial instead of military microelectronic devices suitable for use in military and aerospace electronic systems. ITT A/CD began by developing a qualification plan for procurement. A team conducted surveys, visited vendors, and reviewed parts data to address specific plastic encapsulated microcircuit and nonmilitary concerns (lifetime cost, reliability, performance). ITT A/CD also analyzed commercial part samples, using destructive physical and soniscan methods. This process enabled the company to develop a working preferred supplier list and to identify the critical parameters and specific application requirements of commercial parts.

After receiving customer approval, ITT A/CD produced 32 pilot Single Channel Ground and Airborne Radio System (SINCGARS) devices using COTS parts. These radios were subjected to more than 45,000 hours of production reliability acceptance tests without a single failure. In addition, ITT A/CD ran comparison tests (156,500 hours) on SINCGARS radios with military and COTS parts. The results indicated that the COTS radios were at least as reliable as the military units. In addition, the use of COTS parts reduced material costs by 50 percent, increased part availability tenfold, and eliminated the required test screens and control of detailed drawings of military parts.

MECHANICAL COTS DESIGN PRACTICES

Lockheed Martin NE&SS-SS undertook the Mechanical COTS Design Practices initiative to address issues with the validation of critical design parameters for COTS items to be used in military applications. Through this initiative, Lockheed Martin NE&SS-SS was able to move its design process toward risk reduction testing when designing enclosures for COTS equipment. This approach includes the design, analysis, and testing of hardware prior to environmental qualification. These design practices also enabled the company to use its own data collection methods and equipment at test houses. As a result, the company no longer needs to rely on the vendors' data collection, analysis, and presentation techniques and practices. Since implementing Mechanical COTS Design Practices, Lockheed Martin NE&SS-SS has been able to reduce program costs and develop more robust designs. The combined benefits of analysis and risk reduction testing saved a recent program approximately $120,000 in enclosure material costs alone.

COTS USAGE RISK EVALUATION

The Carnegie Mellon Software Engineering Institute has developed an approach—COTS Usage Risk Evaluation, or CURE—to reduce the number of program failures attributable to COTS software. CURE is intended for use by any program office or contractor that is creating large-scale software systems that rely on COTS products. CURE is a front-end analysis tool that predicts the areas in which COTS software products will have the greatest impact on the program. This allows managers to map out a strategy to address the specific risks uncovered by the evaluation and to monitor their mitigation. CURE is designed to find risks relating to the use of COTS software products and to report those risks back to the organization that is evaluated. The evaluation consists of four activities: preliminary data gathering; on-site interviews of key program personnel to gather more detailed data; analysis of the data, in conjunction with a database of risk factors and risk conditions, to identify a set of COTS-related risks that appear to be significant for the program, as well as program strengths; and presentation of results.

Conclusion

DMSMS concerns about COTS equipment are inevitable. Avoiding DMSMS in COTS equipment calls for effective relationships among program participants: the COTS supplier, the system developer and integrator, and the buyer. Most significant is that while all COTS equipment is subject to DMSMS, particular component classes or parts are prone to specific problems. For example, software, central processing units, memory chips, and disks change frequently. According to OEMs, a degree of obsolescence is always in place in the form of planned minor upgrades or refreshes, typically at the 2- and 4-year points. Beyond that, a complete, major upgrade—a next generation—should be expected.

Considering the information presented in this appendix, a key step in developing an obsolescence management strategy for a COTS-based system is to compile a list of COTS equipment and parts in the system. For each item on the list, the design team should query manufacturers of COTS products to obtain information such as the following:

- Current availability: Will sufficient parts be available during the production cycle to support not only the projected deployable systems but also the spares needs?
- Bill of materials: Will the supplier provide a BOM?
- Product plans: What are the component manufacturer's plans with respect to the component? Is it targeted for discontinuance? Will manufacturing drawings be available?
- Upgrades: Is the component targeted for an upgrade? Will it meet the form, fit, and function interface specifications of the current product?
- Timeline: When will changes be made?
- Customer upgrade support policy: Will the supplier be available to support the product at least until the threshold life cycle is achieved?
- Parts availability support/inventory: What is the current state of parts availability? Will the supplier enter into special microcircuit support agreements? How does the COTS timeline compare with the projected system life cycle?

In summary, if managed for obsolescence, COTS products can offer reductions in manpower, time, and cost and improvements in design. Below are some minimum actions to mitigate the risk of DMSMS in COTS equipment:

- Develop a COTS checklist to survey suppliers
- Perform risk mitigation exercises similar to the FAA and Aegis initiatives to identify areas of risk and avenues of resolution
- Verify design parameters early in the design process
- Develop a qualification plan for COTS item or equipment procurement, such as that used by the ITT A/CD program
- Consider using a predictive tool to pinpoint where COTS items will have the greatest impact on your system (CURE approach) or to forecast electronic parts obsolescence (CALCE project).

Appendix D. Glossary

After-market manufacturing (reverse engineering). Use of an after-market producer to obtain and maintain the design, equipment, and process rights to manufacture the component after the original manufacturer ceases production. The manufacturer must be qualified, by the appropriate service authority, to produce the part.

Alternative source. A source other than the OEM. An example is a smaller company that may undertake production that is no longer profitable for a larger company. A proactive DMSMS management program may identify sources that qualify as small or disadvantaged businesses. It may make sense to allocate the procurement among at least two suppliers to maintain production capability. The buyer must ensure that the alternate source is providing certified parts. One way is through traceability back to the OEM showing authorization from the OEM. The ultimate check is by ensuring part qualification and certification through the weapon system engineering support authority to meet requirements of form, fit, and function.

Availability guarantee. See "contractor requirement."

Breakout. Separation of the DMSMS part from the component or subsystem to facilitate redesign or replacement.

Bridge buy. Procurement of a sufficient number of parts to allow time to develop another solution.

Commercial item substitution. Replacement of an obsolete item (component, SRU, or LRU) with a commercially available item.

Continuous modernization. Process by which state-of-the-art technologies are inserted continuously into weapon systems to increase reliability, lower sustainment costs, and increase the warfighting capability of a system to meet continually evolving customer requirements throughout an indefinite service life.

Contractor requirement. Requirement for a contractor, through contractual agreements, to maintain an inventory of DMSMS items for future production use. Under some circumstances, a supplier may guarantee long-term availability of a part or family of parts. Among factors to be addressed are uncertainties inherent in such an arrangement, high cost, and the feasibility of the existence of such a contract. Contractual approaches may lead to the transition of efforts to solve obsolescence problems from the government to industry, or they may lead to new design approaches or system operation regimens.

Contractor-maintained inventory. Approach requiring the contractor to implement contractual agreements to maintain an inventory of DMSMS items for future DoD needs.

Defense Priorities and Allocations System. System designed to ensure the timely availability of industrial resources to meet national defense and emergency preparedness needs.

Design for obsolescence. Approach that addresses obsolescence during the design phase. An example is use of the Very High Speed Integrated Circuit (VHSIC) Hardware Description Language (VHDL), which has become a standard design tool throughout much of the electronics industry. Components, boards, or systems designed using VHDL are described in such a way that replacement with different components is straightforward. In particular, the replacement of a part or any assembly of parts with newer or different technology does not require redesign. In order for VHDL to be used effectively, it has to be added to the contract. The contractor should be required to deliver to the government, with unlimited rights, a behavioral VHDL model with test bench, for digital components.

Design technique. Approach used to mitigate or minimize the effects of, or the onset of, technology obsolescence. Examples are the inclusion of critical design review criteria specifying manufacturing life before discontinuance and the requirement for a waiver (a 10-year waiver, for instance) if criteria are not met.

DLA War Stopper List. Program that addresses the resolution of Warfighter Critical Shortage List items, including related supply chain issues.

Early-life-cycle parts procurement. Judicious part selection for replacement of an obsolescent part or as a component in a new design to prevent or delay obsolescence. Selecting a part that is relatively new in its life cycle is a hedge against early obsolescence. It is sometimes possible, especially if large production expenditures are involved, to predict the families of parts that will be replaced by a new product line.

Early-warning database. Reactive approach to resolving obsolescence cases. The database should contain information about every part in the system. Such a database can become a proactive tool if projections of the obsolescence of all parts are incorporated and a system health analysis is performed. With a database encompassing the system's entire indentured parts list and a projection of parts obsolescence, a system manager, or engineer, could decide the optimum level (part, board, subsystem, or system) of replacement and then could schedule for replacements required to maintain the functionality of the system. Also, maintaining the data electronically allows quick research of obsolescence notices, part reliability, availability, maintainability, and sustainability. This type of analysis supports the manager's programming for the funds to accomplish the needed replacements. Another reason to have the complete set of system parts in an electronic database is that you can utilize electronic comparison routines. This allows for the comparison of parts you have versus the obsolescence notices that originate from other sources such as GIDEP or DSCC.

Emulation. Use of current design and manufacturing processes to produce an equivalent item (form, fit, and function) for the DMSMS item.

Existing source (stock). Use of source in the current inventory.

Existing substitute. Replacement of the DMSMS item with a substitute item whose performance (in terms of form, fit, and function) matches that of the DMSMS item.

Government/organic fabrication facility. Facility that can be used to produce an obsolete item that qualifies as a special fabrication project. A government/organic fabrication facility can also serve as an after-market manufacturer.

Joint Materiel Priorities and Allocation Board. Board responsible for the following activities:

- Modifying and recommending priorities for allocations of assets for the fulfillment of logistic requirements of the theater (both U.S. and allied forces)
- Reviewing, acting on, or forwarding requests for modifications in force and activity designators to the Joint Staff
- Reviewing, acting on, or forwarding requests to establish or change the priorities in the master urgency list to the Joint Staff
- Recommending, to the Joint Staff, modifications to priorities and allocations of resources assigned to other commanders of a combatant command.

Life-of-type buy. Procurement of a sufficient quantity of a DMSMS part to ensure full production plus repair and replacement spares for the expected life cycle of the system. Costs for packaging, storage, and transportation must be considered. These costs may be reduced by identifying alternate sources.

Modernization through spares. Insertion of spare parts that reflect current technology and the use of commercial products, processes, and practices.

Modification or redesign. Modification or redesign of an assembly such as a circuit card to solve all obsolescence problems in the assembly (as opposed to multiple individual solutions within that assembly).

Nondevelopmental item substitution. Replacement of an obsolete item with an NDI. NDIs are previously developed unique items that have been (or will be) used in a government application.

Open systems architecture. A design approach that uses open systems interface standards to the maximum extent practical. An open systems interface standard is a publicly available document defining specifications for interfaces, services, protocols, or data formats established by consensus and widely used in the marketplace.

Performance-based life-cycle product support. A support strategy, particularly at the system and platform level, in which responsibility for DMSMS and obsolescence planning, as well as continuous modernization and technology insertion, is placed upon the PSI (which, in many instances, is also the OEM).

Performance-based requirement. Parameter that represents the warfighter's needs. These parameters focus on performance or results rather than on design details (how a system should be designed). (See SD-15, *Performance Specification Guide*, for more information about performance-based requirements.)

Reclamation. DMSMS solution in which parts are taken from marginal or out-of-service equipment or, when economical, from equipment that is in a long supply or potential excess position. This assumes the end item has not been transferred to Defense Reutilization and Marketing Service (DRMS) for disposal. If items have been transferred to DRMS, it may be possible to reclaim them. However, parts from DRMS will not have a handling history. Moreover, they may have drawbacks such as electrostatic discharge damage, handling damage, and heat damage from unsoldering.

Redefined requirement. Redefinition of the military specification through engineering support activities or to enable purchase from a commercial source.

System upgrade and Service Life Extension Program. Means to implement product improvement. However, they are expensive and often require a moratorium on modification of large portions of system fleets during the upgrade process to facilitate configuration management. Upgrade programs often fall prey to budget constraints, when rising operations and support costs detract from modernization funding. The modification prioritization process necessarily gives preference to required safety modifications over performance or modernization upgrades. Because of the high cost of installing modifications into systems for capability, reliability, maintainability, or affordability purposes, individual upgrades are often deferred until they can be collected into affordable block upgrade packages that can be implemented during a single product modification cycle.

Technology refresh. Replacement of the electronics in a system over a specific period of time. The period of technical refresh events depends on the product type and the system support strategy. It will also utilize various DMSMS resolution options. A drawback to this approach is that it is usually quite expensive, but the expense may be offset by the improved operational capability or greater reliability, or both, afforded by the early incorporation of more sophisticated technology. It may also eliminate potential incompatibilities among updates in technology.

Appendix E. Assessment of DMSMS Solution Alternatives

The following table details cost, schedule, and other considerations when evaluating alternative approaches to resolving a DMSMS problem. The information was taken from *Case Resolution Guide*, published by the Air Force Materiel Command, DMSMS Program, in May 1999.

Alternative	Nonrecurring cost impact	Recurring cost impact	Schedule impact	Effectiveness time frame
Encourage existing source to continue production	Low; could involve premium	Potentially higher	Minimal	◆ Temporary unless source is provided a long-term forecast of market viability.
Find alternative source	Potentially higher	Could require requalification	Potentially lengthy	◆ Temporary if market condition for alternate source is the same as for initial source. ◆ Potentially long term if alternate is also used on other products. Combined demands could lengthen market viability.
Substitute part				
◆ Obtain existing substitute item	Low; could require requalification	Low	Minimal impact, if available	◆ Temporary if market condition for alternate source is the same as for initial source. ◆ Potentially long term if substitute is also used on other products. Combined demands could lengthen market viability.
◆ Obtain existing substitute item (derated)	Potentially high; could require requalification	Low	Potentially high impact if requalification prior to procurement	◆ Temporary if market condition for alternate source is the same as for initial (preferred) source. ◆ Potentially long term if substitute is also used on other products. Combined demand could lengthen market viability.
Redefine/tailor military specification requirements	Minimal; could require limited qualification	Low	Minimal	◆ Dependent upon the reason for the obsolescence/unavailability.
Use emulation technology (produce part with emulated functions or produce substitute item)	Variable; could require redesign/requalification	None; piece part production costs only	Variable; could range from none to considerable (lead-time and requalification required)	◆ Dependent upon the reason for the obsolescence/unavailability. ◆ If due to technology obsolescence, may be long term.
Make LOT buy or bridge buy	Cost of inventory only; risk of downstream obsolescence	Minimal; could be lower with higher quantity buy	Minimal	◆ Long term if calculations are correct.
Change prime source if item used GFM	High; requalification needed	Low	High impact (lead-time and requalification required)	◆ Dependent upon the reason for the obsolescence/unavailability. ◆ If unavailable due to market viability, may be temporary.
Reclaim existing item	Low	Low	Minimal	◆ Short term (cannibalize).

Alternative	Nonrecurring cost impact	Recurring cost impact	Schedule impact	Effectiveness time frame
Modify or redesign end item to replace or eliminate	High	High	High impact	◆ Dependent upon the reason for the obsolescence/unavailability. ◆ If unavailable due to market viability, may be temporary.
Replace Item				
◆ Replace entire system	High	High	Lengthy	Dependent upon the reason for the obsolescence/unavailability. If unavailable due to market viability, may be temporary.
◆ Replace NHA	Varies by case; requires FFF analysis and may require requalification/ retesting	Varies by case; requires FFF analysis and may require requalification/ retesting	Varies; may be long if requalification or retesting needed	Could be long term if replaced item has a longer expected life.
◆ Replace with newer technology	Varies by case; requires FFF analysis and may require requalification/ retesting	Varies by case; requires FFF analysis and may require requalification/ retesting	Varies; may be long if requalification or retesting needed	Could increase effect of action significantly and as byproduct could enhance functionality and/or performance.
Require the using contractor to maintain inventory	Cost of inventory only; risk of downstream obsolescence	Minimal; could be lower with higher quantity buy	Minimal	◆ Similar to LOT buy. ◆ Title III–type action.
Obtain production warranty	Low	Low	Minimal	◆ Title III–type action.
Apply reverse engineering	High; may require requalification	Low	Some; dependent upon redesign	◆ Dependent upon the reason for the obsolescence/unavailability. ◆ If unavailable due to market viability, may be temporary.
Apply DPA Title I	Minimal	Low; may involve premium	Minimal	Temporary.

Note: DPA = Defense Production Act; FFF = form, fit, function; GFM = government-furnished material; NHA = next higher assembly.

Appendix F. Examples of Contract Language

The Naval Inventory Control Point has developed a standard set of clauses to be used in its PBL contracts. The following two clauses may be particularly useful. The first assigns all responsibilities for obsolescence management to the contractor. The second requires the contractor to provide a plan for meeting its DMSMS responsibilities:

> The Contractor is responsible for managing obsolescence over the entire period of the contract, and notwithstanding any obsolescence issues or problems, the Contractor remains responsible for meeting all performance and other requirements of this contract. This obsolescence management responsibility includes an ongoing review and identification of actual and potential obsolescence issues, including but not limited to obsolescence of components, assemblies, sub-assemblies, piece parts, and material (hereafter referred to for purposes of this section only as "parts and/or material"). The Contractor is responsible for all costs associated with obtaining a replacement if and when any parts and/or material become obsolete. The costs for which the Contractor is responsible include, but are not limited to, the costs of investigating part availability, interchangeability and substitutability, locating part replacement, vendor interface, engineering efforts, testing requirements, internal drawing changes, etc. The Contractor shall prevent any additional costs from being incurred by the Government due to obsolescence. Any configuration changes due to obsolescence shall be approved in accordance with the Configuration Management requirements of this SOW. The Contractor shall provide the Government with obsolescence status briefs, as part of the periodic program reviews provided for under the contract.
>
> The Contractor shall develop and submit as part of its proposal (with an advance copy supplied to the Government at time of cost estimate submission), an Obsolescence and DMSMS Management Plan for managing the loss, or impending loss, of manufacturers or suppliers of parts and/or material required for performance of this contract. This plan will also address DMSMS Management. At a minimum, the plan shall address the following:
>
> - Means and approach for providing the Government with information regarding obsolescence and DMSMS issues
> - Planned resolution of current obsolescence and DMSMS issues
> - Parts list screening
> - Parts list monitoring
> - Processing GIDEP DMSMS Alerts
> - Processing DLA DMSMS Alerts
> - Communication with and availability of information to the Government
> - Means and approach for establishing obsolescence and DMSMS solutions
> - Plan for conducting DMSMS predictions

One source of guidance on the preparation of an obsolescence and DMSMS plan is *Program Manager's Handbook: Common Practices to Mitigate the Risk of Obsolescence*, published by the Defense MicroElectronics Activity. In lieu of preparing and submitting an obsolescence and DMSMS plan, the contractor could provide an existing plan or existing written processes and procedures for review.

Below are other contract clauses to be considered:

> The Contractor is responsible for managing obsolescence over the entire period of the contract to ensure compliance with all performance and contract requirements. Responsibility includes all costs associated with locating part replacement, vendor interface, and engineering efforts. The Contractor shall develop a plan for managing the loss, or impending loss, of manufacturers or suppliers of components, assemblies, or materials used in the system. Changes

considered necessary by the Contractor to ensure the continued manufacture and/or repair of the equipment shall be made in accordance with the Configuration Management requirements of this SOW. The Contractor's Obsolescence Plan shall include participation in GIDEP.

The Contractor will not be responsible for redesign cost for obsolescence initiatives producing Class I changes. Redesign effort to proceed only after the Contractor has exhausted all options to accomplish engineering efforts for drop in replacement.

The Contractor's obsolescence program shall prevent impact to contract performance metrics and shall prevent additional costs being incurred by the Government due to obsolescence.

The Contractor is 100% responsible for all obsolescence issues/problems with regard to the items in the contract, including: managing the loss or impending loss of manufacturers or suppliers for the spare and repairable items covered under the H-60 PBL Program. The Contractor must manage obsolescence issues/problems in order to prevent impact to contract performance metrics. Cost related to obsolescence issues/problems will be borne by the Contractor during the life of the contract. Changes considered necessary by the Contractor to ensure the continued manufacture and/or repair of the items will be made in accordance with … requirements and/or Configuration Management requirements.

The Contractor, on a continuous basis during contract performance, shall review and identify obsolescence issues related to piece parts for the items listed in Attachment "X." The Contractor shall be responsible for piece part acquisition of replacement items to avoid obsolescence or repair turnaround issues. Should obsolescence or DMSMS issues occur that preclude the Contractor from obtaining spares of the current design for any vendor repairable item, as identified in Attachment "X," any redesign, qualification and production efforts will be considered "over and above" this statement of work. Such issue shall relieve the Contractor from availability for that item. The Contractor will perform an engineering analysis of these items and provide recommended solutions. If in the course of an engineering review of the items in Attachment "X," the Contractor identifies other obsolescence issues concerning the end item test sets, the Contractor may notify the Government of these issues and possible remedies.

In addition to the above clauses, all contracts should encourage the contractor to share obsolescence resolution data with GIDEP, the DKSP, and the Shared Data Warehouse Obsolescence Data Repository. As a measure that obsolescence management is being effectively performed, the contractor should also provide case resolution metrics. In all cases, the contractor should make available to the government sufficient BOMs and parts lists to verify potential engineering change proposals or to verify if government resources could solve a problem. In summary, all decisions related to the resolution of any DMSMS problem part must be documented and the government must be invited to participate in all decisions.

When it may not be cost-effective for a contractor to perform obsolescence management activities, as may be the case for legacy systems, then the contract should contain clauses requiring the contractor to provide BOMs, which are crucial for government organic resources or third-party contractors to objectively managing obsolescence.

Appendix G. Design Interface Assessment Criteria

The following table contains criteria that can be used as a guide for developing assessment criteria for DMSMS programs. The information was taken from *Independent Logistics Assessment Handbook* (NAVSO P-3692), published by the Department of the Navy,

Criterion	Milestone				
	B	C	FRP	IOC	FOC
A formal DMSMS program has been established and documented consistent with the following DoD and DoN policy and guidance: ◆ DoD 4140.1-R, DoD Supply Chain Material Management Regulation of 23 May 03 ◆ ASN(RD&A) memo of 27 Jan 05, "DMSMS Management Guidance" ◆ DASN(LOG) memo of 12 Apr 05, "DMSMS Program Management Plans and Metrics" (and attached Management Plan Guidance) ◆ ASN(RD&A) memo of 12 May 06, "DMSMS Guidance for Developing Contractual Requirements" (and attached contractual guidance).	X	X	X	X	X
The DMSMS strategy is integrated with the program's technology roadmap, as well as the industry technology roadmaps for embedded microelectronics. The road mapping process considers the following: ◆ Identification of critical items/technologies ◆ Identification of emerging technologies.	X	X	X	X	X
The DMSMS management approach (e.g., the level of indenture) and strategy (e.g., organic, commercial, PBL, field activity managed) are defined and implemented.	X	X	X	X	X
DMSMS forecasting/management tools and/or service providers have been researched and selected, and BOM has been loaded into the system. The program also has a strategy for obtaining the following: ◆ Design disclosed items, including subtier hardware indenture levels ◆ Form-fit-function/proprietary design items, including subtier hardware indenture levels.		X	X	X	X
Ongoing review of the parts lists and BOM to identify obsolescence/ discontinuance issues is conducted and the periodicity defined.	X	X	X	X	X
The design approach includes BCA results to minimize the impact of DMSMS, to include the following: ◆ Open system architecture ◆ Order of precedence for parts selection ◆ Application-specific integrated circuits vs. field-programmable gate arrays ◆ Use of qualified manufacturers lists parts, particularly for applications requiring extended temperature ranges	X	X	X		

Criterion	Milestone				
	B	C	FRP	IOC	FOC
There is a requirement for a preferred parts list and parts control prior to detailed design to minimize obsolescence issues.	X	X	X		
Design reviews address DMSMS management approaches and solutions.	X	X	X		
DMSMS BCA is performed as part of trade studies to determine return on investment on mitigation actions and to support DMSMS decisions.		X	X	X	X
Systems that utilize the same components and technologies are identified, and commodity management and preferred material across program funding.	X	X	X	X	X
Current and outyear budget established/planned on DMSMS forecast, tracking, and mitigation efforts. Budget planning decisions for technology refresh strategies reference the sponsor's decision and are reflected in the LRFS.	X	X	X	X	X
The program has defined DMSMS metrics and tracks DMSMS cases, trends, and associated solutions and costs per DASN(L) guidance of 12 Apr 05.	X	X	X	X	X
An exit strategy has been developed and is contained in contractual/PBL documentation that provides DMSMS configuration data access necessary to transition product support capability.	X	X	X	X	X
Contractual data requirements define, as appropriate, the following: ◆Requirement for the contractor to define ad implement DMSMS management program ◆Contractor vs. government life-cycle DMSMS tasks and responsibilities ◆DMSMS incentive/awards ◆Decision on ownership of product/technical data package rights and COTS licensing agreements ◆PBL/TSPR strategy for legacy system DMSMS.	X	X	X	X	X
Supply chain monitoring/management includes contractor/vendor notification of pending parts obsolescence and part/firmware changes; system architecture/design to minimize obsolescence costs.		X	X	X	X
Technical data package supports the DMSMS mitigation strategy: ◆ Specifications, technical manuals, engineering drawings/product data models that provide appropriate level of detail for reprocurement, maintenance, and manufacture of the product ◆Special instructions for items such as unique manufacturing, quality and test processes, preservation, and packaging ◆VHDL documentation of digital electronic circuitry ◆Version, release, change status, and other identification details of each deliverable item ◆Program, design and production readiness reviews of contractor DMSMS management effectiveness ◆Provisioning screening required for maximum use of existing supply items.	X	X	X	X	X

Notes: ASN(RD&A) = Assistant Secretary of the Navy for Research, Development and Acquisition, BCA = business case analysis, BOM = bill of materials, DASN(RD&A) = Deputy Assistant Secretary of the Navy for Logistics, FOC = full operational capability, FRP = full rate production, IOC = initial operational capability, LRFS = logistics requirements funding summary, PBL = performance-based logistics, TSPR = total system performance requirement, VHDL = VHSIC (Very High Speed Integrated Circuit) Hardware Description Language.

Appendix H. Abbreviations

ACTFAST	Aegis COTS Technology Family Analysis and Selection Tool
AL	assembly level
ALT	administrative lead-time
AME	Advanced Microcircuit Emulation (program)
AQEC	Aerospace Qualified Electronic Components
BCA	business case analysis
BEP	breakeven point
BMP	Best Manufacturing Practices (program)
BOM	bill of materials
CALCE	Center for Advanced Life Cycle Engineering
COTS	commercial off-the-shelf
CURE	COTS Usage Risk Evaluation
DAU	Defense Acquisition University
DKSP	DMSMS Knowledge Sharing Portal
DLA	Defense Logistics Agency
DMP	DMSMS Management Plan
DMSMS	Diminishing Manufacturing Sources and Material Shortages
DMT	DMSMS management team
DoD	Department of Defense
DRMS	Defense Reutilization and Marketing Service
DSCC	Defense Supply Center Columbus
DSPO	Defense Standardization Program Office
ECL	emitter-coupled logic
ECP	engineering change proposal
EPSC	Electronic Products and Systems Center
FAA	Federal Aviation Administration
GIDEP	Government-Industry Data Exchange Program
IPT	Integrated Product Team
ITT A/CD	ITT Aerospace/Communications Division
LCS	life-cycle sustainment
LOT	life-of-type
LRU	line replaceable unit
MIL-STD	military standard
MLDT	mean logistics delay time

MOCA	Mitigation of Obsolescence Cost Analysis
NDI	nondevelopmental item
NE&SS-SS	Naval Electronics and Surveillance Systems–Surface Systems
NRE	nonrecurring engineering
OEM	original equipment manufacturer
OIA	operations impact analysis
ONR	Office of Naval Research
OSA	open systems architecture
OSD	Office of the Secretary of Defense
PBL	performance-based life-cycle product support
PEM	program element monitor
PI	progress indicator
PIA	program integrating agent
PL	piece part level
PLT	production lead-time
PM	program manager
POM	Program Objective Memorandum
PPR	Problem Part Report
PSI	product support integrator
QRB	quick-response budget
SINCGARS	Single Channel Ground and Airborne Radio System
SOE	system operational effectiveness
SPD	system program director
SRU	shop replaceable unit
SSM	system support manager
TLCSM	total life-cycle systems management
TOC	total ownership cost
VECP	value engineering change proposal
VHDL	VHSIC Hardware Description Language
VHSIC	Very High Speed Integrated Circuit

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