SD-22

Diminishing Manufacturing Sources and Material Shortages

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

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CONTENTS

FOREWORD

This guidebook on Diminishing Manufacturing Sources and Material Shortages (DMSMS) is both a tutorial and 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 22060-6221, or e-mail DSPO@dla.mil.

This version is an interim update to the 2009 version. A complete rewrite is expected in 2011. Below are the principal changes in this interim update:

- Updated nonrecurring engineering (NRE) cost and time metrics data
- Procedures to escalate resolution cost estimates to future years
- Appendix D, Using Business Case Analysis to Evaluate Resolution Alternatives
- Appendix E, Ontology of DMSMS Solutions
- Appendix I, Developing Program-Specific NRE Cost Metrics.

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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, the DoD seeks to prolong the life of weapon systems. These conflicting trends cause DMSMS problems as repair parts and/or materials disappear before the end of the weapon system life cycle. Although electronics are most likely to be discontinued, obsolescence of non-electronic 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 proactive 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 the preparation for sustainment early in the weapon system life cycle. Both TLCSM and PBL relate to DMSMS mitigation:

- TLCSM treats obsolescence as one of the cost drivers in the system life cycle. 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 assigns the life-cycle manager 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 performance package 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 enablers that "when appropriately addressed, positively impact Material Readiness outcomes." PBL is enabler number one, and DMSMS management 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 also with implementing improved governance and decision processes. DMSMS poses a threat to those aspirations. An efficient, proactive process to manage and mitigate DMSMS problems is critical to providing available, affordable, and supportable systems by identifying and mitigating DMSMS issues. Thus, DMSMS management is in line with the TLCSM and PBL disciplines.

Understanding TLCSM

TLCSM emphasizes design for system reliability, availability, maintainability, manufacturability, and supportability. The objective of TLCSM is to improve 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 SOE by influencing early design.

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

Understanding PBL

PBL is one strategy to deal with obsolescence throughout the life of a product. PBL manages the support of weapon systems, assemblies, subassemblies, and components. As responsibility for meeting performance requirements shifts to the product support integrator (PSI) under the PM, PBL provides a 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 incorporates continuous modernization and obsolescence mitigation. With PBL, the PM, rather than purchasing parts or products, purchases an integrated product support package. You can pursue PBL through a long-term contract or through a memorandum of agreement or understanding with an organic support source. In either case, the focus is on establishing performance guarantees.

Programs using PBL should require the contractor to 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. A properly implemented PBL strategy incentivizes the contractor to manage DMSMS proactively as one means to achieve the performance outcomes. Long-term PBL contracts lower contractor risk and facilitate DMSMS mitigation efforts such as life-of-type buys, long-term contracts with prime contractors, long-term contracts between primes and subcontractors.

The PBL contractor is motivated to continuously improve performance, because of its bottom-line profit 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.

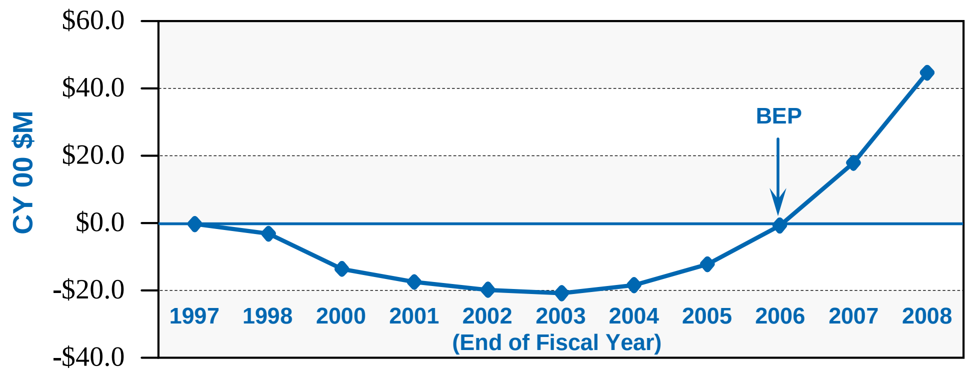
THE BUSINESS CASE FOR PROACTIVE DMSMS MANAGEMENT

In 1999, the B-2 bomber program developed a business case analysis (BCA) comparing the projected 20-year cost streams of a reactive approach to the proactive approach to managing DMSMS. The outcome of the BCA demonstrated that proactive DMSMS management was cost-effective and confirmed the DoD policy of proactive DMSMS management. It was highly probable that other programs would experience similar BCA results. The two scenarios for the B-2 BCA were as follows:

- *Reactive approach scenario.* DMSMS problems would go unnoticed until a part, such as a microcircuit, was needed to repair a shop replaceable unit/shop replaceable assembly (SRU/SRA). If the part was obsolete and unavailable, the SRU/SRA would receive focused attention from the responsible integrated product team (IPT). The cost and complexity of the resultant corrective action would depend on the severity of obsolescence in the SRU/SRA. To model this scenario across the entire platform, and to generate a cost stream for it, it was necessary to estimate and mathematically relate three items:
  - Number of problems each year caused by obsolete unavailable parts (for 20 years into the future)
  - Distribution of degree of obsolescence present in all SRUs/SRAs over the 20-year span
  - Solution costs for those SRUs/SRAs associated with the varying degrees of obsolescence.
- *Proactive approach scenario.* The DMSMS Management Team (DMT) would identify problem parts in the platform configuration and act to develop and implement solutions before the problems affected the system support posture and operational availability. To model this scenario, it was necessary to estimate and mathematically relate three items (different from the reactive approach):
  - Historical mix of solution types (e.g., substitute part, emulation)
  - Number of obsolescence problems estimated to be solved each year
  - Cost data for each type of solution.

One output of the BCA was the breakeven point (BEP), which was 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 was the difference between the costs of the reactive and proactive approaches. The BEP—the point at which the plot crosses the x-axis, as shown in Figure 1—signifies when cumulative investment in the proactive approach equals the cumulative benefit derived from that investment. At this point, the extra costs of the program are offset and savings begin to accrue.

Figure 1. Sample Plot Showing Breakeven Point



In addition to the BEP plot, a typical BCA would include a table of econometric values. Table 1 is an example.

Table1. Sample Economic Analysis Summary (20-Year Study)

Item	Reactive	Proactive	Notes
Cost			
DMSMS program costs	NA	$30M	
DMSMS solution costs	$180M	$65M	
Total	$180M	$95M	
Benefit		$115M	$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

The BCA for the B-2 showed that a proactive approach to DMSMS management yields the best economical return in terms of keeping the system supportable over the target horizon. 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.

DMSMS PROGRAM FUNDAMENTAL CONCEPTS

DMSMS Program Levels

Effective DMSMS management requires proactive resolution 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) or weapon replaceable assemblies (WRAs) that are obsolete, or will be in the foreseeable future. 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) constitute the essence of a proactive program.
- *Assess.* Considering the population of problem parts, determine and prioritize the LRUs/WRAs most at risk for current and future DMSMS impacts.
- *Analyze.* Research the problem parts in the high-priority LRUs/WRAs first and, for each LRU or WRA, develop an optimum set of DMSMS solutions.
- *Implement.* Budget, fund, contract for, schedule, and execute the solutions for the high-priority LRUs/WRAs.

Developing solutions for a few obsolete parts isn't too hard. However, implementing a DMSMS management program on a platform 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 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 2 identifies the set of practices for each intensity level; each higher level includes the practices of all lower levels.

Table 2. DMSMS Mitigation Practices for Each Intensity Level

Intensity Level 1	Intensity Level 2	Intensity Level 3	Intensity Level 4
DMSMS program established and funded DMT formed DMT trained in ◆ 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	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 obsolescence solutions Website established Method established to prioritize LRUs/WRAs for DMSMS risk	All Level 2 practices implemented. DMSMS life-cycle costs and cost avoidance estimates developed DMT trained in ◆ 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 DMSMS metrics established[a] Electronic data interchange used	All Level 3 practices implemented Technology road mapping used System upgrades planned Technology transparency attained Accessibility realized for alternate source development (VHDL, emulation, MEPs)

Notes: BOM = bill of materials, MEP = Manufacturing Extension Partnership, and VHDL = Very High Speed Integrated Circuit (VHSIC) Hardware Description Language.

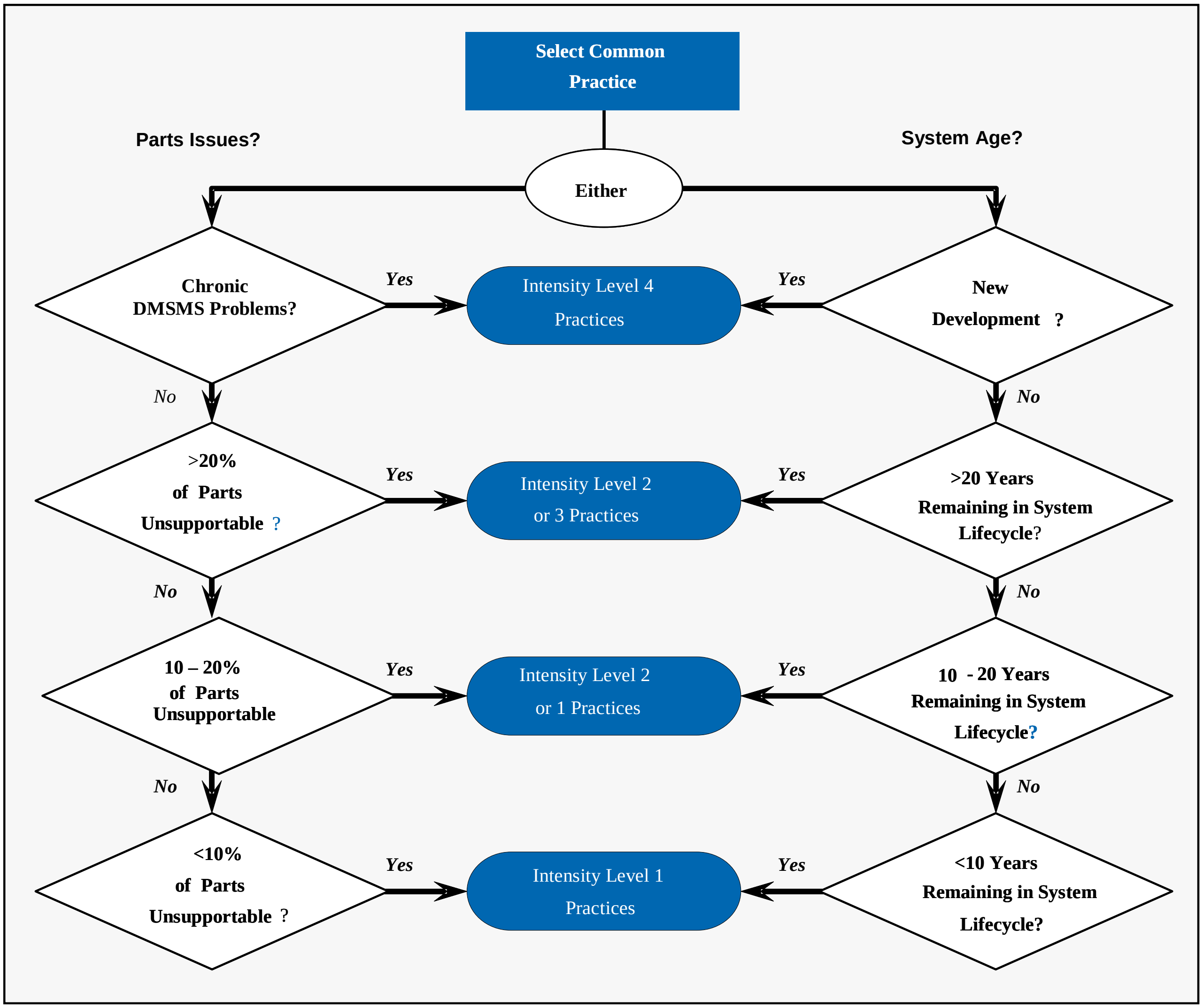
[a] Metrics include number of cases, number of solutions implemented, life-cycle costs, and cost avoidance.

Selecting DMSMS Mitigation Practices for Your Program

Adoption of DMSMS management practices could follow a “trigger” event such as a no-bid on spare SRUs/SRAs because of obsolete microcircuits or concerns from DMSMS-induced depot maintenance delays.

Use the logic of Figure 2 to select the appropriate intensity level for your program. You also should consider the complexity of the program, available resources, and acquisition life-cycle phase. For example, a program entering the technology development phase could incorporate Intensity Level 3 DMSMS practices in the request for proposals for the next phase. However, a program in the operations and support phase could not practically afford to convert all the drawings into an electronic format, for example.

Figure 2. Logic for Selecting Intensity Level



The Customer's Perspective on Level of Practice

The customer's (government program office's) perspective on DMSMS management is "How do I protect myself and my system?" DoD DMSMS management efforts range from no program awareness of DMSMS to proactive DMSMS programs. Typical DMSMS management programs use Level 1 and Level 2 DMSMS mitigation practices, focusing on resolving DMSMS problems that have surfaced. Usually, these programs are run by the logistics team with minimal program management support. To implement Level 3 and Level 4 practices, organizations must go beyond DMSMS damage control and focus on implementing a proactive approach to minimize 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 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 presents a quandary: "How do I do the right thing (which would add overhead cost) and still maintain a competitive edge (which requires lower overhead cost)?" The objectives of business are to lower costs and increase revenue, but implementing DMSMS practices requires expending time and resources. The contractor's senior management must believe that DMSMS management is good business. For example, applying DMSMS avoidance techniques makes products 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 increase the probability of winning. Under sole-source conditions, using DMSMS avoidance techniques is a strong factor to protect the contractor's competitive advantage. Therefore, having an effective DMSMS program may promote increased sales and profits on other DoD contracts.

Implications of Level of Practice for Source Selection

The government is focused on acquisition cost and TOC. In contrast, the contractor generally is unconcerned with TOC, because it does not need to deal with the long-term postdeployment sustainment costs. However, the contractor recognizes the perceived higher acquisition cost introduced by DMSMS avoidance costs. Therefore, 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 source selection. This evaluation factor will motivate the contractor to spend money up front for DMSMS mitigation in development and production, which will promote both long-term savings and system supportability. This up-front commitment to DMSMS will require the government and the contractor to accept the annual investment costs (software, support, travel, website) of Level 3 DMSMS mitigation practices. 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

DMSMS policy documents, training courses, and other resources are readily available. Some locations (e.g., Tinker Air Force Base and Warner-Robins Air Force Base) have resident subject matter experts in DMSMS.

Appendix A lists key DMSMS documents. One document of particular interest is MIL-STD-3018, "Parts Management," which prescribes an effective parts management program for DoD acquisitions. Parts management is a design requirement to reduce the use of unique or specialized parts in a system to promote standardization, reliability, maintainability, and supportability. This requirement helps to minimize DMSMS (fewer parts mean less obsolescence). The parts management plan required by MIL-STD-3018 addresses procedures for obsolescence management, including obsolescence forecasting, initial screening of designs, and planning for resolution of obsolescence issues. DMSMS risk mitigation is one facet of the larger process of parts management.

If you are new to the DMSMS discipline, consider taking 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.

DAU also 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 have links to DMSMS management subjects as well as to useful tools. The primary site is the DMSMS Knowledge Sharing Portal (DKSP at www.dmsms.org), established by the Defense Standardization Program

Office (DSPO). Portions of the site have unrestricted access, while other portions are restricted (password required). The restricted sections of the DKSP are for Government-Industry Data Exchange Program (GIDEP) users (see how to register for GIDEP at www.gidep.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)
- DMT
- Predictive tools
- Accurate bills of materials (BOMs)
- Financial resources.

Support from Management

Management buy-in (commitment) is crucial to the DMSMS program. The interest of senior leaders ensures that the acquisition disciplines (engineering, logistics, management, contracting) will support the DMSMS program. One method for securing cooperation from managers of both the customer (program office) and the supplier is to conduct periodic DMSMS management reviews.

What is the right organizational level for DMSMS management? Efficiencies can be realized by monitoring DMSMS at the highest level of commonality. That means common items should be managed at the DoD level to leverage volume, which in turn will lower unit cost, and reduce redundancies in managing like items.

DMSMS Management Team

DMSMS is collaborative and multidisciplined; therefore, a DMT is fundamentally important. The DMT composition 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 Logistics Agency–Land and Marine (DLA-L&M) or Defense MicroElectronics Activity. The DMT needs a plan to guide the DMSMS program. The team will need adequate resources to ensure success.

Predictive Tools

Use of a predictive tool is integral to finding DMSMS in electronic components in the configuration. All predictive tools monitor the status of electronic components in the BOM and forecast their obsolescence. Each tool has different loading criteria and output and report formats. The DMT should carefully select the tool that is right for its program based on needs and cost.

Bills of Materials

A BOM is a list of the subordinate parts (electronic, electrical, mechanical) in an assembly (e.g., an SRU/SRA or a subsystem assembly). Without it, forecasting, impact analysis, component analysis, and other DMSMS-related activities are not possible. An indentured BOM depicts the top-down breakout relationship of parts to the next higher assembly (NHA) components (from system to box to board). A flat-file BOM lists parts without indenturing relationships. An initial task-of the DMT is to (1) obtain the BOMs (from the integrating OEM), (2) develop them from available data, or (3) negotiate for access to contractor-owned technical data packages (TDPs), technical manuals (illustrated parts breakdowns), and engineering change proposals (ECPs).

Ideally, the BOM is an editable electronic file. As part of the contract data requirements, consider requiring DI-SESS-81656, "Data Item Description, Source Data for Forecasting Diminishing Manufacturing Sources and Material Shortages."

The DMT can start proactive DMSMS management if it can obtain or create a minimal BOM containing the active devices (e.g., microcircuits or semiconductors). The DMT can then load a predictive tool, identify the status of those active components, and perform basic analysis. Any redesign or new system acquisition should include the BOM, along with the new boards or systems. If possible, require the procurement of BOM data on any new system acquisition.

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

If BOMs for COTS products are unavailable, you can periodically survey the OEM to obtain updated status and projected life of the product. In PBL contracts, BOMs are not required to be maintained by the DMT, because obsolescence management is delegated to the PBL contractor. Nevertheless, DoD must be protected in case the contractor ends its support 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 PBL support or establish organic capability. An excellent example is the V-22 Engine Technical Data license. 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 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 required to provide access to the BOM well before 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.

Financial Resources for DMSMS

Ideally, funding for DMSMS would be available early in the development of a program—when the design is most cost-effective to influence—to ensure that the DMSMS management program is properly resourced. The cost of implementing resolutions is generally not part of the DMT funding. It typically comes from research and development funds or operation and support funds. DMSMS corrective action projects (e.g., an SRU/SRA redesign due to DMSMS) must of course must be prioritized (racked and stacked) with all other program needs. To be competitive, the case for spending money to fix DMSMS must be compelling.

An effective DMT will document the justification of the cost to implement critical solutions. The cost may be distributed over several years. If there are alternative scenarios for addressing the DMSMS problems in the configuration, the DMT should employ business case analysis techniques to evaluate the alternatives. Appendix D illustrates how to use BCA techniques to help choose among alternatives.

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, the contractor will formally request an $80,000 budget from the 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 have three elements: infrastructure, operations, and support. These elements must be well defined, integrated, and exercised.

INFRASTRUCTURE

Infrastructure is 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 plan should conform to the template in the automated DMP generator: “Plan Builder” (www.dmsms.org/PlanBuilder). 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.

The DMT must choose a DMSMS predictive software tool. The available predictive tools are described in the DKSP (www.dmsms.org/PartSearchTools/). Before choosing a predictive tool, the DMT should have demonstrations of the candidate tools and their outputs. The DMT must purchase the tool (on a contract or on a subscription basis). Remember that a specific tool alone will not solve all DMSMS problems. Engineering and logistics analysis and judgment are still key factors in addressing DMSMS issues, coupled with judicious interpretation of the tool’s output.

The DMT uses other tools to identify problems and pursue solutions. Table 3 lists some of the tools available from the government. A more comprehensive list, developed by the DMSMS Working Group Common Use Tool Committee, is found at http://www.dmsms.org/, along with a detailed description of each tool.

Table 3. Tools Linking to Potential Data Sources

Tool	OPR	Fee?	Usage
ASSIST	DSPO	No	Specifications and standards
CDMD-OA	NAVSEA	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
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	DLA-L&M	No	Mfg PN to standard microcircuit drawings
PC Link	DLA	No	Access to service databases
REMIS	AFMC	No	Reliability data
SDW	HQ DLA	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, CDMD-OA = Configuration Data Managers Database–Open Architecture, D200C = Recoverable Item Requirements Computation System (USAF), GIDEP = Government-Industry Data Exchange Program, JEDMICS = Joint Engineering Data Management Information and Control System, 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, WebFLIS = Federal Logistics Information System Web Inquiry, and WebLink = Web Logistics Information Network.

The DMT uses 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. (If the program has only a few DMSMS problems, a spreadsheet may suffice.)

The DMT must adopt or develop a method for prioritizing the DMSMS issues. This is crucial for a complex weapon system, with many systems, each with multiple LRUs/WRAs with their subordinate SRUs/SRAs. Below are possible criteria for prioritizing LRUs/WRAs 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/SRAs or LRUs/WRAs) by the DMSMS issue?

- *Funding.* When, where, and how will money be available to address the DMSMS issue?

Equipped with a prioritization method, the DMT collects the input data required by the method, applies the data to the list of systems, and rank orders the LRUs/WRAs. The prioritization input data could include platform data (e.g., relative obsolescence and mission essentiality of the LRUs/WRAs). Therefore, the prioritization approach must be based on easily available (yet meaningful) input data.

The process of collecting configuration data and loading the predictive software tool is continuous. Typical configuration data sources include technical orders and engineering parts lists. It may be necessary to convert paper data to electronic data files to load into the predictive software. After the data are loaded, the magnitude of the current and future DMSMS problem on the platform will be seen. 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/WRA.

OPERATIONS

The operations element encompasses executing the DMSMS problem identification and solution recommendation activity in accordance with the DMP. Below are some important considerations:

- *Operations follows a bottom-up approach, starting with a technical review of the subordinate parts in LRUs/WRAs.* The DMT documents all the information to support a recommendation for corrective action on an individual problem (obsolete) part in a problem part report (PPR). Processing 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 is crucial to success.* After the initial research, the operations staff 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 go to contractors, logistics centers, and the owning IPT. The DMT, or PIA, will need to check that the PPRs are being worked and not languishing in someone's inbox.

- *DMSMS metrics are essential to understand the costs of DMSMS management and to measure the success of a DMSMS program.* A fundamental metric is the list of recommended, approved, and implemented solutions. An ever-growing list of recommendations that require follow-up action will come from the process of producing PPRs. For example, if there are obsolescence problems on 14 SRUs in a given LRU/WRA, there would be a mix of recommendations (each a miniproject) for substitute part validations, multiyear buys, and part emulations. The organization that "owns" the SRUs/SRAs must track these proposed corrective action projects and submit them into the budget process.

- *Synthesizing individual solutions into a recommendation for an entire LRU/WRA or subsystem requires evaluation of tradeoffs.* For example, should the solution be seven substitute parts and one emulation or an SRU/SRA redesign? The DMSMS operations element must condense the individual recommendations into a succinct report (sometimes called a DMSMS Engineering Requirements Plan) for a given LRU/WRA that facilitates understanding, tracking, and action.

For an organization with dispersed sites, having a DMT liaison at each site can prevent processing delays. Timeliness in processing PPRs, getting data, and following up on actions is essential to the functioning of the DMT. If the PPRs are sent to organizations with no DMT member, the review process will probably break down. 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 communication, follow-up, 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 agendas and minutes for DMT meetings
- Participate in DMT teleconferences
- Train DMT members about program DMSMS procedures and tools
- Develop a descriptive presentation of the DMSMS program
- Prepare and deliver program management reviews
- Provide monthly metrics on PPR processing and DMT output
- Report on the cost and operational effectiveness of the DMSMS program
- Represent the DMSMS program at external meetings, conferences, and forums

- Collect part consumption and failure data
- Collect data on the cost of completed DMSMS projects
- Keep a record of DMSMS success stories
- Prepare Program Objective Memorandum justification for solution projects.

Taxonomy of DMSMS Resolutions

A taxonomy is a classification of a "collection of items" arranged in a logical hierarchical structure. Table 4 shows the taxonomy of DMSMS resolution categories and types, and Appendix E contains definitions and examples of the taxonomy types. This taxonomy is intended to standardize the resolution type definitions (until now, there has never been an accepted set of standard definitions of the DMSMS resolution types).

Table 4. Summary Taxonomy of Resolution Types by Life-Cycle Phase

Resolution taxonomy category	Resolution taxonomy type	Life-cycle phase		
		Plan	Acquire	Sustain
Logistics	No corrective action		X	X
	Procurement			X
	Negotiation with source		X	X
	Reclamation		X	X
Engineering	Alternative source		X	X
	Administrative substitute		X	X
	Desktop substitute		X	X
	Normal substitute		X	X
	Complex substitute		X	X
	Aftermarket manufacturing (reverse engineering)			X
	Emulation			X
	Redesign–COTS product		X	X
	Redesign–Custom part		X	X
	Redesign–Peculiar NHA (PNHA)		X	X
	Redesign–LRU/WRA level			X

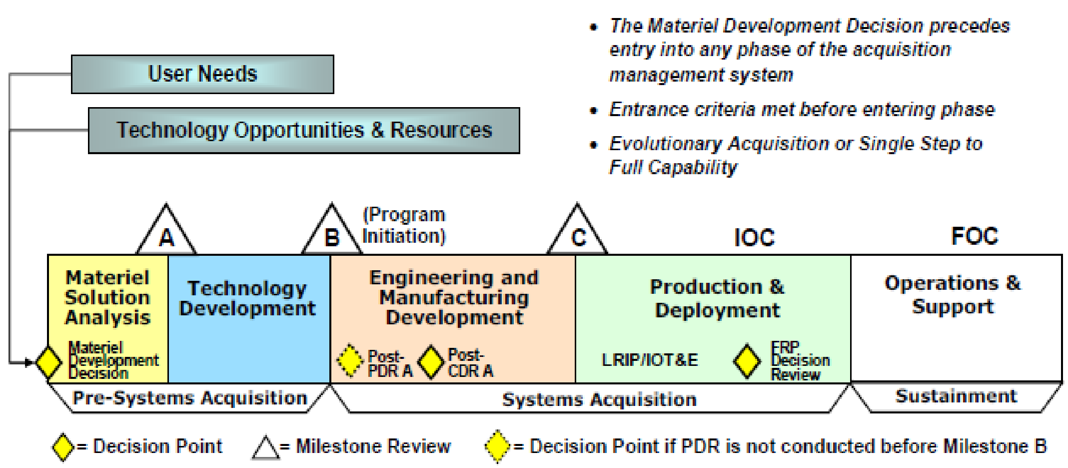
Table 4. Summary Taxonomy of Resolution Types by Life-Cycle Phase

Resolution taxonomy category	Resolution taxonomy type	Life-cycle phase		
		Plan	Acquire	Sustain
Programmatic initiatives	Performance-based logistics	X	X	
	Continuous modernization		X	X
	System upgrade and SLEP			X
	Technology refresh		X	X
	Modernization through spares	X	X	X
	Open systems architecture	X	X	
	Design for obsolescence	X	X	
	Contractor-maintained inventory		X	X

Note: SLEP = Service Life Extension Program.

Possible strategies and solutions for DMSMS problems depend on where the item, or supported system, is in its life cycle (Figure 3 shows the phases of the DoD acquisition life cycle). Use the Table 4 resolution types to categorize solutions to your DMSMS problems. Appendix F defines the terms used in the table, and Appendix G contains a table that you can use when considering alternative solutions to a specific DMSMS problem.

Figure 3. The DoD Acquisition Life Cycle



Programmatic Strategies

Planned, continuous modernization is a weapon system support strategy that is characterized by applying COTS parts and nondevelopmental items (NDIs), ECPs and value engineering change proposals (VECPs), PBL, open systems architecture (OSA), and microcircuit emulation programs. These strategies are described below.

COTS and NDI Solutions

The Government Electronics and Information Technology Association, in collaboration with DSPO, has developed requirements for COTS/NDI integrated circuits and semiconductors and designated them as Aerospace Qualified Electronic Components (AQECs). AQEC suppliers include semiconductor manufacturers and avionics developers who promote usage of COTS items throughout DoD.

AQEC documents establish guidelines for producing "modified COTS" parts. Such documents are like military and commercial specifications. AQEC suppliers agree to provide products for 5 years or more or to provide procurement information on discontinued parts.

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.

ECPs and VECPs

The government sometimes uses the ECP process to initiate obsolescence mitigations. The ECP process can be slow. On the other hand, the VECP process can be used by contractors to initiate mitigation of DMSMS risks. The VECP process has several advantages:

- Develops solutions to DMSMS problems with collateral benefits (e.g., reduced cost, increased quality, and improved performance)
- Puts those solutions in place rapidly
- Provides contractors with a profit-based incentive for using their engineering workforce to mitigate DoD DMSMS issues as part of a 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 NRE costs over time, making them far easier to fund.

The use of PBL does not remove the need for value engineering. VECPs incentivize the contractor to adopt an approach that benefits the DoD in the long term. (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.)

Performance-Based Life-Cycle Product Support

PBL is contracting for levels of performance (sustainability and availability). PBL facilitates continuous modernization because the support integrator and provider bear the risk and cost of obsolescence. PBL contracts should require turnover of all configuration data to the government at some trigger event or time. The PSI can help carry this out. The PSI is 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 PBL. PBL practices give significant latitude to the PSI to manage technology refreshment. The PSI is responsible for performance outcomes and is incentivized to use (replace) state-of-the-art technology, COTS items, and readily available items as necessary to meet the performance requirements. (Appendix H contains examples of contract language that has proven useful in implementing DMSMS programs.)

Open Systems Architecture

OSA is a vendor-independent, nonproprietary design approach based on official and/or popular system standards. It allows all vendors (in competition with one another) to create add-on products that increase a system’s flexibility, functionality, interoperability, potential use, and useful life. OSA enables the users to customize and extend a system’s capabilities to suit individual requirements. The objective of an OSA is to improve weapon system affordability and sustainment by minimizing proprietary technology or relying on a single source.

MICROCIRCUIT EMULATION PROGRAMS

Using an innovative approach of combining government-sponsored technology development with industry production capacity, the Defense Logistics Agency (specifically DLA-L&M) 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 (GEM) program supports 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 supports newer digital logic families (54F, 54AS, 54FCT, 10H ECL); the AME program also can emulate application-specific integrated circuits (ASICs) ranging from 10,000 to 200,000 gates, and can perform advanced reverse engineering. AME supports 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. 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 management program. The purpose is to answer this question: How proactive is the DMSMS program? One approach is to use the self-assessment guide in Figure 4 to determine the intensity level of the DMSMS program's mitigation practices.

Figure 4. DMSMS Program Self-Assessment Guide

Intensity Level 1

- ☐ DMSMS program established and funded
- ☐ DMT formed and 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 inserted in the appropriate 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 LRUs/WRAs 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 (VHDL, emulation, MEPs)

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).

Program Cost

Cost Trades Analysis

Once a PM selects a solution to a DMSMS problem, you need to estimate the implementation cost. Figure 5 is a sample worksheet.

Figure 5. Sample Worksheet for Estimating Costs of Alternative Source Solutions

ROM Cost Estimate

Alternative Source

Requirements ______ x Unit Cost ________ = __________

Nonrecurring Engineering = __________

Prototype Development = __________

Tech Data Development / Compilation = __________

Qualification = __________

Part Testing (Form, Fit & Function) = __________

System Testing = __________

Documentation Revision = __________

Warehousing & Disbursement = __________

DMSMS Analysis Labor:

Engineer Manhours ______ x Rate ________ = __________

Analyst Manhours ______ x Rate ________ = __________

Other Manhours ______ x Rate ________ = __________

Solution Total = __________

Cost Avoidance Analysis

Recall that the primary motivation for proactive DMSMS management is that "finding solutions early will save money." The solution must be implemented for avoidance or savings to result. Cost data have been updated in 2010 on the mean and 90 percent confidence range of costs for the engineering resolution types from the DMSMS taxonomy. Table 5 shows cost metrics and the average reported duration (weeks to resolve) for the resolution types. The table is based on the 2009 Department of Commerce (DOC) survey of military and contractor organizations covering resolutions completed from FY07 through FY09.

Table 5. NRE Resolution Cost and Time Metrics (FY11 $)

Resolution type	90% confidence (left limit)	Mean	90% confidence (right limit)	Weeks to resolve (average)
Reclamation	$1,000	$20,000	$39,000	12
Alternate source [a]	$0	$41,000	$92,000	11
Administrative substitute	$1,000	$3,000	$5,000	4
Desktop substitute	$0	$5,000	$10,000	8
Normal substitute	$22,000	$34,000	$46,000	25
Complex substitute	$122,000	$432,000	$724,000	40
Emulation [b]	$29,000	$73,000	$117,000	26

Table 5. NRE Resolution Cost and Time Metrics (FY11 $)

Resolution type	90% confidence (left limit)	Mean	90% confidence (right limit)	Weeks to resolve (average)
Aftermarket manufacturing	$0	$33,000	$58,000	21
Redesign–COTS product	$82,000	$1,118,000	$2,154,000	42
Redesign–Custom part [c]	$542,000	$1,094,000	$1,646,000	61
Redesign–PNHA	$654,000	$1,010,000	$1,366,000	64

Source: 2009 Department of Commerce Survey.

[a] Alternate source includes parts from a different manufacturer (not already in the applicable technical data package) that meet the part specification.

[b] Emulation cost values were provided by DLA. They represent the historical costs to DLA to emulate a part from the GEM and GEM AME programs; they do not include integration into the next higher assembly or system.

[c] Redesign–Custom part includes the development and validation in the application of new component-level parts.

You should use the cost values from the “mean” column for the resolution cost. The values for the left and right 90 percent confidence limits provide a 90 percent assurance that the true mean cost lies within that interval range. A wider confidence range indicates a lower precision of measurement. Some left limit values in Table 5 are zero because of the small sample size and the wide range of values in that sample.

The values in Table 5 do not include the costs of system-level qualification testing, software testing, and certification testing for safety of flight or flight tests. You should add these costs into the analysis if applicable. Also, you should incorporate your program-unique life-of-type buy or multiyear buy costs into the analysis.

The cost metrics presented in Table 5 are in FY11 constant-year dollars. When projecting resolution costs, you must take the effects of inflation into account. The term “then-year” (also known as “budget-year”) describes future-year costs that include the effects of inflation. Then-year costs should be used for budgeting. (If you do not escalate the resolution cost metrics to obtain the best budgetary cost estimates for DMSMS resolution projects, you will fall short of the funding required for corrective actions.)

The government provides weighted inflation factors that are updated each year. Weighted inflation factors should be used to escalate constant dollars (FY11) to budget-year/then-year dollars (FY12 and beyond). Weighted inflation factors are used to account for the time lag between budgeting of funds (congressional appropriations), contracting for goods and services, and the receipt (completion) of the goods and services. The weighted factor is calculated by multiplying the raw inflation index by the outlay profile factors to account for the inflation that occurs during the expenditure years. DoD, each military service, and each major appropriation category (e.g., RDT&E or Military Construction) have distinct weighted inflation (escalation) factors, but generally the differences are at the third decimal point.

The Naval Center for Cost Analysis (NCCA) has an online inflation calculator that includes DoD-wide, Navy, Marine Corps, and Army weighted inflation factors (http://www.ncca.navy.mil/services/inflation.cfm). For example, the metric for a complex substitute resolution in FY11 is $423,000. From the NCCA tool, the DoD-wide weighted index to escalate the cost from FY11 to FY12 is 1.0295. Therefore, the value to use in FY12 is $423,000 × 1.0295 = $435,000 (rounded). (The Air Force has a similar tool, but it has restricted access.)

The program DMT should keep track of actual solution costs and use them to develop a set of program-specific resolution metrics (from proposals, rough order-of-magnitude estimates, past similar completed projects). Those program-specific metrics should be used when estimating the cost of solutions associated with individual PPRs or solutions documented in DMSMS engineering requirements plans. Table 5 metrics should be used only as a default. See Appendix I for guidance on generating program-specific cost metrics.

The resolution cost metrics from Table 5 can be used to compute 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 a complex substitute solution was selected, it may not have been possible to use an aftermarket or emulation solution. The redesign–custom part solution would be the next technically viable option. An NHA redesign may resolve multiple component DMSMS problems. Cases have been documented in which as many as five obsolete part problems were solved with one SRU/SRA redesign.

The 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 from the next most feasible average cost solution (assumed to result from taking no action or a reactive DMSMS program). If, for example, an obsolete part can be solved with an alternate source in FY11 ($41,000 from Table 5) and the next feasible solution is a complex substitute ($423,000 also from Table 5), the cost avoidance of $382,000 is realized ($423,000 − $41,000).

As the DMSMS program implements actual solutions, it should capture the cost data. 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 6.

Table 6. Sample Cost Avoidance for a Set of DMSMS Program Solutions

Solution type	Solution status	Count	Cost avoidance estimate ($)	Basis
Complex substitute	Complete In work Unfunded	1 2 2	587,000 1,174,000 0	Redesign − PNHA/Complex substitute
Normal substitute	Complete In work Unfunded	5 1 10	1,945,000 389,000 0	Complex substitute − Normal substitute
Multiyear buy	Complete Unfunded	20 298	300,000 0	Reclamation − $100,000 (multiyear buy cost)
No support impact	Approved alternate available Part no longer used Part still available Sufficient quantity on hand	30 17 60 80	0 0 0 0	No avoidance
Reclamation	Reclaimed parts on hand Unfunded	4 2	56,000 0	Normal substitute − Reclamation

Use of Business Case Analysis to Evaluate Resolution Alternatives

In most cases, the applicable (and only logical) resolution for a DMSMS problem (from the taxonomy of resolutions) will be obvious. However, it is possible to have alternative scenarios of corrective action sets. For example, numerous parts in an SRU pose a serious DMSMS threat. Is it better to fix the individual problems or to redesign the entire SRU? Clearly, many considerations (technical, logistics, and economic) must be documented to justify the recommendation.

The standard (economic) criterion for deciding whether a government program (or in our case, DMSMS resolution alternatives) can be justified on economic principles is net present value (NPV)—the discounted monetized value of expected net benefits (benefits minus costs). NPV is computed by assigning monetary values to benefits and costs, discounting future benefits and costs using an appropriate discount rate, and subtracting the sum total of discounted costs from the sum total of discounted benefits.

For DMSMS alternatives, the one with the least NPV cost is preferred. We assume that the benefit of mitigating the DMSMS condition is the same for each alternative, namely mitigation of negative impacts on system operational readiness; hence, present cost is as good as NPV in choosing among alternatives.

Appendix D has a detailed illustration of how to compute the NPV of cost streams associated with alternative corrective action scenarios.

FUNDING IMPACT VERSUS TIME

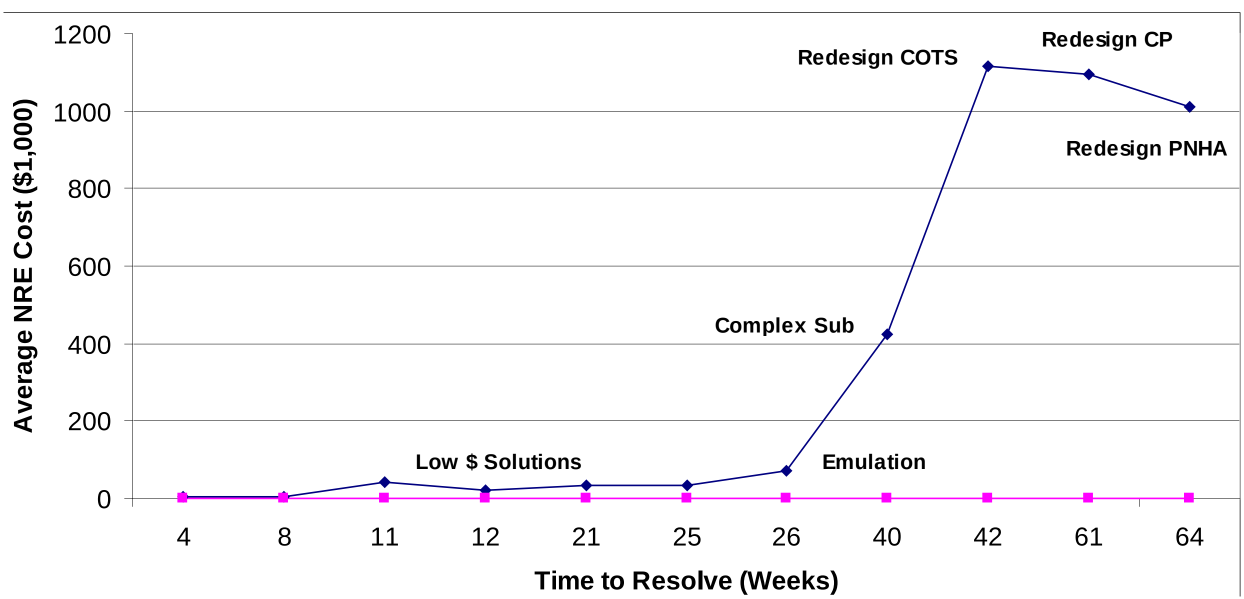
Funding for implementation is generally the responsibility of the “owning IPT.” The job of the DMT is to give the IPT the justification and the valid estimate of the corrective action requirement. To implement the selected solution, the DMT will need to secure funding. If funding is not available, the DMT 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 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.

Program Schedule

The costs and typical times to solve DMSMS problems can be plotted. Figure 6 is an example based on the resolution cost and time metrics from Table 5. As you would expect, the time required to solve a problem increases as the complexity of the solution increases:

Timeline = Acquisition lead-time + Production lead-time + Funding timeline.

Figure 6. Average NRE Cost and Time to Resolve by Solution Type ($ K)



Program 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/WRA and SRU/SRA (board or SRA) spares—and, ultimately, the weapon system?" From a proactive view, the SRU/SRA that will become obsolete first is the one you should examine first.

The OIA is sensitive to the following complex data sets:

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

The OIA approach assumes that, without intervention, every year more failed SRUs/SRAs would not get repaired because the failed parts are obsolete, not procurable, and not in the repair parts stock. We also assume that some obsolete parts can be reclaimed from a pool of nonreparable SRU/SRA carcasses (but the yield of pool parts from the carcasses will be less than 100 percent). Eventually, the SRU/SRA spares pool will become exhausted, causing the effective loss of an LRU/WRA spare when used to supply a spare of the needed SRU/SRA. The model is driven by operational hours and failure rates.

As your DMT implements solutions for 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 then carried (in the model) as "available" and would not contribute to the depletion of the SRU/SRA spares population. You can use this information to measure the effect of implementations on operational supportability.

The output of the OIA is a chart showing the drawdown of the population of SRU/SRA or LRU/WRA spares, as described above. Table 7 is a sample output of an OIA at the LRU/WRA 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/WRA 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/WRAs with serious DMSMS problems and to plan for a technology refresh or modernization.

Table 7. Sample OIA Output (LRU/WRA Level)

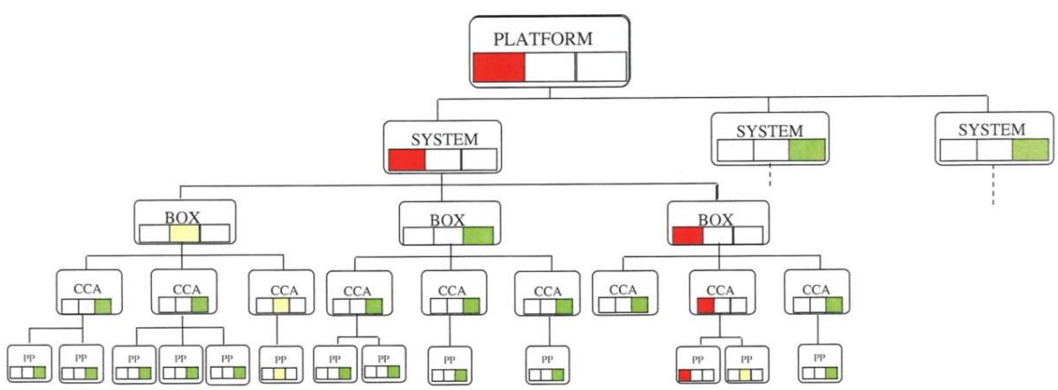
LRU/WRA name	Initial quantity LRU/WRA spares	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Control unit	3	G 3	G 2	G 1	Y 0	R −2	R −4	R −6	R −8	R −11	R −15	R −19
UHF radio	5	G 5	G 5	G 5	G 5	G 4	G 4	G 4	G 3	G 3	G 3	G 2
VHF radio	2	Y 0	Y 0	R −1	R −1	R −2	R −3	R −3	R −4	R −4	R −5	R −6
Elec. assembly	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

Notes: "Green" = two or more viable manufacturers, "Yellow" = only one viable manufacturer, "Red" = no manufacturers (the part is obsolete), and "Blue" = the manufacturing sources for the part are not known.

Platform Readiness Status

Platform readiness status is based on the systems that 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 7 is an example.

Figure 7. Sample Model for Depicting Platform Readiness



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.

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/SRAs, and LRU/WRAs, by color code, in each system	
DMT database	Cumulative number of PPRs	Determine DMT productivity
	Cumulative generation of LRU/WRA 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 MYBs 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 avoid-ance
Other sources	Projected DMSMS-induced depletion of LRU/WRA and s spares	Analyze operational impacts

[a] “Green” = two or more viable manufacturers, “Yellow” = only one viable manufacturer, Red” = no manufacturers (the part is obsolete), and “Blue” = the manufacturing sources for the part are not known.

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 you DMSMS program. Appendix J 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. Performance can be measured as the ratio of good events to total events. In the field of reliability engineering, inherent availability (A_i) is measured by the ratio of uptime to total time:

$$A_i = \text{Uptime} \div (\text{Uptime} + \text{Downtime}).$$

Success in DMSMS management is 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 (A_o) considers parts availability as part of the equation as mean logistics delay time (MLDT):

$$A_o = \text{Uptime} \div [(\text{Uptime} + \text{Downtime}) + \text{MLDT}].$$

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 red (false positives), the PI will be low.
- If the predictive tool reports reds as green (false positives), 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:

- Relationship of TLCSM and PBL tenets to 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 reference documents that provide DMSMS policy and guidance
- Awareness of DMSMS tools.

The message of 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, *Integrated 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

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.

DLA–L&M (http://www.dscc.dla.mil/). Contains DMSMS information on electronic components.

DLA–L&M, 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.

Defense Logistics Information Service (http://www.dlis.dla.mil/).

Defense MicroElectronics Activity (http://www.dmea.osd.mil/). Contains information on technologically correct and economically viable solutions to microelectronic obsolescence.

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 Center for Cost Analysis (http://www.ncca.navy.mil/services/inflation.cfm). An inflation calculator that includes DoD-wide, Navy, Marine Corps, and Army weighted inflation factors (for use in projecting resolution costs to future years).

Naval Sea Systems Command, Corona Division, Sunset Supply Base (http://www.dmsms.org/SSB). Serves 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 information on DMSMS management and solutions.

Naval Supply Systems Command, Navy Logistics Productivity Research and Development (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 can reduce the risks typical of custom-developed systems. However, COTS solutions present challenges that are specific to the commercial market. For example, the rapid turnover of COTS products creates obsolescence-induced supportability issues, as does the as-is nature of COTS product configurations, which often may not meet military requirements.

Avoiding DMSMS in COTS-based systems calls for effective relationships among program participants: the supplier of the COTS items, the system developer and integrator, and the buyer. Although all COTS equipment is subject to DMSMS, particular component classes are prone to DMSMS 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.

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 DMT should query the manufacturers to learn the following:

- *Current availability*. Will COTS items be available to support the deployable systems and spares needs?
- *Bill of materials.* Will the manufacturer provide a BOM of the COTS item?
- *Product plans.* Is the COTS item targeted for discontinuance or upgrade? Will engineering drawings be available?
- *Upgrades.* Is the item 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 support policy*. How long will the supplier support the product? How does the COTS timeline compare with the projected system life cycle?
- *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?

The remainder of this appendix covers practices developed by six organizations for acquiring and supporting COTS-based systems.

Federal Aviation Administration

FAA 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 FAA approach emphasizes the system engineering process of programmatic risk management. The guide presents a method for acquiring and supporting COTS products along with commonly experienced lessons-learned, or risk factors, and risk mitigation strategies. The guide covers the "what, why, how, and when" discussion of each mitigation strategy.

Office of Naval Research

The Office of Naval Research created the Best Manufacturing Practices (BMP) program to help businesses identify, research, and promote exceptional manufacturing practices, methods, and procedures. The BMP program has three core components:

- Best practices surveys, which identify, validate, and document best practices
- Systems engineering, which is facilitated by the Program Manager's WorkStation, a suite of software tools for risk management, engineering support, and failure
- Web technologies, which provide an integrated digital environment to access a common set of documents on the web.

The BMP program highlights innovative COTS products and management techniques that provide resolutions to specific problems.

Center for Advanced Life Cycle Engineering

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

- *Electronic part obsolescence forecasting.* This method, developed by the CALCE Electronic Products and Systems Center, uses data-mining-based algorithms to forecast electronic part obsolescence. In the center's basic 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.

Lockheed Martin Naval Electronics and Surveillance Systems–Surface Systems

Lockheed Martin Naval Electronics and Surveillance Systems–Surface Systems (NE&SS-SS) developed the Aegis COTS Technology Family Analysis and Selection Tool. This tool addresses four acquisition focus areas:

- Technical/performance
- Program management (development, production, operations, support, training)
- Total cost
- Road maps (multiple baselines, viability, market/technology trends).

The tool supports a three-phased approach consisting of technology identification, vendor selection, and end-product choice. Tailored questions lead to categories that require data collection. The data are then refined and assessed by the IPT prior to making a selection.

Lockheed Martin NE&SS-SS also undertook a Mechanical COTS Design Practices initiative to address issues with the validation of critical design parameters for COTS items in military applications. Their approach includes the design, analysis, and testing of COTS hardware prior to environmental qualification. These design practices 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.

ITT Aerospace/Communications Division

ITT Aerospace/Communications Division (A/CD) has a process for the procurement of commercial microcircuits suitable for use in military and aerospace electronic systems. The company conducted surveys, visited vendors, and reviewed parts data to evaluate military usage of plastic encapsulated microcircuits (e.g., lifetime cost, reliability, performance). ITT A/CD also analyzed commercial part samples, using destructive physical and soniscan methods. From this experience, the company developed a working preferred supplier list and identified the critical parameters and specific application requirements of commercial parts.

Carnegie Mellon Software Engineering

The Carnegie Mellon Software Engineering Institute developed an approach—COTS Usage Risk Evaluation, or CURE—to reduce the number of program failures attributable to COTS software. CURE can be used by organizations creating large-scale systems that rely on COTS products. CURE predicts the areas in which COTS software will have the greatest impact on the program. This allows designers to address the specific risks and to monitor their mitigation. CURE finds and reports risks relating to the use of COTS software.

Summary

Because COTS products will be part of every system, they must be managed for obsolescence. Below are some 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
- 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).

APPENDIX D. USING BUSINESS CASE ANALYSIS TO EVALUATE RESOLUTION ALTERNATIVES

Background

According to Office of Management and Budget (OMB) Circular A-94, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*,

> benefit-cost analysis is the technique to use in a formal economic analysis of government programs. The standard criterion for deciding whether a government program [in our case, DMSMS resolution alternatives] can be justified on economic principles is NPV—the discounted monetized value of expected net benefits (i.e., benefits minus costs). NPV is computed by assigning monetary values to benefits and costs, discounting future benefits and costs using an appropriate discount rate, and subtracting the sum total of discounted costs from the sum total of discounted benefits.

For DMSMS alternatives, the one with the least present cost is preferred. We assume that the benefit of mitigating a given DMSMS condition is the same for each alternative; hence, present cost is as good as net present value in choosing among alternatives. To compute present cost, you must "discount" future costs using the OMB discount rate (accounts for the time value of money). Costs are worth more if they are experienced sooner (delay is economical). The higher the discount rate, the lower the present cost of future cash outlays.

The discount rate is actually the forecasted interest rate as reported by OMB (see http://www.whitehouse.gov/omb/circulars/a094). Table D-1 (from OMB Circular A-94) is the real interest forecast from the 2011 budget. These rates are used for discounting constant-dollar flows, as is required in cost-effectiveness analysis.

Table D-1. Real Interest Rates on Treasury Notes and Bonds of Specified Maturities (FY11 Budget)

3-year	5-year	7-year	10-year	20-year	30-year
0.9%	1.6%	1.9%	2.2%	2.7%	2.7%

The discount factor is calculated as $1/(1 + i)^t$, where i is the interest rate and t is the year (current year is year 0, next year is year 1). Here are two example computations using the 7-year interest rate of 1.9 percent (0.019) (7 years is the time horizon in the following illustration):

Discount rate for year 2 (FY13) = $1/(1+0.019)^2 = 0.963$.

Discount rate for year 6 (FY17) = $1/(1+0.019)^6 = 0.893$.

BCA Application to a DMSMS Scenario

In 2008, a particular SRU in the fuel management system of the B-2 had become a top DMSMS concern with six serious DMSMS issues. The approved PPRs recommended individual solutions (with costs coming from the resolution cost metrics) as follows:

- A complex substitute project for FY14–FY15 and another complex substitute project for FY15–FY16
- Two normal substitute projects in FY16, and two other normal substitute projects in FY17.

Every BCA requires alternatives. This case has two alternatives:

- Alternative 1—fund and initiate six individual projects in the time periods indicated.
- Alternative 2—redesign the SRU immediately (starting in FY11) and complete it in 3 years. The FY11 cost of $1,010,000 would be allocated 40 percent the first year ($404,000), 40 percent the second year ($404,000), and 20 percent the third year ($202,000).

To calculate the present value of these alternatives over 7 years (in this illustration, the projects are executed over a 7-year period), we must generate a cost stream for each by (1) computing the then-year cost for the set of corrective actions and (2) discounting those costs to the present year (FY11). We use the following data inputs:

- Seven-year real interest rate of 1.9 percent, from Table D-1
- DoD weighted inflation factors from the NCCA (FY11 constant year to 7 future “then-years”) (see http://www.ncca.navy.mil/services/inflation.cfm)
- FY11 mean cost values from the resolution cost factors, as seen in Table D-2.

Table D-2. Resolution NRE Cost Metrics (FY11)

Resolution type	90% confidence (left limit)	Mean	90% confidence (right limit)	Weeks to resolve (average)
Reclamation	$1,000	$20,000	$39,000	12
Alternate source [a]	$0	$41,000	$92,000	11
Administrative substitute	$1,000	$3,000	$5,000	4
Desktop substitute	$0	$5,000	$10,000	8
Normal substitute	$22,000	$34,000	$46,000	25
Complex substitute	$122,000	$432,000	$724,000	40
Emulation [b]	$29,000	$73,000	$117,000	26
Aftermarket manufacturing	$0	$33,000	$58,000	21
Redesign–COTS product	$82,000	$1,118,000	$2,154,000	42
Redesign–Custom part [c]	$542,000	$1,094,000	$1,646,000	61
Redesign–PNHA	$654,000	$1,010,000	$1,366,000	64

[a] Alternate source includes parts from a different manufacturer (not already in the applicable technical data package) that meet the part specification.

[b] Emulation cost values were provided by DLA. They represent the historical costs to DLA to emulate a part from the GEM and GEM AME programs; they do not include integration into the next higher assembly or system.

[c] Redesign–Custom part includes the development and validation in the application of new component-level parts.

Table D-3 shows the computation of the present cost of Alternative 1 (considering rounding). The solution costs are distributed over 2 years for the complex substitutes. We do not attempt to compute a benefit, because it will be the same as for Alternative 2 (the benefit is DMSMS mitigation). Here, the present cost of spending the money in the future years is $986,000 (rounded). This value would then be compared to the computation of present value for Alternative 2 ($1,021,000 rounded), which is in Table D-4.

Table D-3. Computing Present NRE Cost of Alternative 1 (Mix of Solutions)

Fiscal year	Year no.	FY11 cost: Complex substitute	FY11 cost: Normal substitute	Total	DoD weighted inflation	OMB discount [a]	Present cost
11	0			$0	1.030	1.000	$0
12	1			$0	1.029	0.981	$0
13	2			$0	1.047	0.963	$0
14	3	$211,500		$211,500	1.065	0.945	$212,881
15	4	$423,000		$423,000	1.083	0.927	$424,886
16	5	$211,500	$68,000	$279,500	1.101	0.910	$280,090
17	6		$68,000	$68,000	1.120	0.893	$68,027
Present cost of Alternative 1							$985,884

[a] Based on 7-year real interest rate of 0.019 from Table D-1.

Table D-4. Computing Present NRE Cost of Alternative 2 (SRU/SRA Redesign)

Fiscal year	Year no.	FY11 cost: Redesign SRU	DoD weighted inflation	OMB discount	Present cost
11	0	$404,000	1.013	1.000	$409,142
12	1	$404,000	1.029	0.981	$408,161
13	2	$202,000	1.047	0.963	$203,680
Present cost of Alternative 2					$1,020,983

In this case, the more economical choice is to pursue the individual solutions. If there were more individual solutions, or if they must be started in earlier years, the outcome would have favored the SRU redesign. Of course, the economics of the decision must be tempered with other logistics and technical considerations, such as the more expensive production cost of the redesigned SRUs and the possibility of the SRU redesign incurring a cost and schedule overrun. Also, the timing for project initiation must be sound (as documented in the PPRs).

Whenever alternatives exist, the decision maker will expect to know all rationale for the recommendation. This present-value basis is one such compelling reason.

APPENDIX E. ONTOLOGY OF DMSMS SOLUTIONS

An ontology is a common set of well-defined concepts for use in shared understanding and consistent communication within a particular domain (the domain of DMSMS resolution types in this case). The concepts are defined using the following:

- Subclass hierarchy
- Vocabulary (definitions)
- Assignment and definition of properties, relationships, and constraints.

Figure E-1 shows the subclass hierarchy, and Table E-1 lists the DMSMS resolution types and, for each, provides a definition, identifies the relevant life-cycle phases, indicates the scope, and provides an example.

Figure E-1. DMSMS Resolution Taxonomy

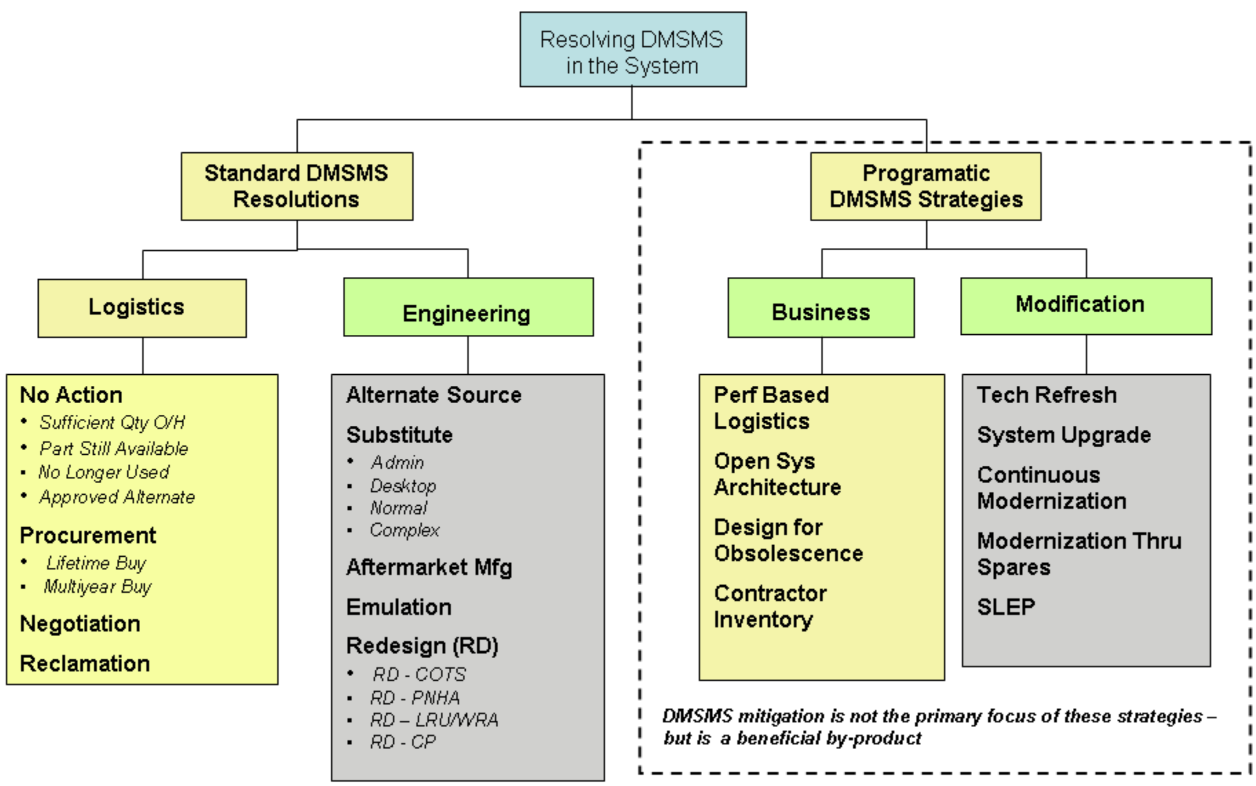


Table E-1. Standard DMSMS Resolution Definitions, Properties, and Relationships: Logistics Actions and Engineering Actions

Resolution type (category)	Definitions, properties, and examples	Objective
Logistics Actions Actions to lay in or secure the availability of the existing Required Item of Supply (RIOS). There are four subtypes of logistics actions.		
No corrective action required	*Definition.* Determining that (1) a sufficient quantity is on hand in controlled inventory, (2) the item is still available (existing stock), (3) the item is no longer used in the system, or (4) an approved alternate is available. *Life-cycle phase (LCP).* Sustainment. *Scope.* Examination of the part sources, inventories, and installations in the configuration. *Example.* A 15-year supply exists in the contractor's depot.	Inventory of the RIOS
Procurement	*Definition.* Purchasing (lifetime buy or multiyear buy) a quantity (e.g., a 20-year supply) of the obsolete item while it is still available (distributor or aftermarket) and maintaining a controlled inventory of the item. *LCP.* Acquisition and sustainment. *Scope.* Identification of a safe quantity, procurement, verification of the traceability of the items (Certificate of Conformance), storage, and issuance as required. *Example.* Finished parts are procured from an aftermarket source.	Inventory of the RIOS
Negotiation	*Definition.* Entering into an agreement with a source to continue supplying the item. *LCP.* Acquisition and sustainment. *Scope.* Development of a contract or other document specifying intent to procure a quantity over a future time. This solution type would be used by contractors to ensure future production of SRUs/SRAs. *Example.* Contractor X strikes an agreement with a specialty RF vendor for four RF hybrids for the next 2 years.	Continuing source
Reclamation/ salvage	*Definition.* Salvaging obsolete parts from unserviceable or surplus NHAs. *LCP.* Acquisition and sustainment. *Scope.* Acquisition of the NHA, removal (de-soldering), cleaning, inspection, testing, verification of the traceability of the items, and packaging of the parts. No TDP changes are required. *Example.* Hybrids are salvaged from an earlier configuration of the NHA.	Inventory of the RIOS
Engineering Actions Actions requiring engineering involvement (requirements, evaluation, design, testing, and documentation). There are 11 subtypes of engineering actions, including 4 types of substitutes and 4 types of redesign.		
Alternate source	*Definition.* Procuring the same part from a different source not designated in the specification control drawing (SCD) or source control drawing (SoCD). *LCP.* Acquisition and sustainment. *Scope.* Small project with no development. Engineering review, (possibly) part testing, and TDP and cataloging changes are required. This solution type may include procuring finished product from a different qualified Source of Supply (SOS) (e.g., Rochester Electronics) or an existing emulated part. *Example.* The SoCD called for a Motorola 2N2222A transistor (discontinued in 1995). The 2N2222A is available from Microsemi Corp. The project is to evaluate the Microsemi equivalent and change the SoCD if approved.	An approved part source

Table E-1. Standard DMSMS Resolution Definitions, Properties, and Relationships: Logistics Actions and Engineering Actions

Resolution type (category)	Definitions, properties, and examples	Objective
Substitute—Authorizing a different existing part with an acceptable degree of nonconformance (more or less stringent electrical or environmental requirements from the original).		
Administrative substitute	*Definition.* Editing the TDP for nonperformance (i.e., administrative or clerical) corrections. *LCP.* Acquisition and sustainment. *Scope.* Changes in the TDP to SOS name, address, part number, Commercial and Government Entity (CAGE) code. Manufacturing and performance are unaffected. *Example.* National Semiconductor Corporation (NSC) purchased Fairchild, kept its military product lines, and changed part numbers to NSC nomenclature (e.g., UA111HMQB to LM111H/883).	An alternate part called out in the TDP
Desktop substitute	*Definition.* Evaluating the TDP of an intrinsically suitable (but different) part, for example, a higher-reliability version (JANTXV versus JANTX) or an existing GEM or GEM AME part. *LCP.* Acquisition and sustainment. *Scope.* TDP changes that are more than clerical. No testing or source evaluation is required to validate the use of the part in the application. *Example.* Resistor RWR xxxx with a ±0.1% tolerance can be replaced by a different one with a ±0.01% tolerance (a higher reliability component). In a second example, a TDP calls for a standard microcircuit drawing but the part is now available only as a MIL-M-38510 version.	An alternate part called out in the TDP
Normal substitute	*Definition.* Validating one known (identified) existing candidate part. *LCP.* Acquisition and sustainment. *Scope.* Engineering review; testing of part for form, fit, function, interface (F^3I); compatibility testing; and performance tests at the NHA level resulting in TDP changes. This solution may require an engineering waiver or deviation because the substitute may not meet some of original specifications. *Example.* Test results for a linear amp from the same SOS with the same package and same temperature level (but with lower response time) are fully satisfactory (slower response time is acceptable). The TDP package is changed to allow the slower time and the new part is listed in the table of recommended sources.	An alternate part called out in the TDP
Complex substitute	*Definition.* Seeking, selecting, and validating a replacement part from several potential candidates. *LCP.* Acquisition and sustainment. *Scope.* Engineering investigation to find acceptable candidates, F^3I part tests, compatibility testing, performance testing at the NHA level, quality conformance testing, and perhaps environmental testing (e.g., for radiation hardness). A waiver or deviation may be required. (If the investigation is not successful, a more expensive resolution must be pursued.) *Example.* Optical coupler approved in the SCD is no longer made. An engineering search found four couplers with similar characteristics. After testing, two are approved for the application. The suggested sources table in the SCD is changed to authorize the new parts.	An alternate part called out in the TDP

Table E-1. Standard DMSMS Resolution Definitions, Properties, and Relationships: Logistics Actions and Engineering Actions

Resolution type (category)	Definitions, properties, and examples	Objective
Aftermarket manufacturing	*Definition.* Contracting with an aftermarket source (AMS) (e.g., Austin Semi, Lansdale, QP Semi, or Rochester) to fabricate, package, and test products that have been discontinued by the original SOS. There are two ways AMS suppliers produce parts: (1) "part finishing," where the AMS packages the original semiconductor die, and (2) "full part manufacturing," where the AMS both produces and packages the die. *LCP.* Sustainment. *Scope.* Review of aftermarket SOS testing data, compatibility testing in the NHA, and changes to the TDP to cite the new SOS and PN. *Example.* NSC sold off all products, including die for military logic, to Arrow/QP Semi. Arrow became the sole source for these former NSC parts. If a program needs a part available only in die, it must contract with Arrow for aftermarket manufacturing.	An alternate part called out in the TDP
Emulation	*Definition.* Contracting with an emulation SOS (e.g., Sarnoff Corp.) to develop an F^3I microcircuit replica from a mask-configurable gate array. The internal configuration of the part is different from the original part, but the input/output characteristics are identical. If a suitable alternate source or substitute is not available, emulation is a preferred method of replacing an obsolete (component-level) part. It is pursued after an investigation shows it to be an economical tradeoff. *LCP.* Sustainment. *Scope.* Contracting process to develop the new emulated replacement part followed by testing in the application and changes to the TDP. (Using a previously existing emulated product is an alternate source.) *Example.* A transmitter has five circuit cards, each hosting 20 obsolete microcircuits (same part number). There is no alternate, substitute, or aftermarket source. There is a high repair demand for the obsolete microcircuit. An engineering study of alternatives concludes that contracting with Sarnoff to develop a new emulated part is the preferred solution.	An alternate part called out in the TDP
Redesign—Designing and developing a new or modified module, or circuit card assembly, or a new component, necessitated by obsolescence.		
Redesign–with COTS product	*Definition.* Undertaking a major engineering project to insert new COTS equipment into a system made necessary from obsolescence of the existing COTS equipment. *LCP.* Pre-acquisition, acquisition, and sustainment. *Scope.* Contracting, design, system integration, and testing. *Example.* The control computer for a ground radar system is no longer supported by the original source. The computer and software must be replaced.	An alternate COTS product NHA in the TDP

Table E-1. Standard DMSMS Resolution Definitions, Properties, and Relationships: Logistics Actions and Engineering Actions

Resolution type (category)	Definitions, properties, and examples	Objective
Redesign–Custom part (reverse engineering)	*Definition.* Undertaking a major DMSMS engineering project, which may involve contracts with specialty (niche) parts suppliers to develop or recreate a replacement for an obsolete part (e.g., normal microcircuit, RF component, ASIC, or hybrid) (possible performance improvements). *LCP.* Acquisition and sustainment. *Scope.* Contracting, design, development, first-article testing, qualification testing, and subsystem and system testing. Typically, this solution is a multiyear project. *Example.* A digitally tuned oscillator used in only one weapon system had extremely tight performance specifications, and the original design data were missing. Only two companies worldwide could develop such devices. A source selection was performed, and a contract was written.	An alternate custom component in the TDP
Redesign–PNHA	*Definition.* Undertaking a major DMSMS engineering project to design and develop an F^3I replacement NHA (circuit card or module). *LCP.* Acquisition and sustainment. *Scope.* Contracting, design, development, first-article testing, qualification testing, and subsystem and system testing. It also may include technology insertion to reduce part count and improve reliability. Typically, this solution is a multiyear project. *Example.* An RF receiver module was not supportable due to having eight obsolete custom parts. The module was redesigned by a different source (original designer out of business), resulting in a producible NHA with a complete TDP for use in reprocurement.	An alternate NHA in the TDP
Redesign–LRU/WRA level	*Definition.* Undertaking a major system engineering project to design and develop a new subsystem to upgrade performance and meet new mission requirements. It would be unusual to undertake such a project solely due to DMSMS. *LCP.* Acquisition and sustainment. *Scope.* Major engineering effort. As a by-product, DMSMS issues in the old configuration are resolved. *Example.* An aircraft radar was replaced to use a different operating frequency. Many obsolescence issues were eliminated in the new design.	A new LRU/WRA

Table E-2 lists programmatic initiatives that are undertaken at the highest command level of decision making. These initiatives are not the normal purview of the DMSMS practitioner. Clearly, the DMSMS manager of a program would not implement PBL to solve the program's DMSMS problems. However, DMSMS mitigation may be a byproduct of such programmatic initiatives.

Table E-2. Programmatic Initiatives that May Mitigate DMSMS.

Initiative/action type	Life-cycle phase
Performance-based life-cycle product support	Acquisition, sustainment
Continuous modernization	Acquisition, sustainment
System upgrade	Sustainment
Service Life Extension Program	Sustainment
Technology refresh	Acquisition, sustainment
Modernization through spares	Pre-acquisition, acquisition, sustainment
Open systems architecture	Pre-acquisition, acquisition
Design for obsolescence	Pre-acquisition
Contractor-maintained inventory	Acquisition, sustainment

APPENDIX F. GLOSSARY

After-market manufacturing (reverse engineering). Contracting with an after-market source of supply (SOS) (e.g., Austin Semi, Lansdale, QP Semi, or Rochester) possessing the resources to fabricate, package, and test products that have been discontinued by the original SOS. (Procuring finished product from an aftermarket source is not aftermarket manufacturing; it is an alternate source resolution type.

Alternate source. Procurement of the *same* part from a different SOS not designated in the specification control drawing (SCD) or source control drawing (SoCD).

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

Continuous modernization. Programmatic system management strategy 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-maintained inventory. Purchase (via a contract) of a service whereby the contractor maintains an inventory of DMSMS items for future DoD needs.

Design for obsolescence. Addressing obsolescence during the design phase. An example is use of VHDL that promotes easy replacement of obsolete components with different or newer technology parts.

Emulation. Contracting with an emulation SOS (e.g., Sarnoff Corp.) to develop an F^3I microcircuit replacement device from a mask-configurable gate array. The internal configuration of the part is different, but the part is designed to meet all the performance requirements of the SCD or military specification. (Use of an existing emulated product is considered an alternate source.)

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

Existing substitute. Authorizing a different existing part with an acceptable degree of nonconformance. The substitute could have more or less stringent electrical or environmental requirements from the original. Substitutes are further segregated into four subtypes:

> ***Administrative substitute.*** Editing of the TDP for nonperformance corrections.
>
> ***Desktop substitute.*** Evaluation of the TDP of an intrinsically suitable (but different) part, in other words, a higher-reliability version (JANTXV versus JANTX).
>
> ***Normal substitute.*** Validation of one known (identified) existing candidate part.

Complex substitute. Identification, selection, and validation of a new part from several candidates.

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. Programmatic system management strategy to insert spare parts that reflect current technology and the use of commercial products, processes, and practices.

Modification or redesign. Modification or redesign of an assembly to address COTS product obsolescence, specialized component obsolescence, or circuit obsolescence. The ontology of DMSMS resolution types recognizes four subtypes of redesign:

Redesign–COTS product. Major engineering project to insert new COTS equipment into a system made necessary from obsolescence of the existing COTS equipment. Scope covers contracting, design, system integration, and testing. Example: The control computer for a ground radar system is no longer supported by the original source. The computer and software must be replaced.

Redesign–Custom part. Major DMSMS engineering project, which may involve contracts with specialty (niche) parts suppliers to develop or recreate a replacement for an obsolete custom part (e.g., RF component, ASIC or hybrid) (possible performance improvements). Scope covers contracting, design, development, first-article testing, qualification testing, and subsystem and system testing, and is typically a multiyear project. Example: A digitally tuned oscillator used in only one weapon system was the top obsolescence concern. The oscillator had extremely tight performance specifications, and the original design data were missing. Only two companies worldwide could develop such devices. A source selection was performed, and a contract was written.

Redesign–Peculiar Next Higher Assembly. Major DMSMS engineering project to design and develop an F^3I replacement NHA (SRU/SRA or module). Scope covers contracting, design, development, first-article testing, qualification testing, and subsystem and system testing. It may include technology insertion to reduce part count and improve reliability, and it typically is a multiyear project. Example: An RF receiver module had eight obsolete custom parts. The module was redesigned by a different source (original designer out of business), resulting in a producible NHA with a complete TDP for use in reprocurement.

Redesign–LRU/WRA. Major system engineering project to design and develop a new subsystem to upgrade performance and meet new mission requirements. It would be very unusual to undertake such a project solely due to DMSMS. This is a major engineering effort; as a byproduct, DMSMS issues in the old configuration would be resolved. Example: An aircraft radar was replaced to use a different operating frequency. Many obsolescence issues were eliminated in the new design.

Open systems architecture. Design approach that uses publicly available documents defining specifications for interfaces, services, protocols, or data formats established by consensus and widely used in the marketplace.

Performance-based life-cycle product support. Programmatic system management strategy, particularly at the system and platform levels, 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. System design parameter that specifies performance or results rather than design details. (See SD-15, *Performance Specification Guide*, for more information about performance-based requirements.)

Reclamation. Salvaging obsolete parts from unserviceable or surplus next higher assemblies.

System upgrade and Service Life Extension Program (SLEP). Programmatic system management strategy to implement major capability changes and product improvements.

Technology refresh. Programmatic system management strategy to replace the electronics in a system over a specific period of time. It is usually expensive but justified by the improved operational capability or greater reliability, or both, afforded by the incorporation of more sophisticated technology. It may also eliminate potential incompatibilities among previous updates in technology.

APPENDIX G. ASSESSMENT OF DMSMS SOLUTION ALTERNATIVES

Table G-1 details cost, schedule, and other considerations when evaluating alternative approaches to resolving a DMSMS problem.

Table G-1. Assessment of DMSMS Solution Alternatives

Taxonomy alternative	Nonrecurring cost impact	Recurring cost impact	Schedule impact	Effectiveness time frame
Negotiation	Low; could involve premium	Potentially higher	Minimal	Temporary unless source is provided a long-term forecast of market viability
Alternate 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	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
Procurement	Cost of inventory only; risk of downstream obsolescence	Minimal; could be lower with higher quantity buy	Minimal	Long term if calculations are correct
Reclamation	Low	Low	Minimal	Short term (cannibalize)
Emulation	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 or unavailability If due to technology obsolescence, may be long term
Redesign	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
Aftermarket manufacturing	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

APPENDIX H. 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 engineer-

ing 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 DMSMS Knowledge Sharing Portal, 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, the contract should contain clauses requiring the contractor to provide BOMs, which are crucial for government organic resources or third-party contractors to objectively manage obsolescence.

APPENDIX I. DEVELOPING PROGRAM-SPECIFIC NRE COST METRICS

The DMSMS resolution cost metrics (Table 5 in this document) will suffice as average costs when there are no actual cost data for your program. Assume that at some future time, a program initiates a DMSMS corrective action project. Cost data from that "actual" project should be used where possible to generate program-specific metrics. Obviously, an actual cost of a specific resolution type would be the best estimate for future occurrences of that same type. But what can be done to generate better estimates of the other resolution types? This appendix illustrates how to use the actual data to arrive at a program-specific estimate.

Here's the scenario. In 2008, a microcircuit specified in a Company Y SCD had become a top DMSMS concern. Some 5 years earlier, 12 units of the part had been purchased (a multiyear buy) and stored in a program-dedicated inventory. However, in the last 2 years, 9 of those units had been consumed (on the Company Y LRU and on two other LRUs). The program office awarded a contract to Company Z, the prime contractor, who in turn subcontracted to Company Y. The scope of the contract was to find a suitable solution (categorized as a complex substitute).

The outcome of the project was to identify the most promising candidate and validate a commercially available component (a complex substitute). There was testing at the part level (radiation hardness) and at the NHA level (acceptance test procedures on three different NHAs) along with the technical documentation, quality oversight, and management oversight. The contract cost was $850,000. Any future complex substitution on this weapon system program would be expected to cost about the same.

Cost estimates for other resolution types also could be based on that data point. Using the resolution cost metrics (Table 5), one can compute the ratios of the resolution type cost metrics. Assigning the average cost of the complex substitute as the base value, for the other resolution types, one would simply compute the ratio of the average cost of each type to the average cost of a complex substitute. In other words, one would express each type as a fraction of the complex substitute. Table I-1 shows the ratios.

Table I-1. Ratios of Type Average NRE Costs to Cost of a Complex Substitute

Resolution type	Cost estimate	Ratio of type $/ complex substitute $	Value of ratio
Reclamation	$20,000	= 20,000/423,000	0.047
Alternate source	$41,000	= 41,000/423,000	0.097
Administrative substitute	$3,000	= 3,000/423,000	0.007
Desktop substitute	$5,000	= 5,000/423,000	0.012
Normal substitute	$34,000	= 34,000/423,000	0.080
Complex substitute	$423,000	= 423,000/423,000	1.000
Emulation	$73,000	= 73,000/423,000	0.173
Aftermarket manufacturing	$33,000	= 333,000/423,000	0.078
Redesign–COTS product	$1,118,000	=1,118,000/423,000	2.643
Redesign–Custom part	$1,094,000	=1,094,000/423,000	2.586
Redesign–PNHA	$1,010,000	= 1,010,000/423,000	2.388

By using the new actual cost of the complex substitute ($850,000) as the base (instead of the $423,000 from Table 5), revised estimates of the average resolution costs can be projected as seen in Table I-2.

Table I-2. New NRE Cost Metrics Based on Actual Cost of a Complex Substitute

Resolution type	Type $/complex substitute $ (from Table I-1)	Ratio × $850,000 (new base)	Revised program estimate 1
Reclamation	0.047	= 0.047 × $850,000	$40,189
Alternate source	0.097	= 0.097 × $850,000	$82,388
Administrative substitute	0.007	= 0.007 × $850,000	$6,028
Desktop substitute	0.012	= 0.012 × $850,000	$10,047
Normal substitute	0.080	= 0.080 × $850,000	$68,322
Complex substitute	1.000	= 1.000 × $850,000	$850,000
Emulation	0.173	= 0.173 × $850,000	$146,690
Aftermarket manufacturing	0.078	= 0.078 × $850,000	$66,312
Redesign–COTS product	2.643	= 2.643 × $850,000	$2,246.572
Redesign–Custom part	2.586	= 2.213 × $850,000	$2,198,345
Redesign–PNHA	2.388	= 2.388 × $850,000	$2,029,551

If another actual cost is incurred (e.g., a normal substitute that costs $90,000), the cost estimates can be refined further by making the new “actual” type cost base to be that of the previous normal substitute ($68,322 from Table I-2). First we recalculate the ratios as seen in Table I-3. Since the complex substitute value of $850,000 was an actual cost, it is not adjusted.

Table I-3. Ratios of Type Average NRE Costs to Actual Cost of a Normal Substitute

Resolution type	Revised estimate (from Table I-2)	Ratio of type $/ normal substitute $	Value of ratio
Reclamation	$40,189	= 40,189 ÷ 68,322	0.588
Alternate source	$82,388	= 82,388 ÷ 68,322	1.206
Administrative substitute	$6,028	= 6,028÷ 68,322	0.088
Desktop substitute	$10,047	= 10,047 ÷ 68,322	0.147
Normal substitute	$68,322	= 68,322 ÷ 68,322	1.000
Complex substitute	$850,000[a]		
Emulation	$146,690	= 146,690 ÷ 68,322	2.147
Aftermarket manufacturing	$66,312	= 66,312 ÷ 68,322	0.971
Redesign–COTS product	$2,246,572	= 2,246,572 ÷ 68,322	32.882
Redesign–Custom part	$2,198,345	= 2,198,345 ÷ 68,322	32.176
Redesign–PNHA	$2,029,551	= 2,029,551 ÷ 68,322	29.706

[a] Based on an actual cost.

As before, by using the Table I-3 ratios and the new known cost of a normal substitute ($90,000), new revised estimates of the resolution costs can be projected as seen in Table I-4 (the value for the known complex substitute would remain unchanged).

Table I-4. Estimates Using Actual Values of Complex Substitute and Normal Substitute

Resolution type	Type $/normal substitute $ (from Table I-3)	Ratio × $90K (New Base)	Revised program estimate 2
Reclamation	0.588	= 0.588 × $90,000	$52,941
Alternate source	1.206	= 1.206 × $90,000	$108,529
Administrative substitute	0.088	= 0.088 × $90,000	$7,941
Desktop substitute	0.147	= 0.147 × $90,000	$13,235
Normal substitute	1.000	= 1.000 × $90,000	$90,000
Complex substitute			$850,000[a]
Emulation	2.147	= 2.147 × $90,000	$193,230
Aftermarket manufacturing	0.971	= 0.971 × $90,000	$87,390
Redesign–COTS product	32.882	= 32.882 × $90,000	$2,959,380
Redesign–Custom part	32.176	= 32.176 × $90,000	$2,895,840
Redesign–PNHA	29.706	= 29.706 × $90,000	$2,673,540

[a] Based on an actual cost.

This technique assumes that the most recent actual cost is the best estimate for any type. A possible variation on that assumption is to use an average of all type cost recomputations. This technique would be performed each time a new actual cost (of any of the resolution types) is incurred. The values in the table that came from previous actuals would not be changed, but all others would be. If other examples of the same resolution type occur, the cost of that type would be changed to the average of the occurrences.

Clearly, this technique requires the DMT to keep track of solutions and their associated costs.

APPENDIX J. DESIGN INTERFACE ASSESSMENT CRITERIA

Table J-1 contains criteria that can be used as a guide for developing assessment criteria for DMSMS programs. The information was taken from *Integrated Logistics Assessment Handbook* (NAVSO P-3692), published by the Department of the Navy, September 2006.

Table J-1. Design Interface Assessment Criteria

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

Table J-1. Design Interface Assessment Criteria

Criterion	Milestone				
	B	C	FRP	IOC	FOC
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 ◆ Minimized use of custom parts.	X	X	X		
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

Table J-1. Design Interface Assessment Criteria

Criterion	Milestone				
	B	C	FRP	IOC	FOC
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: FOC = full operational capability, FRP = full rate production, IOC = initial operational capability, LRFS = logistics requirements funding summary, and TSPR = total system performance requirement.

APPENDIX K. ABBREVIATIONS

AFMC	Air Force Materiel Command
AL	assembly level
AME	Advanced Microcircuit Emulation (program)
AMS	aftermarket source
AQEC	Aerospace Qualified Electronic Component
ASIC	application-specific integrated circuit
BCA	business case analysis
BEP	breakeven point
BMP	Best Manufacturing Practices (program)
BOM	bill of materials
CALCE	Center for Advanced Life Cycle Engineering
CDMD-OA	Configuration Data Managers Database–Open Architecture
COTS	commercial off-the-shelf
CURE	COTS Usage Risk Evaluation
D200C	Recoverable Item Requirements Computation System (Air Force)
DAU	Defense Acquisition University
DKSP	DMSMS Knowledge Sharing Portal
DLA	Defense Logistics Agency
DLA-L&M	DLA–Land and Maritime
DMP	DMSMS Management Plan
DMSMS	Diminishing Manufacturing Sources and Material Shortages
DMT	DMSMS Management Team
DOC	Department of Commerce
DoD	Department of Defense
DSPO	Defense Standardization Program Office
ECL	emitter-coupled logic
ECP	engineering change proposal
F^3I	form, fit, function, interface
FAA	Federal Aviation Administration
FOC	full operational capability

FRP	full-rate production
FY	fiscal year
GEM	Generalized Emulation of Microcircuits
GIDEP	Government-Industry Data Exchange Program
IOC	initial operational capability
IPT	integrated product team
ITT A/CD	ITT Aerospace/Communications Division
JEDMICS	Joint Engineering Data Management Information and Control System
LRFS	logistics requirements funding summary
LRU	line replaceable unit (Air Force and Army usage)
MEDALS	Military Engineering Data Asset Location System
MEP	Manufacturing Extension Partnership
MLDT	mean logistics delay time
MOCA	mitigation of obsolescence cost analysis
NAVSEA	Naval Sea Systems Command
NCCA	Naval Center for Cost Analysis
NDI	nondevelopmental item
NE&SS-SS	Naval Electronics and Surveillance Systems–Surface Systems
NHA	next higher assembly
NPV	net present value
NRE	nonrecurring engineering
NSC	National Semiconductor Corporation
OEM	original equipment manufacturer
OIA	operations impact analysis
OMB	Office of Management and Budget
OPR	Office of Primary Responsibility
OSA	open systems architecture
OSD	Office of the Secretary of Defense
PBL	performance-based life-cycle product support
PI	progress indicator
PIA	program integrating agent
PL	piece part level

PM	program manager
PNHA	peculiar next higher assembly
PPR	problem part report
PSI	product support integrator
QRB	quick-response budget
RDT&E	Research, Development, Test and Evaluation
REMIS	Reliability Engineering Management Information System
RF	radio frequency
RIOS	Required Item of Supply
SCD	specification control drawing
SDW	shared data warehouse
SLEP	Service Life Extension Program
SoCD	source control drawing
SOE	system operational effectiveness
SOS	source of supply
SOW	statement of work
SPD	system program director
SRA	shop replaceable assembly (Navy usage)
SRU	shop replaceable unit (Air Force and Army usage)
SSM	system support manager
TDP	technical data package
TLCSM	total life-cycle systems management
TOC	total ownership cost
TSPR	total system performance requirement
VECP	value engineering change proposal
VHDL	VHSIC Hardware Description Language
VHSIC	very high speed integrated circuit
WebFLIS	Federal Logistics Information System Web Inquiry
WebLink	Web Logistics Information Network
WRA	weapon replaceable assembly (Navy usage)