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MIL-HDBK-502
30 May 1997

DEPARTMENT OF DEFENSE
HANDBOOK

ACQUISITION LOGISTICS

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FOREWORD

This handbook is approved for use by all departments and agencies of the Department of Defense.

This handbook is for guidance only. This handbook cannot be cited as a requirement. If it is, the contractor does not have to comply.

To provide more affordable logistic support for materiel systems the Department of Defense is focusing on total cost of ownership throughout the life cycle. Achieving affordable support depends upon effective acquisition logistics management and planning.

This handbook offers guidance on acquisition logistics as an integral part of the systems engineering process. The information contained herein is applicable, in part or in whole, to all types of materiel and automated information systems and all acquisition strategies. However, this handbook does not present a “cookbook” approach to acquisition logistics—such an approach could not accommodate the vast, widely varying, array of potential materiel acquisitions. It does offer examples and points to consider to help you shape your overall thought processes.

The examples provided are just that—examples only. They are not meant to be a definitive solution to anything. They are meant as a launch platform to give you insights into an innovative solution to your particular problem. Each program is unique. It follows, then, that slavishly following an example in this handbook is likely to create more problems than it solves.

Your recommendations on improving the content of this handbook are welcome. Please send your comments to:

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The focus of this handbook is on providing guidance to the members of the DoD acquisition work force who are directly concerned with the supportability of materiel systems or automated information systems. It addresses:

- How systems engineering fits into the acquisition process.
- Supportability analyses as part of the systems engineering process.
- How to develop supportability requirements.
- The acquisition and generation of support data.
- Logistics considerations for contracts.
- The logisticians role on integrated product teams.

Section 2: Applicable Documents

2.1 GENERAL

This handbook is intended to be a "stand alone" reference. As such we have provided minimal formal references in this section. However, at the end of sections in the body of the handbook we have provided sources of additional information to which readers might refer to expand their knowledge. The specifications, standards, and handbooks identified as additional information are listed in the latest issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto and are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094. The standardization documents (SDs) referenced are also available through this source. The regulations and directives listed are available through the Defense Acquisition Deskbook.

2.2 GOVERNMENT DOCUMENTS

2.2.1 Specifications

MIL-PRF-49506, November 11, 1996, *Logistics Management Information Performance Specification*

(Copies of this specification are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government Documents

Department of Defense Regulation, 5000.2-R, *Mandatory Procedures for Major Defense Acquisition Programs (MDAPS) and Major Automated Information System (MAIS) Acquisition Programs*

DoD Directive 5000.1, *Defense Acquisition*

Section 3:

Definitions

ACRONYMS

A_o	operational availability
ATE	automated test equipment
BCS	baseline comparative system
BIT	built in test
BITE	built in test equipment
CAGE	contractor and government entity
CLIN	contract line item number
CLS	contractor logistics support
C/NDI	commercial and nondevelopmental item
DFARS	Defense Federal Acquisition Regulation Supplement
DID	data item description
DTC	design to cost
FA/A	Functional Analysis/Allocation
FAR	Federal Acquisition Regulation
FMECA	Failure Modes, Effects and Criticality Analysis
GFP	government furnished property
IPPD	integrated product and process development
IPT	integrated product team
LCC	life cycle costs
LCS	logistics cost support
LEM	logistic elements manager
LLTIL	Long Lead Time Items List
LMI	logistics management information
LRU/WRA	line replaceable unit/weapon replaceable assembly
LSAR	Logistic Support Analysis Record
MAIS	Major Automated Information System
MDAPS	Major Defense Acquisition Programs
MPT	manpower, personnel, and training
MTBF	mean time between failure
MTD	maintenance task distribution
MTTR	mean time to repair
NDI	nondevelopmental item
O&S	Operations and Support
OEM	original equipment manufacturer
ORD	Operational Requirements Document

OSD	Office of the Secretary of Defense
PCCN	provisioning contract control number
PHS&T	packaging, handling, storage, and transportation
PIP	product improvement program
PPA	product performance agreement
PLISN	provisioning line item sequence number
PTD	Provisioning technical documentation
RAM	reliability, availability and maintainability
RCM	Reliability Centered Maintenance
RFP	request for proposal
RPSTL	Repair Parts and Special Tools List
RTD	replacement task distribution
SA&C	Systems Analysis and Control
SAIP	spares acquisition integrated with production
SE	support equipment
SERD	support equipment recommendation data
SMR	source maintenance and recoverability
SOO	statement of objectives
SOW	statement of work
SRU/SRA	shop replaceable unit/shop replaceable assembly
SSEB	Source Selection Evaluation Board
SSM	support system manager
SSP	system support package
TMDE	test measurement and diagnostic equipment
UCF	Uniform Contract Format

Section 4:
Systems Engineering and the Acquisition Process

4.1 INTRODUCTION

Acquisition logistics is a multi-functional technical management discipline associated with the design, development, test, production, fielding, sustainment, and improvement modifications of cost effective systems that achieve the user's peacetime and wartime readiness requirements. The principal objectives of acquisition logistics are to ensure that support considerations are an integral part of the system's design requirements, that the system can be cost effectively supported through its life-cycle, and that the infrastructure elements necessary to the initial fielding and operational support of the system are identified and developed and acquired. The majority of a system's life-cycle costs can be attributed directly to operations and support costs once the system is fielded. Because these costs are largely determined early in the system development period, it is vitally important that system developers evaluate the potential operation and support costs of alternate designs and factor these into early design decisions.

Acquisition logistics activities are most effective when they are integral to both the contractor's and Government's system engineering technical and management processes. When this is the case, system designers, acquisition logisticians, and program managers are best able to identify, consider, and trade-off support considerations with other system cost, schedule and performance elements to arrive at an optimum balance of system requirements that meet the user's operational and readiness requirements.

4.2 DEFENSE SYSTEMS ACQUISITION PROCESS

The acquisition of a defense system is conducted within a management framework described in Department of Defense Directive 5000.1, *Defense Acquisition*. This directive establishes a flexible management approach for acquiring systems within recognized constraints. It mandates an integrated, total systems approach to the definition of needs and opportunities, the formulation of alternatives, the acquisition of total systems, and their operational sustainment. In short, it mandates a systems engineering approach for the total life cycle of a system.

The procedures to be used are contained in Department of Defense Regulation, 5000.2-R, *Mandatory Procedures for Major Defense Acquisition Programs (MDAPS) and Major Automated Information System (MAIS) Acquisition Programs*. The procedures described are mandatory for MDAPS and MAIS acquisition programs as they are defined in the instruction. However, the process they describe is to be generally applied to any acquisition program.

The acquisition process addresses the life cycle of a system. Its cyclic nature is best understood by looking at the succession of systems which have been used over time to provide a similar capability (e.g., tanks, fighter aircraft, air defense systems, etc.). The evolutionary relationship of their designs is clear. Most acquisitions are initiated to replace or upgrade existing systems. The systems may no longer meet operational needs, or can be substantially improved in capability, or are no longer affordable to operate. Experience developed during a retiring system's operational life provides important insight for the initial definition of support requirements for its replacement. This information, and the current operational needs, form the basis for establishing supportability requirements and constraints for a new acquisition. And the operational history of that new acquisition will form the basis for its successor when it is no longer serviceable. In reality, then, the trigger which initiates the defense systems acquisition process—the determination and definition of an operational need requiring a materiel solution—occurs during the operational phase of an existing item.

The acquisition process is intentionally flexible to accommodate the wide variety of potential system solutions to a recognized need, opportunity, or deficiency. Supportability analyses are conducted for one of two basic objectives:

- To ensure that supportability is included as a system performance requirement.
- To ensure optimal support system design and infrastructure.

The supportability analyses to be accomplished vary from program to program and from phase to phase. What supportability analyses need to be conducted is largely determined by two key factors—the acquisition phase and the type of acquisition.

The acquisition process is controlled by the acquisition management process. This process divides a program into a series of logical phases. Each phase targets specific issues and objectives which generally correlate to one of the engineering states of a design. The issues and objectives reflect those which should typically be addressed before proceeding to the next phase and state of design.

Acquisition phases are separated by decision points at which total system designs are reviewed and evaluated against phase issues and objectives. These decision points are Milestones 0, I, II, and III. Passing a milestone review represents the decision approval to proceed to the next program phase. The acquisition management process phases are shown in Figure 4-1. However, the specific number of phases and the content of each are aligned with the particular needs of a program.

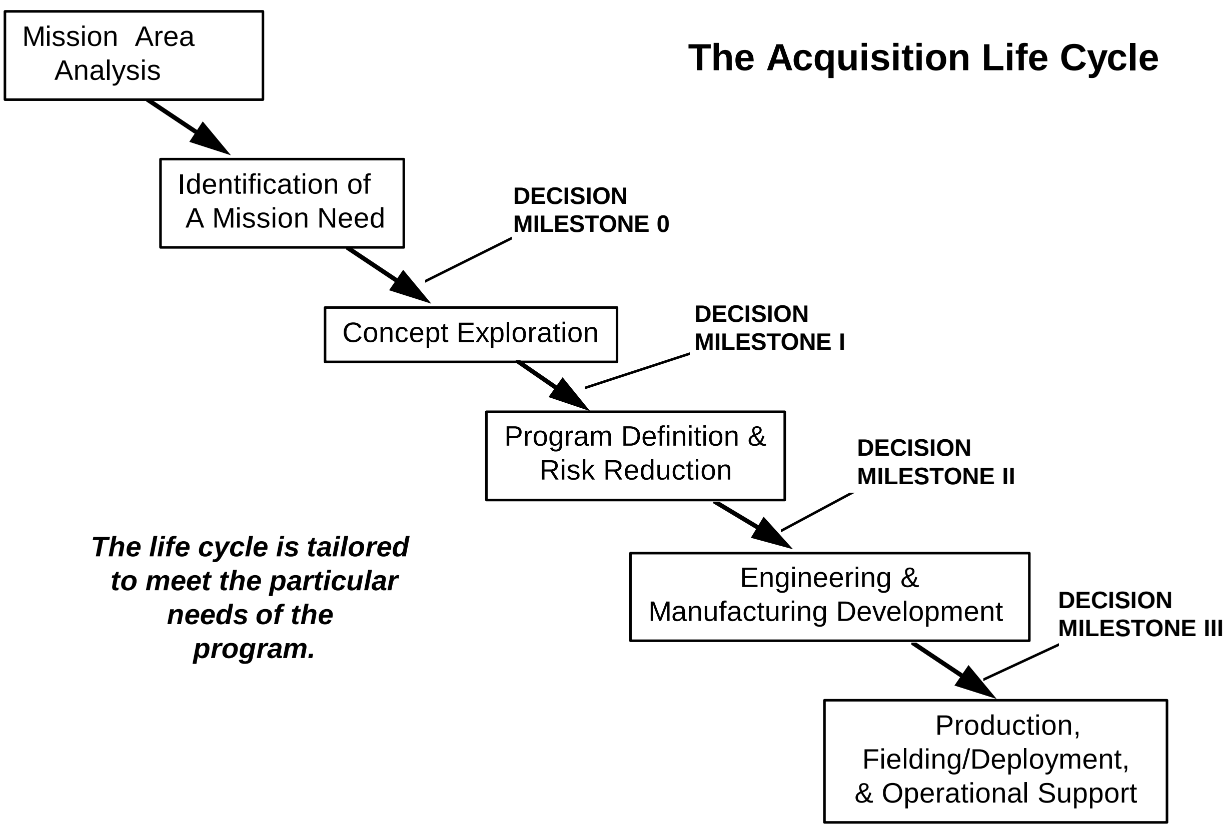

Figure 4-1. Acquisition Life Cycle

4.2.1 Type of Acquisition

"Type of acquisition" generally relates to the amount of design activity required to complete a total system. There are four basic types of acquisitions. The types of acquisition are, in order of preference: (1) modification of an existing system; (2) commercial item, (3) nondevelopmental item (NDI), and; (4) development. There are sub-categories within each type; for example, a product improvement program may be for upgrade of an existing DoD item or for an item developed by a foreign military organization. Figure 4-2 shows the steps in making a type of acquisition decision.

The acquisition type names generally relate to the state of design of the primary mission element of the system being acquired, be it hardware or software. Thus a modification program to an existing combat system may include a full development effort for new operational software and only minor change in hardware and support. Conversely, a full development effort for a training system's hardware may require little or no software or support development if commercial software and support designs are used.

It is DoD policy to acquire total systems which meet operational needs at the most affordable life cycle cost. The options are many. But the goal is always to get the best balance between total system design opportunities, operational needs, and program constraints. To achieve this goal, each aspect of a total system must be considered, the alternatives identified and evaluated, and the tradeoff decisions made and implemented.

Deciding the type of acquisition program to be implemented is the first major step in determining what systems engineering activities to include in a program's acquisition strategy. The supportability analysis portion of the systems engineering process begins with the identification of an operational need. The initial operational requirements and concepts are evaluated to identify support implications and alternatives. Here are two examples: 1) A requirement for a small quantity of a new highly reliable system suggests greater affordability under a commercial repair support concept than under an organic concept. This opportunity should be investigated further. 2) An interoperability requirement suggests a standardization opportunity that might reduce the support burden of the system. The standardization candidate should be evaluated for its performance and design suitability, and the support risks and benefits of the candidate should be explored.

Modification programs are most often conceived of as such from the outset, perhaps because of the significant investment represented by materiel assets to be modified or the limited scope of the modification. In these instances the support evaluations are usually bounded by the scope of the needed change and are conducted in the context of the existing support concept. Where possible, however, opportunities to introduce more responsive and/or affordable support alternatives should be developed.

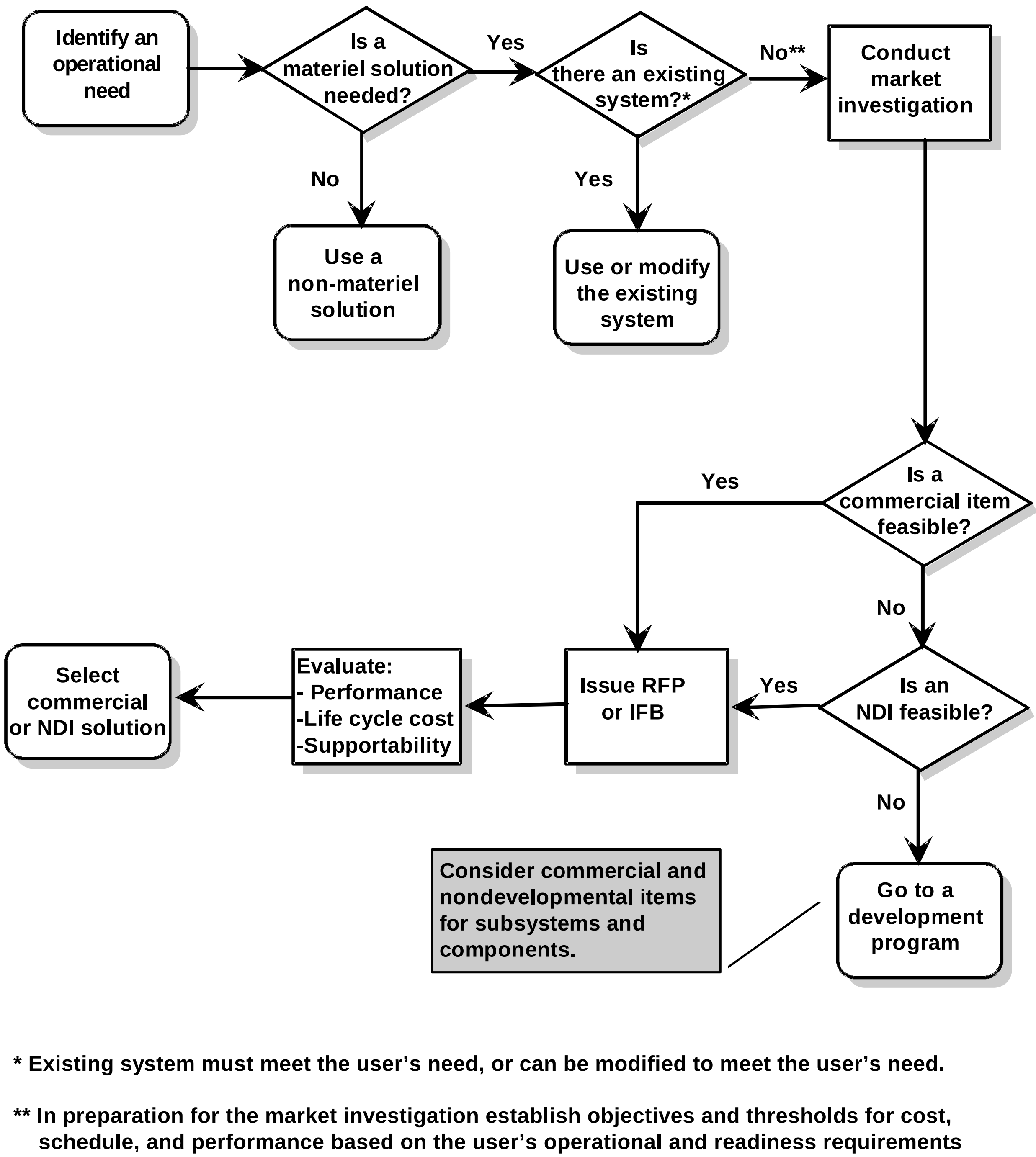

Figure 4-2. Acquisition Decision Process

When modification of an existing system is not the clear program direction, early identification of support issues and alternatives provides key input to system requirements development and tradeoff analysis activities. They are combined with other systems engineering estimates and projections also based upon the operational requirements. The result is a set of performance requirements for the total system.

The total system requirements provide a basis for market investigation of commercial and/or nondevelopmental item solutions that have potential to meet performance needs and other program objectives (e.g., cost, schedule). Flexibility is important in evaluating potential candidate designs. It may be possible to adjust specific needs within acceptable levels or to accept minor modifications to avoid eliminating an otherwise suitable design solution. Ensuring development of performance requirements that address and balance all elements of a total system design helps to avoid the selection of “fixed” design solutions that have not been evaluated against the needs of the total system.

If a commercial or non-development design solution is determined to be acceptable, the supportability analyses’ focus becomes the detailed design of the support. If a commercial support concept was included in the alternative selection decision, supportability analyses should be limited to those aspects of the support system design required to interface the commercial support with the existing support system. Demonstrated supportability characteristics of the total system design are usually sufficient to project and assess commercial support design and performance. If organic support was the preferred alternative for the commercial/non-developmental system design, the design information will be used to conduct the essential analyses for support planning and logistics data product development.

If market investigations do not identify acceptable design solutions, this approach is discontinued, and program activities focus on a development solution for the primary mission element of the system. Even in a full development program, consideration should be given to meeting other system element design requirements (e.g., mission software, support system) with commercial or nondevelopmental solutions. Additionally, lower-level performance functions of the development item should be analyzed for opportunities to include the use of commercial or nondevelopmental subsystems or components.

4.2.2 Acquisition Strategy

An acquisition strategy details the requirements, approaches, and objectives of a program. The strategy development is initiated with the results of the acquisition decision process. This decision is supported by early studies and analyses of operations and support requirements and by market investigation results. The strategy is developed in line with the acquisition decision and the associated systems engineering and other program activity requirements associated with the type of acquisition decision. These requirements are further tailored based upon specific program needs and constraints.

Traditional DoD acquisition environments, based primarily upon proprietary products and isolated data processing systems have resulted in a costly, poorly integrated, and *closed* (rather than *open*) infrastructure in most organizations. The *open systems* approach mandated by current DoD policy (reference DoD 5000.2-R, paragraph 4.3.4) encompasses the selection of specifications and standards adopted by industry standards bodies or de facto standards for selected system interfaces, products, practices, and tools. Open systems standards define interfaces which support portability, interoperability, and scaleability (i.e., expansion); and are available to the public. Potential benefits realized from the use of open systems standards include reduced costs, increased competition, and increased interoperability. Note, however, that an open system standard IS NOT SYNONYMOUS with the use of commercial and non-developmental items (C/NDI) . An open systems standard is primarily concerned with interface compatibility to promote interoperability between multiple suppliers' equipment

Ideally, *open systems* represent a transparent environment in which users can intermix hardware, software, and networks of different vintages from different sources to meet differing needs. In reality, systems are not purely open or closed. Because industry standards do not generally meet all military needs, trade-offs must be made between performance, cost, supportability, availability of standards-based products, and the ability to upgrade. The result is that for any given system, the degree of openness may have many interpretations.

As with any integrated effort, supportability analysis activities must be aligned with the related systems engineering disciplines whose activities provide essential support planning information relative to the hardware and software designs.

4.2.3 Design Flexibility

The degree of flexibility in the total system hardware, software, and support system designs is a basic consideration in deciding what supportability analyses can and should be performed.

The objective of most support system design activities is to identify support considerations (e.g., constraints) which may influence selection of system hardware and software design and support alternatives to improve readiness, supportability, and cost. If the hardware design is fixed, as it would largely be in a commercial or NDI acquisition, these early analyses might seem to have little benefit. In the case of product improvement programs, the scope of proposed improvements might limit design flexibility to specific subsystems and may or may not open non-affected areas of the design to redesign opportunities that would address changes to reduce the anticipated support burdens.

Flexibility may exist for the design of the support system but not in the hardware system. Commercial items for which maintenance support plans have not been developed are typical examples of this situation.

Integrating supportability requirements into system and equipment design requires that designers be oriented toward supportability objectives from the outset. Technical information generated during the design process must be disseminated among designers and members of the supportability disciplines to surface interface problems. Technical design information—diagnostic features, electromechanical interfaces, reliability estimates, item functions, adjustment requirements, and connector and pin assignments—that determines supportability should be an integral part of design documentation. When design flexibility exists, the performing activity's plan should describe the generation, control, and approval of this type of design documentation.

4.2.4 Available Resources

Supportability analyses require time and resources. It is pointless to impose supportability requirements that depend upon an analysis whose results may not be available in time to contribute to the design decisions which they are intended to affect. The exception to this rule would be a situation where the potential improvement can be included as part of future pre-planned product improvements such as technology insertion programs.

It is DoD policy to fund readiness and support considerations in the front end of programs. Nevertheless, resources are constrained in practice. If program funds are short, it may be possible to perform some activities, such as the requirements definition activities, with in-house capabilities. If the in-house capability is limited but funds are available, such analyses might also be accomplished by "program support" contractors with the required expertise.

Another approach is to capitalize on the interrelationships between the analyses. For example, an analysis of an existing system feeds the identification of supportability drivers of a new system. These, in turn, feed the selection of targets for supportability improvement in the new system. If, for some reason, only one of these activities could be afforded, then the identification of targets for improvement would be the logical pick of the two. The process of target identification will obviously lose precision since human judgments and estimates will be substituted for hard data. But this approach does result in the decision as to the program's supportability targets of improvement.

Performance specifications are streamlining the acquisition process by imposing fewer restrictions and giving more decision flexibility to the developer. Many of these programs include a "fast track" approach in scheduling as well. The schedules of these fast track programs may be making it impossible to accomplish all of the supportability analyses that should be accomplished given the type of acquisition. In this situation select those activities that offer the greatest potential return on the investment.

4.2.5 Prior Work Results

Work previously accomplished can seriously impact the analysis selection. Support drivers and improvement initiatives may already have been identified, developed as inputs in the preparation of program documents. The quality and currency of the available results must be assessed, but if deemed adequate, the work already done may eliminate the need for further iterations or limit the effort to one of updating the available results. However, if the stated requirements or constraints are based upon previously conducted analyses it is essential to test their currency before adopting them as hard limitations. For example, if a supportability requirement such as repair turnaround time for a new system was based upon a preliminary demonstration of a new technology, such as a new composite repair procedure, obtain and evaluate updated repair procedure information before accepting the previously developed requirement.

4.2.6 Available Data and Experience

The availability, accuracy, and relevancy of experience and historical data on similar existing systems is crucial for accomplishment of some supportability analyses. Available data must be examined to determine how much work is needed to provide the necessary focus or relevancy to the new system design. If such data is not available, a special "sample data" effort should be considered to create an analysis baseline, particularly if the needed data is in an area of possible high risk or opportunity.

The objectives and specific supportability analysis activities, including the depth to which they are conducted, also depend upon the acquisition phase of the program. As previously indicated, the acquisition phases are generally defined by the state of design development of a hardware/software element of the total system. Program requirements and objectives should be aligned with the phase of the acquisition process that most closely represents the design activities to be accomplished. Too often acquisition programs attempt to make decisions before sufficient knowledge of the design element is known. The result is always an increase in risk.

4.2.7 Phase Considerations

Each of the acquisition phases is generally characterized by issues and objectives associated with a particular level or state of a design (e.g., conceptual, functional, allocated, physical). These issues and objectives must be satisfied through the milestone review procedures in order for a program to proceed.

When permitted by regulation, the phase definitions should be redefined to fit the particular requirements of the program. Phase activities can be combined between two phases or a phase may be eliminated altogether.

A supportability analysis effort evaluating existing support structure in conjunction with force/fleet analysis, threat analysis, and doctrine development must be conducted prior to entry into any acquisition phase. This effort is critical in developing supportable system requirements. Focus of the effort should be on a macro level and should identify the impacts on sustainment any requirement may have. The results should provide a basis for tradeoffs in system capabilities during the actual acquisition phases (which may or may not follow), as well as ensuring that developed requirements are actually achievable at affordable cost.

Concept exploration phase

The concept exploration phase, Phase 0, is the first phase of a DoD system's life cycle. If it occurs at all, it typically consists of competitive, parallel short-term concept studies performed to investigate alternative operations and design concepts. The purpose is to identify, define, and evaluate the advantages/disadvantages, risks, costs, etc. of promising operational concepts and system design alternatives. The studies project characteristics and costs of total systems as reflected by their conceptual designs. The results are reviewed at the Milestone I decision point where promising candidates may be selected for further definition and development.

The design characteristics of the selected alternatives generally provide a functional baseline of the system. These baselines define design performance characteristics required to meet operational needs. The functional baseline serves as the basis for establishing initial design thresholds and objectives. The resulting design requirements support preparation of total system design cost estimates and schedule projections and identification of trade-off opportunities. The system objectives are also the foundation for the acquisition strategy and the test and evaluation strategy.

Program definition and risk reduction phase

Phase I is used to further define and refine the operational concept or concepts and those alternative design approaches determined by the Milestone I decision process to be the most promising. The functional baselines are further decomposed into their lower-tiered subsystems. The performance requirements of the system are then allocated down to the lower level functions. This allocated baseline is used in the supportability analyses to project operations and sustainment requirements to be satisfied in the design of the support system. Support alternatives (contractor-supplied, organic 2 level, organic 3 level, etc.) are evaluated against the operations and sustainment requirements. Support alternatives deemed not viable (those not meeting all support requirements and constraints) are discarded. Those remaining become the basis for development of initial support plans and information products (e.g., technical publications, supply support, etc.).

Phase activities often include the development of product prototypes and the conduct of demonstrations and early operational assessments. These activities help to reduce risk at the Milestone II decision. Cost drivers and life cycle cost estimates are kept current with the design to reflect a more detailed understanding of the total system design characteristics.

Engineering and manufacturing development phase

Phase II of the acquisition process is used to complete a stable design for a total system which meets the performance requirements and is producible, supportable, and affordable. Total system capabilities are demonstrated through testing to validate design assumptions, and deployment planning is initiated. Low rate initial production is begun during this phase to provide the minimum quantities required to support operational testing and other design validation activities and to establish an initial production base for the total system.

The allocated baseline of a total system is transitioned into a full product baseline during this phase. In other words, functional or allocated designs are updated to physical or product baselines representing the actual product hardware. Support system designs are updated as well to keep current with the latest design. The updated support information provides input to tradeoff and other program decisions that may be required. The updated information is also used to update or prepare logistic data products like spares lists, training packages, and technical publications required to implement the support system design.

Production, fielding/deployment, and operational support phase

Phase III includes all design activities needed to:

- Correct deficiencies identified during Phase II test and evaluation activities and low-rate initial production.
- Produce and deploy a total system.

Support activities respond to changes resulting from correction of noted deficiencies and other product baseline changes made to enhance producibility or otherwise improve the product. Additionally, they prepare for transition of the system to operations.

Phase III is used to achieve and sustain an operational capability that satisfies mission needs. The footprint, size, and weight of the system and its logistic support are major considerations for contingency planners. Deploying the total system is very important and needs to be emphasized. The lift requirements and the logistics tail must be kept to a minimum. Operational needs will change over time due to product hardware modifications and aging, the emergence of new threats, changes in the support system capabilities, the introduction of new technologies, and changing economic conditions. Plans are established to monitor the rate and consequence of change on the total system supportability.

4.3 SYSTEMS ENGINEERING

Systems engineering is an interdisciplinary approach to evolve and verify an integrated and life-cycle balanced set of product and processes solutions that satisfy stated customer needs. A total system design would include product hardware, software, and planned logistics resources. This structured, or process, approach integrates the essential elements and design decisions of three interrelated design efforts. The result is a balanced, total system solution to the operational need and other program objectives.

The systems engineering process is used within the Department of Defense to translate operational users' needs into requirements and requirements into designs which meet program performance, cost, and schedule requirements. Figure 4-3 provides an overview of the process.

The systems engineering process follows a logical top-down progression of design refinement. It employs an iterative process in which operational requirements are translated into performance requirements for the functional elements of a system. Design alternatives for each of the system's functional elements are identified and analyzed. The results are used to select the best combination of element designs to achieve the system objective. Performance requirements are refined based upon the selected alternatives, and the updated requirements are further decomposed to the next level of performance function. Once again alternatives are identified and analyzed, and the process is repeated.

The functional decomposition of requirements continues to the lowest logical breakdown of a performance function. At this point the top-down design becomes a bottom-up build. Synthesis of the physical design begins when hardware items are selected to provide identified functions and are arranged in a physical relationship with one another. During this stage of the design's development, analysis is used to verify adherence to each successively higher level of requirement. Estimates and projections are refined and verified through demonstrations and tests.

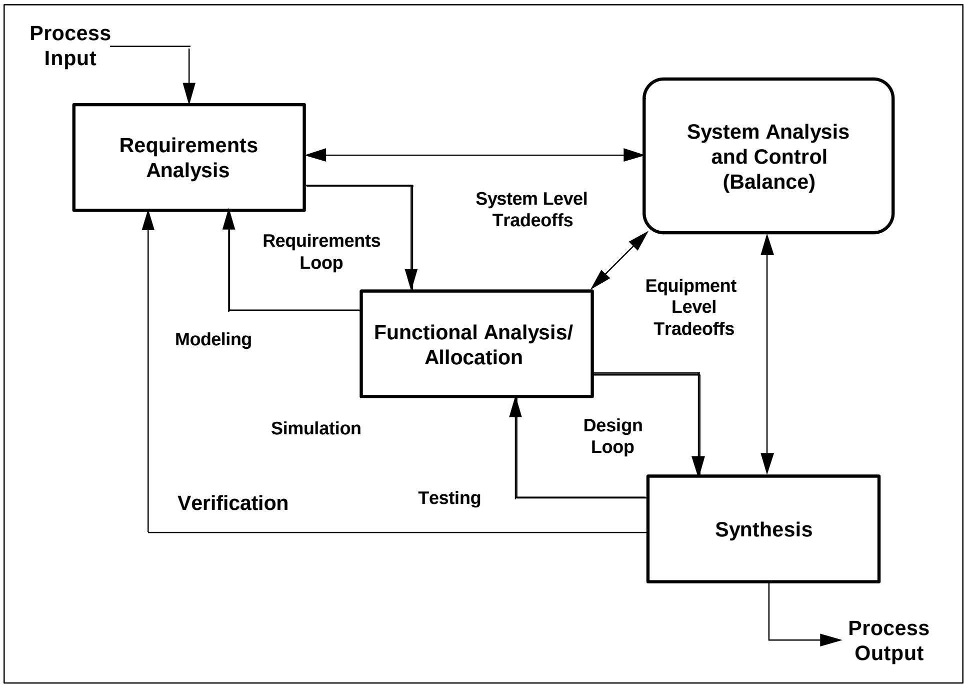

Figure 4-3. Systems Engineering Process Flow

System analysis and control activities in a program serve as a basis for evaluating alternatives, selecting the best solution, measuring progress, and documenting design decisions. These activities include:

- Trade-off studies among requirements, design alternatives, and other cost, schedule and performance related issues.
- Risk management that, throughout the design process, identifies and evaluates potential sources of technical risks based on the technology being used, the design, manufacturing, test and support processes being used, and risk mitigation efforts.
- Configuration management to control the system products, processes and related documentation. The configuration management effort includes identifying, documenting, and verifying the functional and physical characteristics of an item; recording the configuration of an item; and controlling changes to an item and its documentation. It provides a complete audit trail of decisions and design modifications.

- Data management to capture and control the technical baseline (configuration documentation, technical data, and technical manuals), provide data correlation and traceability, and serve as a ready reference for the systems engineering effort.
- The establishment of performance metrics to provide measures of how well the technical development and design are evolving relative to what was planned and relative to meeting system requirements in terms of performance, risk mitigation, producibility, cost, and schedule.
- The establishment of interface controls to ensure all internal and external interface requirement changes are properly recorded and communicated to all affected configuration items.
- Structured program review to demonstrate and confirm completion of required accomplishments and their exit criteria as defined in program planning.

Determining the best set of planned logistic resources for a system is the function of the acquisition logistics discipline of systems engineering. It is accomplished through analysis of those design characteristics which generate a need for, or are associated with, providing operational support to the total system. These design characteristics are developed by many different disciplines pursuing a wide range of systems engineering activities. Individually they may be viewed as either hardware, software, or support system design characteristics. Collectively they represent the "supportability" of a total system.

4.3.1 Supportability

Supportability is the degree to which system design characteristics and planned logistics resources meet system peacetime and wartime requirements. Supportability is the capability of a total system design to support operations and readiness needs throughout the system's service life at an affordable cost. It provides a means of assessing the suitability of a total system design for a set of operational needs within the intended operations and support environment (including cost constraints). Supportability characteristics include many performance measures of the individual elements of a total system. For example: Repair Cycle Time is a support system performance characteristic independent of the hardware system. Mean Time Between Failure and Mean Time to Repair are reliability and maintainability characteristics, respectively, of the system hardware, but their ability to impact operational support of the total system makes them also supportability characteristics.

Supportability characteristics of the total system interrelate the characteristics of the individual designs to provide a top-level assessment of the balance in a total system's design. Operational availability (A_o) and life cycle cost are generally accepted as measures of total system supportability. Other terms used to express similar assessments are equipment readiness and affordability.

Discussions regarding *open system* supportability approaches, methodologies, and recommendations address the unique aspects of an open system interface standard acquisition. When using open system interface standards, a best value approach should be pursued to balance cost, performance, schedule, operational readiness, and supportability. The use of open system interface standards promotes an environment in which interface conformant products from multiple original equipment manufacturers (OEMs) can be integrated to form functional systems. Supportability issues must be part of the criteria evaluated during the selection of the system architecture.

When a total system demonstrates its operational suitability and affordability, the total system element designs are generally considered complete, but most characteristics of a total system are subject to change over time. The rapid turnover in design and software technologies not only creates obsolescence through increased performance capabilities, but also reduces available sources of supply and invalidates repair concepts. So the systems engineering process is used to monitor and assess changes in total system requirements that may lead to new requirements or opportunities for improvement.

The systems engineering approach to design of total systems and their major elements (hardware, software, and support) allows good supportability to be effectively “designed-in.” While poor supportability of a system element can be mitigated through the design of the remaining elements, it can only be improved by a change in design.

4.3.2 Major Supportability Criteria

Every acquisition program is different, and specific criteria and emphasis will vary from one program to another. However, three issues— cost, equipment readiness, and manpower and personnel constraints—should always be considered as part of the total system design process because of their ability to affect system supportability.

Cost

Cost constraints are an inescapable economic reality. Obtaining high quality, capable, and affordable systems which meet user needs is the goal of all defense acquisition programs. Evaluating the affordability of a product requires consideration of support investment and operations and support (O&S) costs, as well as other acquisition costs. Life cycle cost estimates compare the investment and recurring ownership costs for different system alternatives. The cost analysis methodology used should consider the support resources necessary to achieve specified levels of readiness (A_o) for a range of assumptions regarding system reliability and maintainability characteristics, usage rates, and operating scenarios. Because of the uncertainty in estimating resource costs like manpower and energy, sensitivity analyses should be performed. Sensitivity analyses help to identify and weight the various factors which drive life cycle costs. This knowledge is key to understanding and managing program risk.

All major elements of life cycle cost should be addressed as part of the system analysis and control activities. The objective is to minimize cost within major constraints such as readiness requirements. Ongoing assessments of life cycle costs during a product's acquisition and continuing through its service life provide important insight to effective life cycle management. These assessments are required not only because costs change over time, but also because what constitutes acceptable affordability is also subject to change. What is affordable under one set of economic conditions may be unaffordable under another. Therefore, it is important to investigate opportunities to reduce the cost of ownership throughout all phases of a system's life cycle.

Equipment readiness

Readiness is a measure of an organization's capability to perform assigned mission responsibilities when called upon to do so. A combination of A_o and mission frequencies (e.g., sortie rates), for both surge and sustained operations is a measure of equipment readiness. Equipment readiness predictions are a tool for assessing the operational suitability of a product before its introduction into service. Equipment readiness needs will vary from system to system, and from peacetime to wartime. As was true with manpower and personnel, equipment readiness should be addressed at the earliest stage of a new acquisition.

Manpower and personnel constraints

Reductions in manpower and the increasing complexity of defense systems offer a significant challenge in acquiring affordable defense systems. Early consideration of manpower and personnel requirements is very important. Manpower and personnel constraints (quantities, skills, and skill levels) are major cost drivers of every total system and are as important as any other design consideration. Because of their potential impact on product performance, readiness, and cost, all manpower and personnel requirements for new systems should be identified and evaluated early and alternatives considered. For example, use of commercial support for a low-density, highly complex product could eliminate most of the training costs associated with maintaining a qualified cadre of personnel in an environment with frequent personnel changes.

Estimates of manpower and personnel requirements for new systems are reported at each milestone decision point in the defense systems acquisition process. These requirements provide important input to force structure plans, forecasts, and cost estimates, and help to formulate more cost effective alternatives.

4.3.3 Systems Engineering Application

The level of systems engineering activity needed for a total system depends upon the current stage of design development of its hardware, software, and support. The more design development there is to do, the more systems engineering analysis will have to be performed. As the state of the design evolves, the types and depth of the analyses will also change as program objectives are refined.

The general discussion of systems engineering provided here addresses the full design development cycle. But for most defense systems requirements, there are real opportunities to reduce time, costs, and risk associated with any new design activity. These opportunities lie in making the greatest use of available designs for product hardware, for software, and for logistic support resources and services.

The level of design development required diminishes with the increased use of existing designs in a total system. Certainly the need for many of the supportability-related analyses is reduced in scope and depth, or altogether eliminated once a design alternative is selected. This reduction demonstrates proper tailoring of the systems engineering process based on the changing needs of the program. However, use of the systems engineering process approach is equally crucial for modifications or commercial and nondevelopmental item acquisitions—perhaps even more so. In development programs there is usually time to correct mistakes or deficiencies, but existing design characteristics are relatively fixed (significant change may be costly or impossible). So selecting an existing design alternative for the total system is important. Deficiencies in a selected design have to be compensated for through other design elements of the total system, which diminishes the total system overall. Only an integrated systems engineering approach fosters the essential interactions between the related design activities so that imbalances are identified and addressed.

Determining the optimal approach for a total system’s design is a program management decision. All of a program’s technical activities, of which the system engineering activities are a part, are intended to support and facilitate sound program management decisions. These decisions determine the next set of activities, which in turn lead to the next set in a constantly evolving set of issues, analysis requirements, and decisions. The acquisition strategy, which is developed in consonance with the policies and procedures of the defense systems acquisition process, serves as a plan for the management and execution of an acquisition program. Figure 4-4 identifies systems engineering principles.

SYSTEMS ENGINEERING PRINCIPLES

- **Know the problem, the customer, and the consumer**. Become the customer/consumer advocate/surrogate throughout development and in fielding the solution; state the problem in independent terms.
- **Use effectiveness criteria based on needs to make decisions.** Select criteria that are measurable (objective and quantifiable).
- **Establish and manage requirements.** Ensure the customer and consumer understand and accept the requirements.
- **Identify and assess alternatives so as to converge on a solution.** Use a systematic architecture/design method.
- **Verify and validate requirements and solution performance.** Quality must be designed in; know the expected results before testing.
- **Maintain the integrity of the system.** Maintain a systems engineering presence throughout the program.
- **Use an articulated and documented process.** Use readily available automated tools wherever appropriate.

Figure 4-4. Systems Engineering Principles

4.4 ADDITIONAL INFORMATION

Department of Defense Regulation, 5000.2-R, *Mandatory Procedures for Major Defense Acquisition Programs (MDAPS) and Major Automated Information System (MAIS) Acquisition Programs*

DoD Directive 5000.1, *Defense Acquisition*

SD-2, *Buying Commercial & Nondevelopmental Items: A Handbook*

SD-5, *Market Analysis for Nondevelopmental Items*

Section 5: Supportability Analyses

Acquisition logistics includes both technical and management activities. For discussion sake, these activities can be segmented into three interrelated parts: (1) designing the system for support; (2) designing the support system; and (3) acquiring the support elements necessary for initial fielding. The acquisition logistics interface with the design process is through the systems engineering process, and while the systems engineering process applies to all three segments, it is most prominent in the first two.

Supportability is a design characteristic. The early focus of supportability analyses should result in the establishment of support related parameters or specification requirements. These parameters should be expressed both quantitatively and qualitatively in operational terms and specifically relate to systems readiness objectives and the support costs of the system. Achieving and sustaining affordable system supportability is a life cycle management activity and is the result of sound systems engineering.

Supportability analyses are a wide range of related analyses that should be conducted within the systems engineering process. The goals of supportability analyses are to ensure that supportability is included as a system performance requirement and to ensure that the system is concurrently developed or acquired with the optimal support system and infrastructure. The integrated analyses can include any number of tools, practices, or techniques to realize the goals. For example, repair level analysis, reliability predictions, reliability centered maintenance (RCM) analysis, failure modes, effects and criticality analysis (FMECA), life cycle cost analysis, etc., can all be categorized as supportability analyses.

A key to achieving these goals is an effective application of the systems engineering process. This process is described in detail in Section 4. In order to be effective, supportability analyses need to be part and parcel of each segment of the systems engineering process (i.e., the Requirements Analysis, Functional Analysis/Allocation, Synthesis, and Systems Analysis and Control) described in Figure 4-3.

In order to be effective, supportability analyses should be conducted within the framework of the systems engineering process. The life cycle phases established by the defense acquisition process provide a suitable structure for managing the development, production, and operational support of a total system. The supportability analyses conducted within any acquisition phase should be properly aligned with the specific objectives of that phase as defined by the acquisition program needs.

Individual phase requirements are based upon general expectations of the stage of a system design (e.g., concept exploration—functional baseline, engineering and manufacturing development—product baseline, etc.). Within the individual designs of the system, however, it is likely that at any given point in time portions of a design are in every different state. For example, even in the conceptual phase there are elements of the product hardware for which the physical design is known. Likewise, during the production phase of a system, items with noted deficiencies may be in design development as the design community seeks to insert a redesign without affecting the production schedule.

The next two sections will discuss supportability issues that should be addressed during each segment of the systems engineering process (i.e., Requirements Analysis, Functional Analysis/Allocation, and Synthesis) to achieve the principal goals of supportability analyses:

(1) Ensure that supportability is included as a system performance requirement.

(2) Ensure optimal support system design and infrastructure.

Systems engineering should be applied throughout the system's life cycle as a comprehensive, iterative approach. As the system moves through the life cycle phases, new or updated user requirements and new or revised directions or limitations established by the acquisition decision authority will undoubtedly crop up. Therefore, **do not** assume that the task of achieving the supportability analyses goals is a one-shot deal. Rather, these goals will be achieved on an iterative, and often concurrent, basis as updated user requirements and authoritative directions are provided.

5.1 ENSURING SUPPORTABILITY AS A PERFORMANCE REQUIREMENT

Including supportability as a performance requirement is emphasized in the following excerpt from DoD 5000.2-R: *Supportability factors are integral elements of program performance specifications. However, support requirements are not to be stated as distinct logistics elements, but instead as performance requirements that relate to a system's operational effectiveness, operational suitability, and life-cycle cost reduction.* For examples and further discussion of supportability performance requirements, refer to Section 6.

During the Requirements Analysis portion of the systems engineering process, a key first step to ensuring supportability as a performance requirement should be application of supportability analyses during actual development of the system requirements. These initial analyses should focus on the relationships between the evolving operational and readiness requirements, planned support structures, and comparisons with existing force structure and support posture. The output of this initial segment should be an integrated Operational Requirements Document (ORD) which reflects an operational and support concept that the user finds acceptable. Following this initial segment, the primary focus of supportability analyses should be on examining the user's operational and readiness requirements using guidance provided in the Mission Needs Statement and the ORD. The output of the Requirements Analysis segment should identify key issues or supportability "factors" that should be considered when operational needs are later translated into supportability requirements. Supportability factors are those operational needs which, by their nature, impose requirements on the support system and thus affect system supportability. Supportability factors may include deployment, mobility, mission frequency and duration, human capability and limitations, and anticipated service life.

During the Functional Analysis/Allocation (FA/A) segment, these factors and other operational needs which affect supportability should be analyzed to establish initial supportability constraints.

Deployment

Planned deployment scenarios establish the geographical and environmental conditions in which a system must be operated and sustained. Different operating environments impose different design characteristics on a product. These characteristics directly affect the types of support required and the environmental conditions under which the support must be provided. For example, just as planned deployment to an arctic environment will require a product design which can function under conditions of extreme cold, maintenance and operational support activities such as repair or refueling will have to be performed under the same conditions. Product designs should reflect the operational need to perform support functions in environmentally suitable clothing (e.g., arctic clothing, chemical protective clothing, etc.).

Mobility

A unit's mobility requirements establish planned modes of transport and time constraints which must be accommodated by the transportability characteristics of a product. A product which is to be transported by specific modes of transport such as rail, sea, or air, and within each mode, by specific means (C130, C5A, European rail carriers, etc.) must be evaluated to ensure that it's design characteristics allow transport by the planned mode or means. Time constraints, such as 24-hour rapid deployment, impose further considerations to ensure that the product can be prepared for transport within the established time. If, for example, a product must be sectionalized for transport by a designated means such as a C130 aircraft, then the product must be capable of sectionalization, and the support system must have the required support items (tools, support and handling equipment, personnel, containers, etc.) to sectionalize the product, prepare each section for transport, and move the sections to the designated point of embarkation. Additionally, at the point of debarkation, all of the sectionalization and transport preparation will have to be reversed, meaning the receiving end must have the capability to restore, and verify, the product's operational state.

Mission frequency and duration

From an operations support standpoint, mission frequency and duration define the support resources needed to sustain operations. This factor would include rearm/refuel, emplacement/displacement, mission profile changes—in short, those activities which are conducted as a normal part of operations. Meeting turn-around time intervals within the anticipated mission frequencies imposes performance requirements on the support system requiring it to respond to the projected operational demands of the product.

Quantification of support resource requirements is directly related to the characteristics of a product's design and the frequency and duration of the missions which it performs. Mission frequency and duration and the reliability of the product provide the initial basis for determining the range and quantity of support resources that will be required.

Human systems integration

Human beings are an integral part of the performance characteristics of the total system. The ease or difficulty of operating and maintaining a product with acceptable results imposes specific requirements on the product, software, and support system designs. A product which is difficult to operate by virtue of the complexity of its mission requirements or its design characteristics requires individuals with greater cognitive or manual dexterity skills than one which is less complex. The same is true of software and support. The existing force structure and support infrastructure into which the product will be introduced have available a complement of human capabilities and limitations. For the designs of the total system components to minimize their impact on the existing infrastructure, human capabilities that are available and the limitations that exist must be identified so that these considerations are included in the analysis of design alternatives.

Anticipated service life

The planned service life of a product will have significant impact on the total system design alternatives considered and the life cycle cost associated with each. If the program is for a major system and makes a significant investment in the materiel asset, ensure that provisions for future technology insertion are considered. In determining the most cost effective means of support, the service life of a product will be a factor in the decision to use contractor versus organic support. Further, the longer the anticipated service life, the greater the need for planned product upgrades to maintain currency of capability and to reduce support costs by using current technology. Maintaining a support capability for outdated technology is expensive and limits opportunities to use contractor support because the number of sources that can support the older technology reduce dramatically as it is replaced with new technology.

Standardization and interoperability

Standardization and interoperability are primary sources of design requirements and constraints for a system. The difference between requirements and constraints can be a pretty fine line. And while it does not really matter as long as the need is correctly stated, generally, requirements are used to define acceptable solutions and constraints to limit them.

Interoperability with other systems and equipment may lead to standardization opportunities in both functional or physical design efforts. A functional standardization requirement is one which establishes the need for a particular capability such as transmitting a specified signal frequency. The hardware design, in that case, would not be restricted to a single solution. A physical standardization constraint, on the other hand, which imposes the use of a specific transmitter, dictates that portion of the system design.

Standardization requirements are also derived from the software and support system design concepts. Mission software standardization needs may dictate the use of compatible computer hardware, operating software, or program languages. Support standardization could include standardization of the support concept with the support concepts of other operational systems, or the use of specific support resources. An organic support concept, for example, might lead to specific hardware testability requirements ensuring diagnostic support by existing test equipment, or a requirement to perform field level maintenance with existing tools.

Synthesis

The outcome of the FA/A segment should be supportability constraints that are the basis for developing initial supportability requirements expressed as thresholds (minimum acceptable value) and objectives (desired value). The spread between objective and threshold values will be individually set for each program based on the characteristics of the program (e.g., maturity, risk, etc.). The range between the objective and the threshold is known as the "trade space." Program objectives may be refined based on the results of the preceding program phase.

These supportability constraints should be analyzed through a comprehensive systems analysis effort conducted during the Synthesis segment. This effort should include a systems effectiveness/cost analysis that weighs supportability constraints against each other and against user requirements, other system parameters, and life cycle costs. Tradeoff studies within this effort should establish alternative performance requirements (supportability included) to satisfy operational and mission needs. Preliminary support concepts should also be examined at this time in light of constraints imposed by the user's operational and readiness requirements. The support concept is a critical element in determining both specification and support resource requirements, and it needs to be updated throughout the systems acquisition process to reflect modifications to the system and changes in the operation and maintenance requirements. This updating will enable supportability requirements to accurately reflect the evolution of the operational system.

Supportability Risk

Risk assessment of the supportability constraints and concepts should also be an integral part of the systems analysis effort. These assessments should identify risk drivers, determine the sensitivity of interrelated risks, and quantify risk impacts. A major risk factor in defining the operating and support environment is the difficulty in describing the environment as it will be, and not as it is. Depending upon the type of acquisition, the time separation between this initial description of a system's operational environment and the time of fielding can be many years. It is logical to expect the operating and support environment to change during that time as new products, new personnel skills, new support resources, and new operational needs are introduced, and economic considerations change. But these changes must be identified and factored into the supportability analyses to ensure that planning assumptions and decisions for the support system can be adjusted.

To get a good picture of the overall suitability of support system requirements, it is important to consider the best and worst case operating scenarios. System supportability should be assessed under both peacetime and wartime scenarios. Peacetime support planning is based upon equipment readiness and economic considerations. Repair decisions in this scenario are made to reduce the cost of obtaining replacement products.

A wartime scenario should include both surge and sustained rates of operation. Wartime support planning is driven by equipment readiness or operational availability. Detailed component repair may be discarded in favor of major subsystem replacement to reduce system downtime associated with fault isolation and to speed up response time by reducing the number of items in the supply system. Additionally, consumption rates of support resources such as spare and repair parts increase through sustained usage and limitations on allowable maintenance periods. Therefore, supportability analyses must consider both extremes.

The outcome of the tradeoffs and risk assessments should be threshold and objective system performance requirements that satisfy user requirements and mission needs. These become part of the system specification. This includes performance requirements for the supportability of the system..

Remember, ensuring that supportability is included as a performance requirement is not a one time thing. The specificity and number of performance parameters evolve as the program is better defined. At Milestone I, performance parameters should be defined in broad terms. More specific program parameters should be added as necessary as the system requirements become better defined. Also, as new or updated user requirements and authoritative constraints become present, performance requirements will need to be added or changed, including supportability requirements.

5.2 ENSURING OPTIMAL SUPPORT SYSTEM DESIGN

Supportability analyses should identify operations and sustainment support requirements based upon system characteristics and the planned operations and support environment. Supportability requirements are expressed in terms of operations and maintenance task requirements and the associated support resources to accomplish them. Collectively, these define the support burden of a total system. The optimal support system design is one which can deliver the required support and which properly balances with the other total system elements to meet the performance requirements of the user.

Systems engineering done very early in the acquisition life cycle is similar for both commercial and developmental acquisitions (see Section 4 for further discussion on types of acquisition). Development of performance requirements and specifications follow a similar path in the earliest acquisition phases for commercial and developmental buys. Therefore, the type of acquisition has little or no bearing on achieving the first goal of supportability analyses since system performance requirements are established up front in an acquisition. However, this is not true for the second goal of supportability analyses. In fact, the type of acquisition will have a significant impact on the design of the support system.

DoD policy initiatives emphasize the use of commercial or nondevelopmental designs, processes, and services whenever practical to meet operational users' needs. Because of these initiatives and the current economic challenges of the present and foreseeable future, most DoD acquisitions of systems and services will utilize commercially available solutions. Use of commercial systems, software, and logistic support services help to cope with the high ownership costs of defense systems.

Performance requirements, both operational and support, are used in the market investigation to identify potential commercial or nondevelopmental item candidates which may meet the performance requirements. During the market investigation the candidate commercial and nondevelopmental systems' designs are reviewed from a supportability standpoint to:

- Assess standardization issues.
- Compare with experience base.
- Identify support alternatives.
- Evaluate support alternatives.
- Assess impact of deployment.
- Assess post production support.

These assessments of candidate designs are based upon the available design, support, and experience data associated with the system, demonstrations and tests, and the experience of the agency that acquired the data.

If one of the commercial or nondevelopmental candidate designs for the total system is selected, then the supportability analyses should be used to evaluate whether that information is sufficient for implementing the support system design. If it is deemed sufficient, then supportability analyses should be used to prepare the necessary logistics data products (Synthesis segment of systems engineering process) and monitor changes that may affect the products, the support system performance, or otherwise impact the total system supportability (Systems Analysis and Control (SA&C) portion of the systems engineering process).

When available information is not sufficient to support implementation of the support system design (identified during the Requirements Analysis portion of the systems engineering process), the required information can be developed by using a process similar to the one in the following example:

A commercial item with an organic support concept lacks sufficient data for technical publications development .

In general, the missing information of concern will probably be that portion of the support data that addresses organic support responsibilities. For instance, when a commercial support concept is being used, the acquiring agency should be primarily concerned with information needed to interface the existing support infrastructure with *the commercial support system. For those system elements for which organic support is required:*

- *Identify hardware candidates and support functions.*
- *Conduct repair analysis.*
- *Perform functional analysis and task analysis on repairable items for selected support system design.*

The available design data and the operations and support concepts should be analyzed to identify the hardware design repair candidates and the basic functions that should be supported (FA/A segment of the systems engineering process). Analysis should be performed to establish a repair-versus-discard and a level-of-repair policy for each repairable item under each of the support concepts. This repair level analysis should be used to recommend the optimum repair policy and level of repair for the item based upon system availability life cycle costs (Synthesis and SA&C parts of the systems engineering process). Based upon the results a support system design can be selected.

Repairable items should be functionally analyzed under the selected support system design to identify specific corrective, preventive, and other operations and support tasks (FA/A segment of the systems engineering process). Tasks should be analyzed to identify their annual frequency, manpower and personnel requirements, elapsed times, task procedures, spare and repair parts, test equipment—in short, all logistics resources needed to perform the task (Synthesis part of the systems engineering process). Factors that relate system characteristics to support task requirements like annual frequency and hardware reliability should be easily traceable to ensure that the impact of any changes can be recognized and addressed (SA&C portion of the systems engineering process). Support factors such as manpower requirements and sparing rates should be related to hardware oriented maintenance planning factors like the annual operating requirements of the system and the individual task frequencies. This action maintains the linkage between requirement, design, and support. The detailed task information should be used as the source of information for preparing required logistics data products.

A notional supportability analyses process flow for a Commercial/NDI acquisition is shown in Figure 5-1.

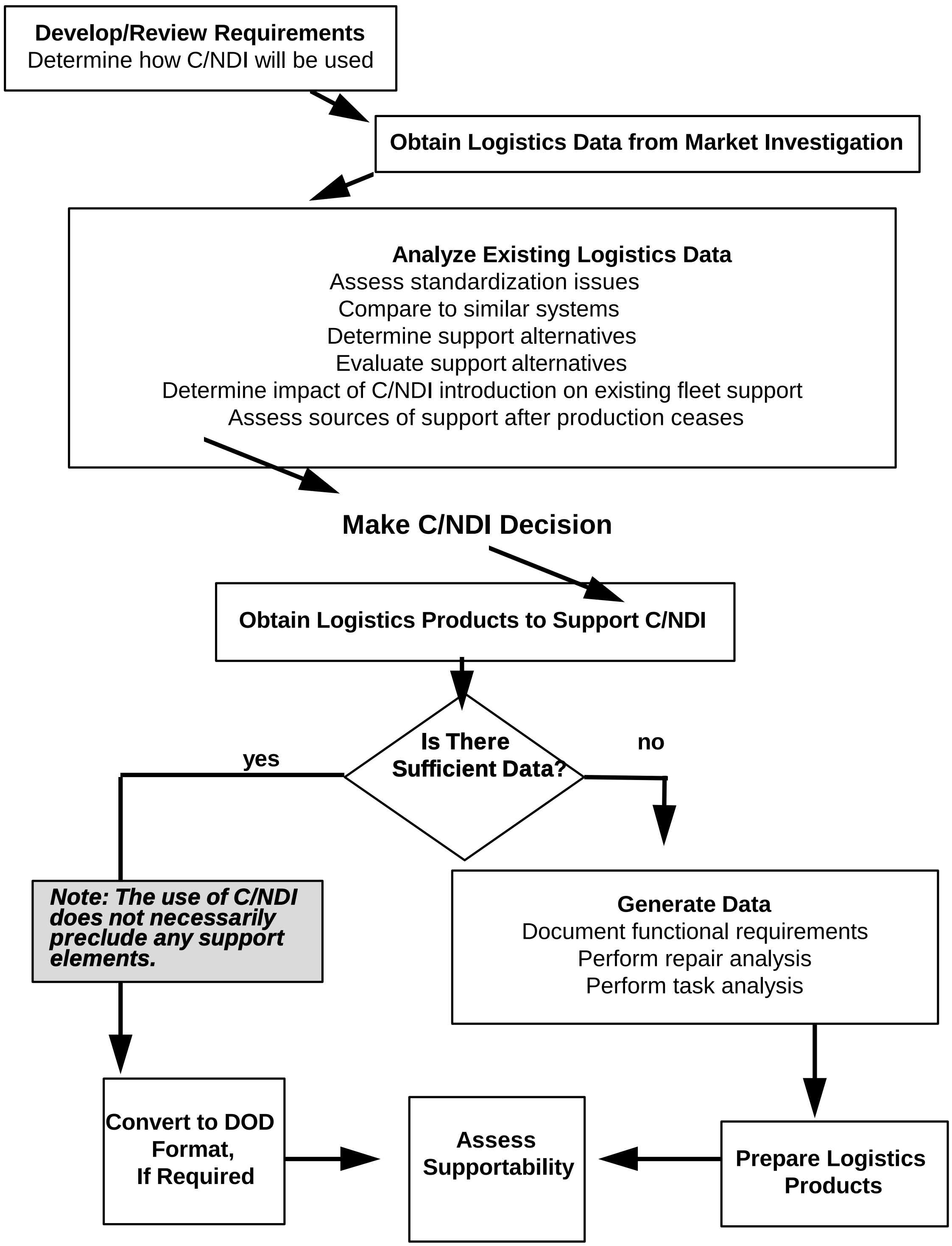

Figure 5-1. Supportability analyses for C/NDI acquisitions

If a development program is the result of the market investigation, the design process should be initiated as described in Section 4. The requirements should be decomposed and analyzed to determine their supportability characteristics (Requirements Analysis segment of the systems engineering process). This information should be used to initiate the support system design. The process will continue as the hardware, software, and support system designs evolve from the requirements through the functional design (FA/A) to the final or physical system design (Synthesis). The analyses should be performed at the system level and applied to the successively more detailed design components.

The specific supportability analyses to be performed on an element of a system's design are those which most correspond to the level of that element's design. For example, when the design data is of a functional nature, identify the functional support requirements and place special emphasis on the identification of new or unique support function requirements. When the available design data represents a physical design, identify and quantify operations and sustainment support resource requirements.

The supportability analyses that were discussed earlier under a commercial acquisition (one that lacked necessary technical publications information) are also applicable here. For those system elements for which support data is required:

- Identify hardware candidates and support functions.
- Conduct repair analysis.
- Perform functional analysis and task analysis on repairable items for selected support system design.

Another area of supportability analyses that applies to both commercial and developmental acquisitions is assessments of system supportability. These are considered part of the Systems Analysis and Control portion of the systems engineering process. This portion of the supportability analyses process is conducted throughout a system's life cycle and is used to:

- demonstrate the validity of the analysis.
- support current planning decisions.
- maintain the accuracy of the information products developed using the analysis results.
- support the assessment of alternative concepts and proposed changes.

Assessment and verification of supportability starts with early planning for verification of support concepts and continues on an iterative basis. Assessment and verification methods and techniques encompass technical reviews, modeling, simulation, demonstration, and testing. Assessment and verification procedures, like all supportability analysis activities, need to be tailored to the type of acquisition, the program phase, and the risk elements being addressed.

Supportability demonstration and test requirements and criteria are developed for the particular performance characteristics to be tested. These requirements are included in the Test and Evaluation Master Plan for the program. All supportability performance requirements, including those which apply to the support system, should be tested and verified.

Results of supportability assessment and verification activities are used to update other supportability analyses information and estimates. Issues resulting from analysis of supportability assessment results are used to develop improvement recommendations.

5.3 Systems Engineering Strategy—Supportability Analyses Inputs

A strategy for performing systems engineering activities should be developed early in the program by the performing organization. As such, selected supportability analyses should be identified as input to the systems engineering strategy. The supportability analyses input should be an integral part of the program's systems engineering strategy. The strategy input should identify, and give the rationale for, the inclusion or exclusion of specific analyses. Each activity that is included should be assigned to an organization responsible for its conduct.

Supportability analyses in each program phase should be scoped to the objectives and level of design anticipated. The strategy should address all supportability analyses needed to analyze, define, and verify the supportability thresholds and objectives for a system and to assess the risks in accomplishing the thresholds and objectives. Select the supportability objectives and analyses to include in the strategy based on the following considerations:

- The probable hardware and software designs, support concepts, and operational approaches for the new total system which include gross estimates of the reliability and maintainability, O&S costs, logistic support resources, and readiness characteristics of each total system component design and the operational concept.
- The availability, accuracy, and relevance of readiness, O&S cost, and logistic support resource data required to perform the proposed support analyses.

- The potential design impact of performing the analyses including the estimated supportability, cost and readiness improvement and the reduction in program risks.

The strategy should also include an initial estimate of the cost to perform each supportability analysis. It should also rate the degree of cost effectiveness of performing each analysis—given the projected costs, the anticipated benefit to be derived, and the program schedule constraints under which it must be conducted. These ratings should then be used to tailor supportability analyses to conform to overall acquisition program strategy, plans, schedules, and funding.

Procedures and schedules should be established and integrated with the overall systems engineering program and other program activities. Supportability reviews should be scheduled consistent with the overall program plans. Consider use of alternative techniques that minimize the cost of reviews such as the use of remote access.

Supportability analyses should have a set of established review procedures which provide consistency of review among the participating disciplines. These procedures should define the acceptance and rejection criteria pertaining to total system supportability requirements.

To be useful, the systems engineering strategy needs to be current. The supportability analyses input should be updated as necessary based upon the analyses' results and subsequent refinement of plans, schedules, and funding profiles. When the results of a specific supportability analysis are no longer required or provide little or no value to the program, the analysis should be discontinued.

5.4 ADDITIONAL INFORMATION

Department of Defense Regulation, 5000.2-R, *Mandatory Procedures for Major Defense Acquisition Programs (MDAPS) and Major Automated Information System (MAIS) Acquisition Programs*

SD-2, *Buying Commercial and Nondevelopmental Items: A Handbook*

Section 6:

How To Develop Measurable and Testable Supportability Requirements

6.1 CONCEPT OF OPERATIONS

Supportability requirements grow directly from the concept of operations. If a clear line from the operational concept to a specific supportability requirement cannot be traced, that requirement should be regarded with suspicion. The beginning point for each supportability requirement should be found in an operational requirement.

6.1.1 Operational Requirements Document

A mandatory format for the Operational Requirements Document (ORD) is presented in DoD Regulation 5000.2R, Appendix II. In it, DoD commitment to addressing supportability issues as an integral part of the procurement process is made clear. Except for the section defining the threat, every paragraph of the regulation addresses logistic issues. The following paragraphs address the logistic implications of each section of that document.

1. General Description of Operational Capability. The description of the overall mission area and type of system is accompanied by the anticipated operational and support concepts—sufficiently detailed to allow for program and logistics support planning. Notice that "logistics support" is integral to the planning process. The intent to mesh supportability requirements with operational requirements from the beginning of a program is clear.

2. Threat. This section does not address logistics.

3. Shortcomings of Existing Systems. This section must address any supportability problems that have arisen over the life of the current system or shortcomings that were built in at the program's inception. Since life-cycle costs are a major factor in any system, the difficulty (or impossibility) of supporting a current system may be its major shortcoming. Increased or improved operational capability may be only a byproduct.

4. Capabilities Required. This section breaks out performance and support considerations. The writers of the ORD are required to identify what they consider key performance parameters. All parameters not identified as key are potential tradeoffs when achieving them impacts supportability. The format for the ORD requires the system developer to make hard choices between "must have" and "nice to have" at the early stages of the program. This information is of vital importance to the logisticians, who then know what they must support, regardless of costs, and what they can trade off.

a. System Performance. System performance parameters like range, accuracy, payload, and speed are to be identified in measurable quantifiable terms. General terms or those whose interpretation is potentially ambiguous must be avoided.

b. Logistics and Readiness. "Measures" and "rates" are key terms in this section. Parameters such as mission-capable rates, sortie/mission completion/abort rates, operational availability, and frequency and duration of preventive or scheduled maintenance actions are expressed in measurable terms. Combat support requirements, mobility requirements, expected maintenance levels, and surge and mobilization capabilities can also be measured quantifiably.

c. Other System Characteristics. The characteristics in this special category tend to be design, cost and risk drivers. Electronic countermeasures are expensive to design. Nuclear, biological, and chemical contamination is expensive to address. Unplanned stimuli (like fast cookoff and sympathetic detonation) introduce major risks. Safety and security considerations affect effective supportability. "What ifs" need to be addressed during support planning.

5. Program Support. Effective program support looks close at hand and far off—in time and space. Fielding a system that provides the operational capability requested is only the first step. But, because this first step is so overwhelmingly important, sometimes the following less obvious steps are neglected. Initial capability is different from full capability, and surge requirements are totally different still. A spares program that might be perfectly adequate for full capability might be totally unable to handle the surge requirements of multiple contingency operations.

Support considerations have become more complex because internal system interfaces are far more complex than they used to be. The demands for standardization and interoperability require that the logistician be familiar with what is going on with many other programs. Learning what supportability requirements other systems have will keep the logistician from reinventing the wheel, and will assist in finding where low-cost solutions can be pursued.

a. Maintenance Planning. It is important that maintenance planning tasks be defined in measurable terms, with threshold percentages or ranges provided. The repair strategy must be clearly envisioned before the ORD is written. The cost/benefit ratio between organic repair and contractor support must be scrutinized before any decisions are made. Contractor support costs must include estimates for increased cost, and DoD incurred costs for life support, security, and transportation in a forward deployed (hostile) environment. This is not an area where preconceived notions of what is appropriate (or what works) can be allowed to dominate.

b. Support Equipment. In this section “realistic and affordable” are key phrases. “One hundred percent fault isolation” is certainly desirable, but is it realistic? And even if it were, would it be practical, from a financial viewpoint? Common support equipment should be acquired instead of peculiar support equipment when possible and cost effective.

c. Human Systems Integration. Manpower issues are crucial to the supportability of many systems. Acceptable risk levels, necessary training levels, manpower ratios, and the like must be addressed as supportability concerns. Initial and continuing training to maintain operator skills is an important consideration. Given the high level of turnover in military personnel, maintaining operator skill is often a crucial issue. Repair and maintenance personnel also turn over rapidly. Support planning must deal with these issues.

d. Computer Resources. This is another area where logisticians needs to have done their homework. What constraints are necessary in order to provide interfaces with other services? What is the tradeoff when X architecture provides a desirable improvement in operational availability but denies access to Y communications network used by another service? The logistician must assess the impact of system changes and determine necessary adjustments to the logistics structure.

e. Other Logistics Considerations. Provisioning strategies and special packaging, handling, and transportation considerations need to be addressed here. Unique data requirements are defined here, but remember that data requirements should be kept to a minimum, and data should be provided in contractor format whenever possible. Logisticians must know how and when they will use the data they request, and they must be able to distinguish between “nice to have to cover possible contingencies” data and essential data. Packaging, handling, transportation, facilities, disposal, and environmental impact considerations are far from the forefront for system designers, developers, and users, but they are important and potentially expensive considerations. Logisticians must understand the potential impact of these issues on the system from its inception, and must raise these issues whenever they impact on program planning.

f. Command, Control, Communications, Computer and Intelligence. This section requires an understanding of future capabilities. Designing a system to interface with those "forecast to exist at the time the system will be fielded" requires the engineer and logistician to be aware of the status of other related acquisition programs. How can this system interface with this planned future communications architecture? Will it support video teleconferencing? Will its anti-jam capability impact our electronics?

g. Transportation and Basing. This is another area that is often neglected in the process of fielding a system. The logistician must raise these issues. Who will transport this system? On what? Under what situations might other means of transport be used? Where the system will be based could affect the decision to use organic or contractor support. Training, maintenance and repairs in non-combat zones can unquestionably be done by contractors. If (or when) these functions will be carried out in combat, the feasibility of contractor support becomes a much more complex issue. Additionally, issues can cross service lines, even for a service-peculiar system.

h. Standardization, Interoperability, and Commonality. The logistician must be aware of the implications of support among and between the various U.S. military services and between them and our allies. The emphasis is on interoperability; and the logistician has a major role to play in this arena. Procedural and technical interfaces affect supportability. Identifying the communications, protocols, and standards that will ensure compatibility and interoperability among our military services and between us and our allies is a painstaking task. Commonality of equipment not only increases the possibility of interoperable systems, it also has implications for support.

i. Mapping, Charting, and Geodesy Support. The logistician may be required to assess the type and level of mapping, charting and geodesy support needed, the formats of the data, the capabilities required of the system (CD-ROM, 4mm, 8mm, 9-track tape), and the lead time for ensuring that these data requirements are met**.**

j. Environmental Support. In these two areas (i. and j.) the logistician is concerned with many of the issues already identified: using standard format data, limiting data requirements to those essential, expressing requirements in measurable terms, using ranges and thresholds.

6. Force Structure. Force structure considerations have two aspects. The first is any changes to the force structure that must be made to support and operate the system. The second is changes in the force structure that can be made because of the system, e.g., reduction in personnel because the system replaces two old systems or because the new system is easier to maintain.

7. Schedule Considerations. The logistician is obviously concerned in scheduling decisions. Support is a vital and integral part of any system that is fielded. Only when logistics is an afterthought should it cause delay. If logistic considerations have been interwoven with the program in all of its phases, then the supportability schedule will have been synchronized with the other system schedules.

8. ***Facilities.*** Special consideration must be given to facilities because of the long lead times involved.

6.2 DEVELOPING PERFORMANCE REQUIREMENTS

DoD policy mandates the use of performance requirements as the preferred method of preparing specifications. In the logistics field this policy means that supportability requirements must be expressed in performance terms. Requirements must express what the desired outcome is, but must not direct how to achieve that outcome. As acquisition management relies more and more on commercial sources rather than on unique military specifications-driven items, we must be careful not to restrict potential contractors. For example, we may have an item that requires careful packaging to avoid breakage. The requirement, in performance terms, will give the acceptable limits, but will not tell how the item is to be packaged:

> *The item, packed for shipping, will pass through a 5x3 ft. hatch, will not be damaged by up to a vertical 3 ft. drop onto a metal surface, and can withstand X pounds per square inch of pressure on all sides simultaneously.*

The goal is to identify the required outcomes, leaving the supplier free to provide the means and/or method that will produce the outcomes we have identified.

DoD 5000.2-R, Part 2, states clearly that support requirements are to be tied in to the program performance specification: "*Supportability factors are integral elements of program performance specifications. However, support requirements are not to be stated as distinct logistics elements, but instead as performance requirements that relate to a system's operational effectiveness, operational suitability, and life-cycle cost reduction*."

It further requires that acquisition logistics be an integral part of system development: *"The PM shall conduct acquisition logistics management activities throughout the system development."*

More detailed guidance on the preparation of performance requirements can be found in SD-15 and in MIL STD 961.

6.2.1 Integration Of Acquisition Logistics Into The Systems Engineering Process

During the systems engineering process, operational needs are analyzed and various design concepts are proposed. Those concepts are then synthesized, evaluated, and optimized. The culmination of this process is definition of the best design.

Unfortunately, acquisition logistics (supportability) objectives often conflict with other design objectives like speed, range, size, etc. How is this inevitable conflict resolved? Early in the process, the issue of tradeoffs must be raised during the analysis of proposed concepts. Careful use of tradeoff studies will guide the engineers and the logisticians in finding the optimal design—one which balances design objectives with supportability requirements. Tradeoffs are an essential part of the design process.

The result of this early collaboration between engineering and logistics personnel is a specification that prescribes performance requirements to be achieved.

The challenge is to ensure that supportability is integrated into the program from the beginning phases. The early design phases of a project, when things change rapidly, may seem of little interest to logisticians, and their attendance at engineering design reviews may seem a waste of time. Actually this period has far reaching logistics impact. During this phase the logisticians can use the leverage of early program involvement to identify approaches that will significantly lower life cycle costs. They may be able to catch an exorbitantly expensive material or time-consuming maintenance process before it has become integrated into the system. The following example is illustrative:

> *During an early design review of a satellite system, the logistician on the team noted that a system component was to be fabricated from beryllium. Although this strong light metal was a logical design choice, the logistician was aware that it is a hazardous material. Using it would require special handling. After he raised the issue, the engineers agreed that a heavier but non-hazardous material should be used instead.*

Logisticians must be prepared to defend the logistics support concepts and supportability design requirements that they propose, not only from the logistics community's point of view, but also from the engineering point of view. They must constantly keep the readiness requirements in mind. The value of teamwork from the earliest stages of a project is that each group has the other's concerns in mind. Cooperation and mutual understanding save time and money.

6.2.2 Differences Between Detail And Performance Requirements

Reliability

- Performance specifications would set requirements in terms of mean time between failure, operational availability, etc.
- Detail specifications may achieve reliability by requiring a known reliable design.

Maintainability

- Performance specifications would specify requirements in terms of mean time to repair, maintenance frequency, skill levels of repair personnel, time required for maintenance, etc.
- Detail specifications may specify exact designs to accomplish maintenance actions.

Reliability and Maintainability Parameters

Reliability and maintainability parameters affect readiness, mission success, manpower and maintenance costs, and other logistics support costs. For these categories reliability and maintainability can be expressed quantifiably as shown in Figure 6-1:

	Reliability	**Maintainability**
Readiness (or availability)	mean time between downing events	mean time to restore system
Mission Success (or dependability)	mission time between critical failures	mission time to restore functions
Maintenance Manpower Cost	mean time between maintenance	direct man-hours per maintenance action
Logistic Support Cost	mean time between demands	total cost to remove a part at all levels of maintenance

Figure 6-1. Reliability and Maintainability

6.2.3 Sample Performance Requirements

The following areas—availability, compatibility, transportability, interoperability, etc.—are some of those in which requirements should be stated in performance terms. In each category an example of a supportability requirement expressed in performance terms is provided. These examples illustrate only one of many requirements that might be imposed.

Availability

A measure of the degree to which an item is in an operable and committable state at the start of a mission when the mission is called for at an unknown (random) time.

Examples

The item will have an operational availability of .95 measured by the total operating time divided by the sum of the total operation time, total corrective maintenance time, total preventive maintenance time, and the total administrative and logistics down time.

The vehicle will have a maintenance ratio (MR) of the total scheduled and unscheduled maintenance man-hours per hour of operation (excluding operator/crew checks and daily operating service) that does not exceed the following values: (1) ORG 0.140; (2) DS 0.043; (3) Total 0.183.

Operational Sustainability

The capability of an item or system, and its inherent support structure, to perform its intended missions over a sustained period of time.

Example

(Requirement) The portable control station will be capable of completing a sustained 4-day operation using only onboard equipment and spares without resupply or support from personnel other than the operators.

(Verification) The operational test of the system will be used to verify the requirement is met. The test will consist of 2 systems performing 4 each of Scenario A, as identified in the ORD, and 2 each of Scenario B (surge), as identified in the ORD. Nine of the 12 scenarios must be fully executed without outside resupply/assisted maintenance. Additionally, at least one surge scenario must be completed without outside resupply/assisted maintenance.

Compatibility

The capability of two or more operational items or systems to exist or function as elements of a larger operational system or environment without mutual interference.

Example

The vehicle must be capable of accepting, supporting, and mounting a MK19, 40mm automatic grenade launcher.

Transportability

The inherent capability of an item or system to be moved efficiently over railways, highways, waterways, oceans, or airways either by carrier, towing, or self-propulsion.

Examples

The vehicle must be capable of being rigged for air drop by the using unit without the use of special tools, within X minutes.

The M939A2 5-ton truck shall be capable of being slingloaded beneath the CH-47D or the CH-53E helicopters using integral vehicle lift points.

Interoperability

The ability of systems, units, or forces to provide services to, and accept services from, other systems, units, or forces and to use the services so exchanged to enable them to operate effectively together.

Example

The aircraft's turreted cannon will mount the XM788 gun system used by the AV-8A Harrier aircraft to provide NATO interoperability among the Armament Development Enfield (ADEN) and Direction D'Etudes et Fabrication D'Armament (DEFA) gun systems currently in use.

Reliability

(a) The duration or probability of failure-free performance under stated conditions. (b) The probability that an item can perform its intended function for a specified interval under stated conditions. (For non-redundant items this is equivalent to definition (a). For redundant items this is equivalent to mission reliability.)

Example

The mean time between failure (MTBF) of the signature-suppressed generator sets (15/30/60 KW) shall not be less than 40 hours.

Maintainability

The measure of the ability of an item to be retained in, or restored to, specified condition when maintenance is performed by personnel having specified skill levels, using prescribed procedures and resources, at each specified level of maintenance and repair.

Example

The vehicle will have a mean time to repair (MTTR) that does not exceed 2.0 hours at X maintenance level.

Manpower Supportability

The consideration of the total supply of persons available and fitted to support a system. It is identified by slots or billets and characterized by descriptions of the required people to fill them.

Examples

Performance of duties will be accomplished by soldiers within the physical capabilities specified in AR 611-201 for each MOS designated to support, operate, maintain, repair, and supervise the employment of the system.

Introduction of the 15/30/60 KW generators into the Army inventory will not cause an increase in the number of personnel to operate or support them in excess of those required to run DoD generator sets.

Human Factors

The design of man-made devices**,** systems, and environments to enhance their use by people. Also called human engineering or ergonomics.

Example

The operational controls shall be within arm's reach for the 95th percentile of soldiers.

Training Requirements

The processes, procedures, techniques, training devices, and equipment used to train civilian and active duty and reserve military personnel to operate and support a materiel system. Those include individual and crew training; new equipment training; initial, formal, and on-the-job training; and logistic support planning for training equipment and training device acquisitions and installations.

Example

Ninety-five percent of the representative soldiers must be capable of performing all critical tasks, for their respective MOSs, to the assigned training standard.

Documentation

Documents, including technical manuals, maintenance allocation charts, parts lists, and similar documents used for the support of the system.

Examples

Technical manuals must be written to the reading grade level and knowledge of their intended users.

Warranty Period

A warranty is a promise or affirmation given by a contractor to the government regarding the nature, usefulness, or condition of the equipment, supplies or performance of services furnished under the contract.

Example

This warranty is in effect for a period of five years beginning on the date that the contract modification which includes this warranty is executed.

Figure 6-2 provides additional warranty examples.

Warranty Examples

DESIGN/MANUFACTURING CONFORMANCE WARRANTY: Notwithstanding government inspection and acceptance of warranted items, the contractor warrants that the supplies covered by the terms of this warranty shall conform to the design and manufacturing requirements in accordance with PDD-ARC210-001, the technical data package (TDP), and approved manuals for the warranty period defined in Part III. Product configuration may be altered or upgraded for product improvements or standardization provided the changes do not impact form, fit, or function at the WRA level. The TDP shall be updated to reflect the resultant changes in accordance with the CDRL requirements.

MATERIAL AND WORKMANSHIP WARRANTY: Notwithstanding government inspection and acceptance of warranted items, the contractor warrants that the supplies covered by the terms of this warranty are free from defects in material and workmanship that would cause a warranted item to fail to conform to the essential performance requirements for the warranty period defined in Part III.

ESSENTIAL PERFORMANCE WARRANTY: For the warranty period in Part III, the contractor warrants the essential performance requirements of the warranted items. Should the warranted items not meet the MTBF, the contractor shall furnish to the government temporary spares in accordance with Part V, subparagraph E. The contractor warrants all RT-1556/ARC and RT-1744/ARC units covered by this warranty for the hourly mean time between failure (MTBF) rates specified for the following time periods:

Guaranteed Mean Time Between Failure

MONTHS (*)	0-12	13-24	25-36	37-48	49-60
MTBF HOURS	667	679	728	853	1100

(*) Months after execution of the contract modification which includes this warranty.

If during the warranty period, the Warranty Review Board (WRB) determines that the ratio of actual average system operation hours to aircraft flight hours differs from the 1.4 “K” factor by 25% or more, the contractor and the government will negotiate an equitable adjustment to the K factor and the resulting MTBF calculation. If after the warranty expires, the WRB determines that the total annual operating time (TOH) as defined in Part V subparagraph D(5), herein, and as determined by NALDA data, differs from the following by 25% or more, the government and contractor will negotiate an equitable adjustment in contract price:

Total Annual Operating Hours

MONTHS (*)	0-12	13-24	25-36	37-48	49-60
TOH	238,395	459,073	668,734	755,730	811,213

(*) Months after execution of the contract modification which includes this warranty.

TURN AROUND TIME WARRANTY: The contractor warrants that all corrective action shall be completed with warranted items ready for delivery to the government within an average turn around time of 30 calendar days from the date the contractor receives the warranted items at the contractor’s facility until the date of shipment from the contractor’s facility in a ready for issue (RFI) condition. The contractor shall ship all processed RFI end items to government controlled storage in the absence of other shipping instructions from the procuring contracting officer or administrative contracting officer (PCO/ACO). If reusable containers are not available, the contractor shall ship end items using best commercial practices to assure safe delivery at destination.

WARRANTY FOR CORRECTED OR REPLACED SUPPLIES: Any warranted item repaired or replaced pursuant to this warranty is subject to the provisions of this clause, in the same manner as warranted items initially delivered.

Figure 6-2. Warranty Examples

Wording the Performance Requirement

The specific wording of requirements presents many pitfalls. Emphasize stating the requirements in performance terms. There are two good reasons for this emphasis. First, the requirement needs to be measurable so that all concerned can judge whether a system is functioning as it should. Subjectivity is not useful in this context, and requirements stated in terms that allow subjective interpretation are harmful. Second, the wording of the requirement should not reflect the user's bias as to the design for the product. The requirement should state what the user needs, not explain how the requirement is to be met. The goal here is not to stifle initiative or arbitrarily cut off innovative approaches to satisfying the requirement.

Poor Examples

The following examples of poorly written supportability requirements are followed by notes explaining their deficiencies.

1. *The signature-suppressed generator sets (15/30/60 KW) shall demonstrate a maintenance ratio (MR) not to exceed .05.*

Note: the term "demonstrate" is ambiguous here. It is more positive to say the maintenance ratio shall not exceed 0.05. The maintenance level (unit or intermediate) should be specified.

2. *The vehicle engine or engine and transmission assembly can be removed and reinstalled in less than 10 man-hours.*

Note: This measurement should be expressed as a percentile; e.g., perform the function in 10 man-hours 90% of the time.

3. *The sniper weapon system bolt assembly must be replaceable within 1 minute, without the use of tools, and without affecting the zero of the weapon.*

4. *The sniper weapon system must be designed to allow the operator to perform necessary maintenance using standard DoD lubricant/ solvent, without the use of any tools other than the cleaning kit equipment.*

5. *The sniper weapon system must have cleaning equipment that is not detrimental to the weapon when used properly and which fits in the M-16 cleaning kit pouch.*

Note: Requirements 3, 4, and 5 are actually design requirements. They are not expressed in clear measurable terms. To measure the operational capability of the weapon system requires that it takes no more than X minutes Y percent of the time to service (clean/repair) the weapon.

6. *Logistics support responsibilities, including maintenance allocation chart (MAC), will be consistent with established Army procedures.*

7. *Material support hardware/software (i.e., tools; petroleum, oils, and lubricants; test equipment; training manuals) shall be allocated to the correct level in number and type for efficient functioning of the logistics concept.*

8. *Appropriately skilled supply and maintenance personnel shall be assigned to the proper level and location.*

Note: Requirements 6, 7, and 8 are weak. They do not relate to the system. They are too generic and have no meaning.

9. *Special tools, if necessary, will be available at the required level.*

Note: This requirement does not provide a useful measure or standard for judging the adequacy of support.

10. *Test measurement and diagnostic equipment (TMDE) and calibration equipment will be standard Army equipment (listed in the Army's TMDE Register, DA Pam 700-20).*

Note: this requirement is not useful for measuring the adequacy of support. If this particular equipment is essential, the explanation should be given. Otherwise this appears to be an unnecessarily constraining requirement, not based on performance.

11. *When rigged on a modular platform and delivered to the ground by parachute during tactical airborne operation, the vehicle must be capable of being derigged by the using unit and available to the assault phase of the operation (within 15 minutes).*

Note: this requirement should be rewritten to reflect a derigging within 15 minutes at least X percent of the time.

12. *Grasping devices and tiedowns must enable the lightweight collapsible pillow tank to be positioned and secured against damage and instability (i.e., rolling, creeping, or sliding) when transported full, partially filled, or empty.*

Note: The emphasis needs to be on securing the tank, not on the specific means for securing it.

13. *When filled, the lightweight collapsible pillow tank must not weigh more than 1,500 pounds and must be capable of being transported externally by CH-47 cargo or UH-60 utility helicopters.*

Note: The specific weight constraint is not an appropriate measure here.

Figure 6-3 provides an example of the translation and evolution of an operational requirement to a supportability requirement.

THE EVOLUTION OF A SUPPORTABILITY REQUIREMENT

The operational requirement:

Provide anti-armor protection with air cavalry and air mobile escort.

An operational sub-requirement:

Have a 1.9 hour endurance in a mission scenario.

The relevant overarching logistic requirement:

Have an operational availability of 0.70 to 0.80.

Related logistic sub-requirements:

Have a mean time to repair at organizational, intermediate, and depot support levels of 0.65 to 0.90 hours.

Inspections limited to not more than 1.0 maintenance man-hour per flight hour.

Dynamic components have a mean time between removal of not less than 1200 flight hours.

Be designed for combat zone maintainability.

Figure 6-3. From Operational to Supportability Requirement

6.3 METRICS

What do metrics do? Metrics measure things. The goal of using metrics is to learn what we have. When we know what we have, we can see how to make changes to improve the product.

6.3.1 Metrics Model

Successful metrics involve inputs, processes, and outputs. The desired output is, in the final analysis, a satisfied customer. The inputs come, in one way or another, from the user. The processes, the actions that turn the inputs into outputs, are affected by controls—those policies, resources, rules or technologies that constrain the design of the processes—and also by enablers—those tools or techniques that assist in shaping the design of the processes. The balance between controls and enablers assists in the design of a good metric.

6.3.2 Characteristics of a Good Metric

What distinguishes a good metric? A good metric:

- Is imposed on the organization that controls the process producing the metric.
- Is accepted as meaningful by the customer, e.g., user, procuring agency, etc..
- Shows how well goals and objectives are being met through processes and tasks.
- Measures something useful (valid) and measures it consistently over time (reliable).
- Reveals a trend.
- Is defined unambiguously.
- Has economical data collection.
- Is timely.
- Has clear cause and effect relationship between what is measured and the intended use of the information.

6.3.3 Developing Good Metrics

Developing a good metric is a systematic process. The following steps explain how to produce one.

1. Identify your purpose. Your purpose must be aligned with your organization’s mission. What do you need to measure? Why? What is your end purpose?

2. Begin with your customer. Your job is to define the who, what, when, why, and how in sufficient detail to permit consistent, repeatable, and valid measurement to take place. Who **is** your customer? What are his or her expectations? Your job is to define characteristics of the product, service, or process which can be measured internally, and which, if improved, would better satisfy expectations. This is the first element of your metric package.

3. Define what it is that you want to measure. Start with a blank sheet of paper. Before you examine existing metrics, or plan new ones, decide where you are and where you want to go.

4. Examine existing measurement systems and generate new metrics if necessary. Look for existing measurements. What do they measure? Do they measure processes, or are they focused on outputs—products or services for external customers? Ask if the data has been accumulated over time. If you don't get clear answers, or if you don't feel that the data is useful in managing what you want to manage, create a new, better metric.

5. Rate your metric. Is the who, what, when, why, and how defined in sufficient detail to permit consistent, repeatable, and valid measurement to take place? Rate your metric against the "Characteristics of a Good Metric" given in the previous section. Have you selected the proper tool for analyzing and displaying the data you have decided to collect?

6. Collect and analyze metric data over time. First, baseline your process. Start acquiring metric data, from the existing metrics or from the new ones you have generated. You need a baseline as a starting point. As the data accumulates over time, look for trends. Investigate special or common cause effects on the data. Assign them to their sources. Compare the data to interim performance levels. This is the second element of your metric package.

7. Finalize the metric presentation. When you have completed the first six steps, you are ready to present the information your metric has generated. The graphic presentation you provide will clearly and concisely communicate how you are performing based on a standard and where you plan to go. This is the third element of your metric package.

8. Initiate improvement goals. Remember, this step is the most important if your improvement efforts are to become a reality! Metrics are a means to an end—the end is continuous improvement. Of course, once the improvements have been implemented, you are ready to start over again. As improvement is an iterative process, so is the process of developing metrics to measure it.

6.3.4 Feedback Loop

Another important aspect of metrics is the design of the feedback loop. Because metrics measure things and tell us what we have, we can make changes. Feedback loops tell us if the changes we made improved the product. Figure 6-4 examines the feedback loop for a Department of Defense product.

FEEDBACK LOOP

User provides feedback to DoD activities.

DoD activities analyze:

engineering
logistics support
training
manning
cost

Analysis results in:

Alterations–
improved parts and support
better training and manning
engineering change proposals

End result?

Improved readiness.

Figure 6-4. Metrics Feedback Loop

6.4 SUPPORTABILITY ISSUES

6.4.1 Supportability Requirements

Supportability issues—constraints, down time, turn around times, life-cycle costs, stockage levels, and the like—become specific logistics objectives.

- Operations and maintenance manpower and man-hour constraints
- Personnel skill level constraints
- Operating and support costs constraints
- Target percentages of system failures (downing events) correctable at each maintenance level
- Mean down time in the operational environment
- Turn around time in the operational environment
- Standardization and interoperability requirements
- Life-cycle costs
- Stockage levels of materiel
- Repair level

6.4.2 Supportability Design Factors

The following figures (6-5 and 6-6) provide good examples of expressing supportability requirements in measurable terms and building supportability requirements into the design.

F-18 MAINTENANCE REQUIREMENTS

Direct maintenance:

Man-hours/flight hour	11.02
Operational availability	80%
Turn around time (max. 3 men)	15 min.
Mean time to repair	1 hr. 46 min.
Fault isolate time	90% in 5 min.
Fault isolate time	100% in 10 min.
Engine change	21 min. (4 men)
Radar remove and replace	21 min. (2 men)

Figure 6-5. Maintenance Requirements

What happens when the logistician isn't involved in the design process? Logistic problems get built into the design. For example, when the F-4 was designed, the radio was placed to the left of the rear seat bucket under the air data computer. This placement made good sense from the design point of view because it kept a heavy object forward. The radio was relatively reliable, and routine maintenance could be performed in ten minutes or so. The problem was that in order to get to the radio the ejection seat had to be dearmed and the seat bucket and computer removed—and then the process had to be completed in reverse after the radio maintenance had been completed. The ten minute job had become a four or five hour job. Even worse was the possibility of maintenance-induced failure of the computer when it was reinstalled, which would render the aircraft non-flyable.

SUPPORTABILTY RELATED DESIGN FACTOR FOR THE F-16

Terms:	Range/Value:
Weapon system reliability	.90 - .92
Mean time between maintenance (inherent)	4.0 - 5.0 hrs.
Mean time between maintenance (total)	1.6 - 2.0 hrs.
Fix rate	60% in 2 hrs. 75% in 4 hrs. 85% in 8 hrs.
Total not-mission-capable rate maintenance rate	8%
Total not-mission-capable supply rate	2%
Sortie generation rate	classified (see req. doc.)
Integrated combat turn around time	15 min.
Primary authorized aircraft airlift support	6-8 C-141B equiv.
Direct maintenance personnel	7 to 12 AFSCs
Reduced number of Air Force Specialty Codes	4 to 6 AFSCs

Figure 6-6. Designing for Support

Supportability design factors include the following categories:

- System reliability (mean time between failures)
- System maintainability (mean time to repair)
- Maintenance burden (maintenance man-hours per operating hour)
- Built in fault isolation capability (percent successful isolation)
- Transportability requirements (identification of conveyances on which transportable)

Many factors influence supportability decisions. As the Department of Defense looks more and more toward the commercial marketplace as a source for procuring goods and services for government use, differing goals and objectives surface.

The issue of packaging is a good example of differing military and commercial goals. In fact, our reliance on military specifications and standards dates to unsatisfactory packaging provided by contractors during the Spanish American War. Today the situation is reversed. Commercial packaging is designed to protect both the contents and the outside of the package. The package is expected to look good on arrival: the company logo prominently and neatly displayed, the undented container visually promising an excellent product within. The military packaging goal is much simpler—protection of the contents is the sole mission. A damaged container on arrival is not a problem, as long as the contents are unharmed.

6.4.3 Logistics Support Parameters

Provisioning Objectives

- What is the spares to availability target?
- Want spares to be available when?
- Want spared to what level?
- Want what percent inherent availability?

Figure 6-7 provides two examples of provisioning requirements.

SAMPLE PROVISIONING REQUIREMENTS

The prescribed load list will have a 90 percent demand accommodation and 90 percent demand satisfaction on deadlining items at organizational level.

Forward direct support authorized stockage list will have an 80 percent demand accommodation and an 85 percent demand satisfaction.

Figure 6-7. Provisioning Requirements

Supply Support Objectives

- Fill rates
- Order and shipping times
- Guarantee X% availability

Examples of Support Cost Reductions

Logistic decisions affect costs. Figure 6-8 presents two examples of logistic planning decisions that significantly reduced the costs of a submarine and an aircraft procurement.

TRIDENT SUBMARINE: LOGISTICS HATCHES

All spaces (except the reactor compartment) are directly accessible via special, large diameter logistics hatches.

F-16: COMMON AND INTERCHANGEABLE COMPONENTS

Main landing gear assemblies are 80% interchangeable.

Flaperons are interchangeable left and right.

Horizontal tails are interchangeable left and right.

There are 5 common electrohydraulic servos.

There are 5 common actuators.

Figure 6-8. Logistics Planning

6.5 COMMERCIAL EQUIPMENT SUPPORTABILITY

The Department of Defense is adopting new business practices as it shifts away from development and toward commercial procurement. Although off-the-shelf items developed for the commercial market frequently meet DoD needs, the long term supportability of these items is much more problematical. Since commercial items will probably be used in harsher environments than those for which they were developed, kept in service longer than intended by the commercial developer, and required to interface with other systems, the logistical implications of using commercial items need careful scrutiny.

6.5.1 Acquisition Logistics Lessons Learned

The following report describes the recent experiences of the Air Intelligence Agency in acquiring electronics systems:

> "The agency is no longer developing its own systems; currently our systems are made up entirely of COTS equipment (excluding interfaces and occasional software). We use small quantities of equipment; generally less than five of any particular item. COTS equipment complements

our mission requirements, and vendor competition is fierce for continuous product improvement.

"COTS maintenance manuals and drawings are limited. At best they will allow repair and identify support to the LRU (circuit card, power supply, etc.). Any more extensive data is either proprietary or the vendor asks for extremely large sums of money. To be effective, the depot should be able to perform piece part repair. This is only possible through reverse engineering, mockups, or the development of ATE software. The time and cost associated with these processes cannot be justified based on the quantities of equipment we buy. Instead we receive extended warranties and allow contractors who already have repair capability to repair failed LRUs. There is also the cost issue of training maintenance technicians on new equipment.

"The type of equipment we procure has been found to have long mean times between failure. There are exceptions, but generally we get 2-3 years before any failures on our operator positions. Also technology is constantly evolving, and in many instances we are upgrading the system with this new technology within three years. Because our equipment typically does not stay in the field a long time, it is not cost effective to strive for organic repair capability.

"Although we possess some organic maintenance capability, the majority of COTS equipment is contractor supported. Rather than acquire the equipment and support capability on separate contracts as we did in the past, we found it beneficial to acquire them together. Tying the support capability into the equipment purchase is best accomplished by establishing a logistics support strategy early in the program before the RFP."

The experience of this agency is instructive. The following principles underlie the success of its efforts:

- Plan for supportability from the initial planning stages.
- Base supportability strategies on the expected service life of the product.
- Be willing to consider nontraditional approaches to support: extended warranties, disposal upon failure, etc.

6.6 ADDITIONAL INFORMATION

Program Manager's Kneepad Checklist, Pamphlet 63-101, Aeronautical Systems Center (AFMC) ASC

SD-15, *Performance Specifications Guide*

Section 7: Support Data

7.1 SUPPORT DATA

"Data requirements shall be consistent with the planned support concept and represent the minimum essential to effectively support the fielded system. Government requirements for contractor developed support data shall be coordinated with the data requirements of other program functional specialties to minimize data redundancies and inconsistencies." This direct quotation from paragraph 4.3.3.3 of DoD 5000.2-R makes it clear that support data requirements must be coordinated with data requirements from other program elements. Not explicitly stated, but clearly implied, is the need for the different functional elements of support to coordinate their data requirements also.

SOURCES FOR SUPPORT RELATED DATA

Consider obtaining these types of data:

Reliability Availability and Maintainability (RAM)
Logistics Management Information (LMI)
Technical Publications
Transportability
Training

From these kinds of sources:

Industry standards
Other commercial or military customers
LMI specification summaries
Contractor's in-house data

Figure 7-1. Support Data Sources

As with the non-logistics functional specialties, the different functional elements of support must coordinate with each other in order to eliminate buying redundant support data. For example, it would be possible for a logistician to get reliability and maintainability data through one of the logistics management information (LMI) summaries or, as Figure 7-1 indicates, from commercial or government sources. However, if the same information is being delivered to the reliability availability and maintainability (RAM) community via industry standards, then the logistician should utilize it and not buy redundant data. On the other hand, some of the reliability and maintainability data a logistician would like to see may not be delivered to the RAM community. In this case, one of the LMI summaries, such as Maintenance Planning, could be utilized to get the necessary data. If RAM data is requested on this summary, the data should be in the same format and have the same definition that is specified in appropriate RAM standards. This restriction precludes levying government-unique requirements on the contractor.

The remainder of this section will focus on using the LMI performance specification as a source for support data. Remember, this specification is not the only source of support data. In fact, its specific definitions in Appendix B are mainly for provisioning, packaging, cataloging, and support equipment, but the LMI specification summaries can be used to obtain information in other support areas.

7.2 MIL-PRF-49506, LOGISTICS MANAGEMENT INFORMATION

As a result of the Secretary of Defense’s policy on usage of specifications and standards, MIL-PRF-49506, LMI, has been developed to replace MIL-STD-1388-2B. It is not a revision of MIL-STD-1388-2B. Rather, it represents a fundamental change in the way data requirements are levied on contracts. MIL-PRF-49506 does not contain any “how to’s.” The new specification is designed to minimize oversight and government-unique requirements. The underlying philosophy of MIL-PRF-49506 is to allow contractors maximum flexibility in designing systems and developing, maintaining, and providing support and support related engineering data. In order to achieve this objective, the new specification has the following characteristics:

1. The principal focus of MIL-PRF-49506, LMI, is on providing DoD with a contractual method for acquiring support and support related engineering data. The Department of Defense uses this data in-house in existing DoD materiel management automated systems such as those for initial provisioning, maintenance planning, cataloging, support equipment data, and item management.

2. Data products intended primarily for in-house use by contractors during their design process or those developed internally by the Department of Defense are beyond the scope of this specification.

3. MIL-PRF-49506, LMI, is *not* intended to specify, define, or imply a requirement for contractors to establish or maintain any logistic database.

4. Electronic data interchange, on-line access, and all other automation issues are outside the scope of the specification and must be addressed separately using other appropriate documents such as MIL-STD-1840.

5. Information summaries are only examples of support information that DoD managers may want to request from contractors. These sample summaries are not all inclusive or exclusive and are intentionally stated in general terms to encourage maximum contractor flexibility. Project offices can tailor samples to fit their information needs.

6. Contractors are strongly encouraged to offer support and support related engineering data to the government in their own commercial formats if the data is readily available and can cost-effectively meet DoD's needs.

7. MIL-PRF-49506, LMI, contains verification criteria based strictly upon performance.

8. The LMI specification may be tailored down or tailored up (see summary worksheet example, Figure 7-11).

7.2.1 Guidance from DoD 5000.2-R

The following paragraphs discuss provisions of DoD 5000.2-R that relate to the execution of MIL-PRF-49506, LMI. The first few paragraphs touch on not imposing government-unique requirements and on issues related to digital data.

To paraphrase paragraph 3.3.4.2: The government shall avoid imposing government-unique requirements that significantly increase industry compliance costs. Examples of practices designed to accomplish this direction include the open systems approach (one that emphasizes commercially supported practices, products, specifications, and standards); and replacement of government-unique management and manufacturing systems with common, facility-wide systems.

Furthermore, paragraph 3.3.4.5 states, *"Beginning in FY97, all new contracts shall require on-line access to, or delivery of, their programmatic and technical data in digital form, unless analysis shows that life-cycle time or life-cycle costs would be increased by doing so. Preference shall be given to on-line access to contractor developed data through contractor information services rather than data delivery. No on-going contract, including negotiated or priced options, shall be re-*

negotiated solely to require the use of digital data, unless analysis shows that life-cycle costs would be reduced.

*"Acquisition strategies and plans shall describe the extent of implementation of these requirements in accordance with **DFARS 207.105**. Solicitations shall require specific proposals for an integrated data environment to support systems engineering and logistics activities. The PM shall ensure compatibility of data deliverables with existing internal information systems, and augment such systems as required to provide timely data access and distribution consistent with **DFARS 227** and **252.**"*

Paragraph 4.3.3.1 (the next paragraph) talks specifically to supportability analyses. This quotation relates directly to Appendix A of the LMI specification, "Supportability Analysis Summaries": *"Supportability analyses shall be conducted as an integral part of the systems engineering process beginning at program initiation and continuing throughout program development. Supportability analyses shall form the basis for related design requirements included in the system specification and for subsequent decisions concerning how to most cost-effectively support the system over its entire life-cycle. Programs shall allow contractors the maximum flexibility in proposing the most appropriate supportability analyses."*

7.3 EXPLANATION OF LMI SUMMARIES

LMI summaries contain information that the government needs in order to assess design status, conduct logistics planning and analysis, influence program decisions, and verify that contractor performance meets system supportability requirements. Appendix A of the LMI specification identifies eight types of summaries in broad, general terms and contains associated worksheets that can be used to identify the content of the summaries. Please note that these summary titles do not have to be used. For example, the requiring authority could identify on the worksheets a summary for a Long Lead Time Items List with the necessary content, instead of specifically calling out a Supply Support summary.

The LMI summaries may include any information deemed necessary by the requiring authority. The summaries can include data products from Appendix B of the LMI specification, or they may include information not in Appendix B. If a summary contains data or information not defined in Appendix B, the requiring authority must specify the definition and format (or reference the governing or appropriate standard or specification) for such information.

The LMI summaries can be delivered as stand-alone reports or as an integral part of other systems engineering documentation. Requirements for these summaries should be coordinated with data requirements of other program functional elements (e.g., RAM, TMs/TOs, etc.) to minimize redundancies and inconsistencies. There is one hollow data item description (DID), DI-ALSS-81530, which can be used to contract for one or more summaries. If multiple summaries are required at different times, this DID can be called out multiple times, and for each separate contract line item the specific summary and delivery date(s) can be identified.

7.3.1 Life Cycle Application

Most of the LMI summaries are applicable in some way during all phases of a system's life cycle, with the exception of the Post Production Support Summary. Tailoring should be conducted in a given phase to correspond to the level of information available regarding the design level and resource requirements.

Phase 0 and Phase I Life Cycle Applications

During these early phases (Concept Exploration, and Program Definition and Risk Reduction) the design of a system is usually very flexible and opportunities for conducting tradeoffs and analyses, identifying alternatives, and affecting design from a supportability standpoint exist. For example, these opportunities include determining early support equipment requirements (built-in test vs. automatic test equipment) and analyzing organic support versus contractor support or extended warranties.

Also, Repair Analysis summaries may identify items or parts that should be designed for discard instead of repair. It is also possible at this point to identify high level maintenance and provisioning requirements for tools and test equipment, which can assist in the development of budgets and funding levels for later phases.

Programs that make commercial or nondevelopmental item buys should already have information regarding necessary maintenance actions. From this information, good manpower, skill level, and training projections can be made.

In modification programs, high level source maintenance and recoverability (SMR) coding may occur. Consequently a Maintenance Planning or Supply Support type summary, which provides an early view of the contractor's coding practices, may enable the government to determine whether or not these practices are correct and correspond with the intended maintenance concept.

Facilities summaries are especially relevant during Phase I because of the long lead-time normally required for establishing or modifying facilities. These summaries can be used to identify necessary facility requirements such as test equipment, training aids, building size, and any other special considerations.

The transportability portion of Packaging, Handling, Storage and Transportation (PHS&T) summaries is also applicable during Phase I since high level transportation requirements can be determined. These transportation requirements can be checked by each service's transportability command to insure the system's parameters fit within the requirements of the theater to which they will be transported. After all, we do not want to build a tank to operate in the European theater that is too wide to fit through local railway tunnels when being transported.

Phase II and Phase III Life Cycle Applications

These phases (Engineering and Manufacturing Development, Production, Fielding/Deployment, and Operational Support) usually allow less design influence from a logistics standpoint, but provide detailed information concerning such things as preventive and corrective maintenance actions and the required spares and support equipment.

The Maintenance Planning summaries can be used to review contractor specified maintenance actions and ensure they are aligned with the maintenance concept. These summaries could also be used as a preliminary check in the development of technical publications.

Repair Analysis summaries can be used to identify the optimal support structure and assist in development of SMR codes and maintenance products. They are also applicable to fielded systems as an analysis tool when:

- a major increase or decrease in an item's cost or failure rate occurs.
- an engineering change proposal is submitted.
- a change from total contractor support to organic support is under consideration.
- fielded system review is scheduled.

Supply Support summaries can be used as preliminary checkpoints before data is loaded into the required provisioning system, or they can serve as the actual deliverable product. Obviously, Supply Support type summaries are applicable to fielded systems when an engineering change proposal is submitted; or a change from contractor support to organic support is being considered; or as part of a scheduled fielded system review.

Support and Test Equipment summaries can provide data necessary to register, or verify the registry of, the support or test equipment in the government's inventory.

Manpower, Personnel, and Training summaries can be used to verify that manpower and skill level requirements or thresholds are being met. Also, these summaries could be used to identify new or modified skill level requirements when hardware or manpower analysis and training requirements analysis are performed.

Special PHS&T instructions should be detailed in PHS&T type summaries during Phase II and identify critical requirements prior to initial provisioning and fielding, especially the handling of hazardous materials.

Post Production Support reports are initiated in Phase II and continue in Phase III. This summary should focus on items which may cause support difficulties over the remaining life of the system. These difficulties may be due to inadequate sources of supply after production lines are shut down or vendors go out of business.

The following paragraphs describe general content and life cycle application for each summary. Contractor format is acceptable and encouraged. *Note: The following samples are general in nature and do not provide specific guidance*.

7.3.2 Maintenance Planning

Purpose and Content

These summaries provide maintenance planning information that may be used to develop initial fielding plans for the end item's support structure. These summaries may also be used to verify that the maintenance actions and support structure are aligned with the government's requirements and maintenance concept. The information contained within these summaries is associated against system components to the level of detail specified on contract. The repairable items should be identified within the hierarchy of the end item, broken down by an agreed upon configuration control method. The summaries may identify preventive and corrective maintenance actions and the required spares and support equipment. These summaries may also be used to provide supporting information that justifies the need for each maintenance action, for example, elapsed time of maintenance actions, task frequency, failure rate of an item, and mean time to repair an item. **Figure 7-2 presents a sample summary layout.**

MAINTENANCE PLANNING SUMMARY

SECTION I: GENERAL

Inspection/fault location to be accomplished by organizational maintenance, with follow-on inspection/fault location and replacement of door-screen and engine assemblies performed by intermediate support as well as the replacement of compressor and repair of all assemblies except the wire harness, which requires the attention of depot maintenance.

SECTION II: MAINTENANCE ACTIONS

ITEM NAME	ACTION	ESTIMATED TIME	MAINT LEVEL
engine	overhaul	4 hours	DEPOT
pistons	remove&relace	1.13 hours	INTERMED
plugs	remove&replace	.75 hours	INTERMED
radio	fault locate	.25 hours	ORG

Figure 7-2. Sample Maintenance Planning Summary

Engineering and logistics functional elements must coordinate and interface to maximize the usage of the data developed by each program element. Effective coordination can eliminate costly duplications of effort. The precursor to maintenance planning information is RAM data. The following excerpt from DoD 5000.2-R, paragraph 4.3.6, reveals this link, *"Reliability requirements shall address both mission reliability and logistic reliability. Maintainability requirements shall address servicing, preventive, and corrective maintenance."*

A maintenance planning summary may include supporting information from the RAM community that justifies the need for each maintenance action (e.g., failure modes, etc.). Other reliability and maintainability data that could also be incorporated includes, but is not limited to: task frequency, failure rate of an item or mean time between failure, mean time to repair an item, mean time between maintenance actions, mean time between removals, and operational availability (A_o).

7.3.3 Repair Analysis

Purpose and Content

These reports summarize the conclusions and recommendations of the repair level analysis. The government may verify the conclusions and recommendations by using contractor's inputs to perform an in-house analysis. These summaries may also be used by the government to develop initial fielding plans for the end item's support structure. The conclusions may include actions and recommendations for influencing the system design; and a list of which items should be repaired and which should be discarded. These summaries may identify for each item being repaired the level of maintenance at which the repair should be performed and the associated costs. They may identify, for the system support structure, the operational readiness achieved and the placement and allocation of spares, support equipment, and personnel.

These summaries may also include supporting information for the analysis performed. For example:

- a list of the input data (e.g., failure rates, repair times, etc.) and their corresponding values
- sources of the data
- operational scenario modeled
- assumptions made
- constraints (i.e., non-economic factors) imposed on the system
- maintenance alternatives considered (i.e., use of support equipment/personnel, BIT/BITE, and supply and maintenance facilities)
- the analytical method or model used to perform the economic evaluations
- discussion of the sensitivity evaluations performed and results obtained

Input data for maintenance repair analysis can come from logistics management information files; other systems engineering analyses or programs (e.g., transportation analysis, safety assessment, reliability, availability and maintainability); and historical data bases for similar systems.

Economic evaluations may consider cost factors (e.g., spare parts, transportation, inventories, labor, and training) and performance factors (e.g., mean time to repair, operational availability, and mean time between failures). Non-economic evaluations may consider preemptive factors (e.g., safety, vulnerability, mobility, policy, and manpower) that restrict or constrain the maintenance level where repair or discard can be performed.

Sensitivity evaluations should be conducted to assess how variations in input parameters affect the baseline maintenance concept and associated risks. Two significant areas that may be assessed during sensitivity evaluations are changes in repair level assignments for an item and total life cycle cost. **Figure 7-3 presents a sample summary layout.**

REPAIR ANALYSIS SUMMARY

SUMMARY: Analysis was performed based upon planned fielding to all 46 sites currently employing the Autonomous Robotics System (ARS) as well as the 23 sites where fielding is planned. The IPCS will replace existing PCSs at the current sites and will be fielded with the ARS at the other 23. As the ARS Test Set has already been developed, fielded to the existing sites, and programmed for the other sites, its cost was considered sunk. Development costs for the revised test program set have been included. Training costs have not been included, as no additional training requirements exist over current training program. No additional equipment costs are foreseen for the contact team. Annual operating time of 2400 hours per system was considered, per existing ARS specification.

ITEM	Remove/Replace	Repair	Dispose
IPCS	**n/a**	**USER**	**n/a**
CONTROL UNIT	**USER**	**ORG**	**DEPOT**
KEYBOARD	**ORG**	**TOSS[1]**	**CONTACT TEAM**
INTERFACE UNIT	**ORG**	**CONTACT TEAM**	**DEPOT**
DISPLAY ASSY	**CONTACT TEAM**	**DEPOT**	**n/a**
DISPLAY	**DEPOT**	**DEPOT**	**DEPOT**
CABINET	**DEPOT**	**DEPOT**	**DEPOT**
CCA	**DEPOT**	**MANUFACTURER**	**n/a**
CPU	**ORG**	**CONTACT TEAM**	**DEPOT**
POWER SUPPLY	**CONTACT TEAM**	**TOSS**	**CONTACT TEAM**
CCA Controller	**CONTACT TEAM**	**DEPOT**	**DEPOT**
CCA Memory	**CONTACT TEAM**	**TOSS[2]**	**DEPOT**
ANTENNA ASSY	**n/a**	**n/a**	**n/a**
ANTENNA	**USER**	**n/a[3]**	**USER**
CABLE ASSY	**USER**	**CONTACT TEAM**	**CONTACT TEAM**
POWER ASSY	**n/a**	**USER**	**n/a**
BATTERY ASSY	**USER**	**n/a**	**DEPOT[4]**
CABLE ASSY	**USER**	**CONTACT TEAM**	**DEPOT**
AC/DC CONVERTER	**USER**	**TOSS**	**CONTACT TEAM**

NOTES:

[1] While most repairs by removing and replacing components is not cost effective, a general cleaning in the contact shelter with existing ARS equipment may return some items to service.

[2] Although the capability exists to replace blown memory chips and the overall support costs are slightly lower than the toss option (see page 3 for cost comparison matrix), the low failure rate of the card (see input values beginning on page 6) together with the rapidly expanding capabilities of the technology lead us to recommend tossing the memory cards. [3] No analysis of antenna was performed, as is simply not repairable.

[4] Disposal at depot is selected not based upon economics but rather on environmental laws and concerns. This decision was documented during the Critical Design Review and the information is simply presented here to be all inclusive of the system.

Assumptions and Sensitivities:

1. No estimates of failure rates were available from the manufacturer of the display CCA. While the new CCA is marketed as far more reliable, the value of the old CCA was used. Sensitivity analysis performed using values from 75% to 150% showed no change in maintenance policy.

Figure 7-3. Sample Repair Analysis Summary

7.3.4 Support and Test Equipment

Purpose and Content

These reports provide data necessary to register, or verify the registry of, the support or test equipment in the government's inventory. They may provide technical parameters, give details of the test measurement and diagnostic equipment (TMDE) calibration procedures, and list any piece of Category III support equipment needed to maintain the required system's support equipment.

The information contained within these summaries is normally associated with the reference number and CAGE of the support equipment. **Figure 7-4 presents a sample summary layout.**

SUPPORT AND TEST EQUIPMENT SUMMARY

SECTION I - TECHNICAL DESCRIPTION

SE Reference Number	CAGE	Item Name
5D43-139-A	10855	Compressor, Ring

Description And Function Of Support Equipment:
A band type sleeve with a mechanical leverage mechanism to facilitate easy reduction of ring radii.

Depth	Width	Height	UM	Weight	UM
4.0	5.0	5.0	In	3.5	Lb

Skill Specialty Code For SE	TMDE RAM Characteristics MTBF	MTTR	Cal Time	NSN and Related Data	Unit Cost
52C20	300 hrs	50 hrs	1 min	5820-003478650	75.75

SECTION II - Unit Under Test Requirements

Supported IPC	Item Name	Characteristics Measured/Stimulus Required I/O Parameter	Range From	Range To
005	Internal Compressor	Diameter In.	32	45
		Diameter	32	42

Figure 7-4. Sample Support and Test Equipment Summary

7.3.5 Supply Support

Purpose and Content

Information provided in these summaries details the static and application-related hardware information used to determine initial requirements and cataloging of support items to be procured through the provisioning process. These summaries may include identification of the system breakdown, design change information, maintenance coding, overhaul rates, roll up quantities, maintenance replacement factors, and associated technical manuals.

These summaries may show information on different categories of provisioning items, such as long lead time items, bulk items, tools and test equipment, etc. They may also allow for review of PLISN assignment or cross referencing PLISNs with reference numbers. **Figure 7-5 presents a sample summary layout.**

SUPPLY SUPPORT SUMMARY

CAGE	REFERENCE NUMBER	NSN	PCCN	PLISN	ITEM NAME	UI	QPEI	SMR
97384	59822-90082-30	6130-01-279-3436	1BGL0	A003	power supply	ea	5	PAHZZ
97384	59822-90086-20		1BGL0	A004	programmer	ea	2	PAHHD
97384	59822-90086-30	5998-01-293-2774	1BGL0	A005	circuit card assembly	ea	5	PAHZZ
97384	59822-90119-21	5998-01-268-8589	1BGL0	A006	circuit card assembly	ea	8	PAHZZ
97384	59822-90119-211		1BGL0	A007	microcircuit	ea	25	PAHZZ
97384	63603-40140-20		1BGL0	A002	cabinet console	ea	1	XBHHD
97384	63603-46200-10		1BGL0	A001	test station	ea	1	PEHHD

Figure 7-5. Sample Supply Support Summary

7.3.6 Manpower, Personnel, and Training

Purpose and Content

The purpose of these summaries is to provide information to the government so it can establish training plans and ensure manpower and personnel constraints are met. Downsizing in the services causes an even greater concern in the area of human systems integration. As DoD 5000.2-R states in paragraph 4.3.8, "*A comprehensive management and technical strategy for human systems integration shall be initiated early in the acquisition process to ensure that: human performance; the burden the design imposes on manpower, personnel, and training (MPT); and safety and health aspects are considered throughout the system design and development processes*." These summaries may identify personnel skills required to perform maintenance tasks, any training required for these tasks to be performed, and manpower estimates by maintenance level. **Figure 7-6 presents a sample summary layout.**

MANPOWER, PERSONNEL AND TRAINING SUMMARY

SECTION I - MANPOWER AND PERSONNEL SUMMARY

SSC	MAINTENANCE LEVEL	REQUIRED MAN-HOURS
35B20	OPER/CREW (C)	100.00
35B30	INT/DS/AVIM (F)	100.00
44E10	INT/DS/AVIM (F)	0.00
52C10	ORG/ON EQP (O)	25.00
52C20	ORG/ON EQP (O)	600.00
	INT/DS/AVIM (F)	1200.00
76J10	OPER/CREW (C)	50.00

SECTION II - NEW OR MODIFIED SKILL AND TRAINING REQUIREMENTS

ORIGINAL SSC	NEW/MOD SSC	DUTY POSITION REQUIRING NEW/MOD SKILL	RECOMMENDED RANK/RATE/GRADE MIL RANK CIVIL GRADE
52C10	52C20		

NEW OR MODIFIED SKILL REQUIREMENTS:

EDUCATIONAL QUALIFICATIONS:

ADDITIONAL TRAINING REQUIREMENTS:

Figure 7-6. Sample Manpower, Personnel, and Training Summary

7.3.7 Facilities

Purpose and Content

The purpose of these summaries is to identify the facilities required to maintain, operate, and test an item and train personnel in its use. The facilities may be test facilities, organizational, intermediate, or depot-level maintenance facilities, training facilities, or mobile facilities. These summaries can help plan for any modification to an existing facility or development of a new facility.

Other information normally contained in these summaries includes, but is not limited to, items to be repaired (identified by CAGE and Reference Number) at a facility, and any new training requirements for a facility. Data provided must be in compliance with all DoD and national health, life, and environmental codes. **Figure 7-7 presents a sample summary layout.**

FACILITIES SUMMARY

FACILITY NAME	FACILITY CLASS	AREA
Redstone Army Depot	Missile Repair Facility	15000 sq. ft.

ITEM NAME	MAINTENANCE ACTION
Wire Harness	test wire harness assembly repair wire harness assembly
Engine	repair engine assembly

1. **FACILITY LOCATION:**
   Redstone Arsenal, Huntsville, Alabama, Building 3441, Bay A.
2. **FACILITIES REQUIREMENTS FOR OPERATIONS:**
   Must rewire bay for forty 120 volts P/S spaced evenly along the walls.
3. **FACILITIES REQUIREMENTS FOR TRAINING:**
   2 work areas should be set aside for training
4. **FACILITY INSTALLATION LEAD TIME:**
   2 years

Figure 7-7. Sample Facilities Summary

7.3.8 Packaging, Handling, Storage, and Transportation (PHS&T)

Purpose and Content

These summaries identify packaging, handling, and storage information. They also may provide information relevant to the development of a transportability analysis report. These summaries normally should contain information such as the dimensions and weight of an item, the degree of packaging, and any special packaging, handling, or storage instructions. The transportability information should include the dimensions and weight of an item, the different modes of transportation, any special tiedown or loading instructions, and other similar information. **Figure 7-8 presents a sample summary layout.**

PACKAGING, HANDLING, STORAGE, AND TRANSPORTATION SUMMARY

SECTION I - PACKAGING, HANDLING AND STORAGE

CAGE	REFERENCE NUMBER	NAT STOCK NUMBER	ITEM NAME
10855	AA06BR200	2803-00-378-2804	engine

UI	WEIGHT	UM	LENGTH	WIDTH	HEIGHT	UM
EA	345	LB	3.0	2.0	3.5	FT

DOP	QUP	PKG-CAT	PRES MATL	WRAP MATL	CUSH MATL	UNIT CONT	SPEC MKG
B	001	8080	00	--	0 0	WR	99

SECTION II - TRANSPORT

MILITARY UNIT MODES OF TRANSPORT: This unit will be transported by a ground transportation company; fixed wing C-130, C-141, and C-5 units; helicopters CH-47 and CH-53 units. This unit will be used by different armored divisions.

SHIPPING WEIGHT EMPTY	SHIPPING WEIGHT LOADED	CREST ANGLE	FRONT IN	FRONT OUT	REAR IN	REAR OUT
346 lbs	346 lbs	N/A	N/A	105.8	N/A	N/A

LIFTING AND TIEDOWN REMARKS: The engine meets the minimum strength requirements for lifting and tiedown provisions. When final configuration of the engine installed is established, all lifting and tiedown provisions will have to be reevaluated.

Sample

Figure 7-8 Sample Packaging, Handling, Storage, and Transportation Summary

7.3.9 Post Production Support

Purpose and Content

These summaries are used to analyze life cycle support requirements of a system or equipment before production lines are closed to ensure supportability over the system or equipment's remaining life. These summaries identify items within the system that will present potential problems due to inadequate sources of supply, or modification after shutdown of production lines. They also may identify alternative solutions for anticipated support difficulties during the remaining life of the system or equipment.

General topics that may be addressed in this summary include, but are not limited to, manufacturing, repair centers, data modifications, supply management, configuration management, and other related areas. **Figure 7-9 presents a sample summary layout**.

Post Production Support Summary

Section I - Potential Problem Items

CAGE	REF. NUMBER	NSN	PCCN	PLISN	ITEM NAME	SMR
97384	59822-40310-20		P1BGK0	D265	analyzer, frequency	PAHHD
97384	59822-47021	5998-01-415-5833	P1BGK0	A714	circuit card assembly	PAHHD
97384	59822-90086-121	6130-01-415-7156	P1BGK0	B867	power supply	PAHDD
97384	63603-40001-20		P1BGK0	B436	controller	PAHDD
97384	63603-90023		P1BGK0	A251	disk drive unit	PAHZZ

Section II - Alternative Solutions

CAGE	REFERENCE NUMBER	ALTERNATIVES	COST

Sample

Figure 7-9. Sample Post Production Support Summary

7.4 EXPLANATION OF LMI DATA PRODUCTS

The LMI individual data products are organized alphabetically in Appendix B of the LMI specification. Appendix B contains definitions and format criteria for each of the data products. Specific data products needed for delivery may be specified by the requiring authority on the data product worksheets (Worksheet 2, Figure 2, in Appendix B of the LMI specification). The hollow data item descriptions (DID), DI-ALSS-81529 (Data Products) and DI-ALSS-81530 (LMI Summaries) can be used to contract for one or more data products. If multiple data product deliverables are required at different times, this DID can be called out multiple times. For example, a requiring authority may want a Long Lead Time Items List (LLTIL) and another provisioning list which is not required as early as the LLTIL.

Data required from Appendix B of the LMI specification should ultimately populate internal government data processing systems necessary for item fielding and sustainment. Alternative methods for delivering this data to its final destination are strongly encouraged and should be considered by the requiring authority.

7.4.1 Life Cycle Application of LMI Data

Logistic support resource needs associated with proposed systems, such as those depicted by LMI data, must be identified and refined as the system progresses through its development. The extent of the identification depends upon the type of acquisition (e.g., NDI, commercial, new start, etc.), the maintenance concept (e.g., full organic, interim contractor support, lifetime contractor support), the complexity of the system, and the phase of the acquisition cycle. As development progresses and the basic design and operational characteristics are established, this identification becomes a process of analyzing specific design and operational data to identify detailed logistics support needs more completely. This analysis can be very costly and involve the development of a considerable amount of data. In determining the timing and scope of this analysis and the corresponding data, consider the following points:

1. Early identification of logistics support resources should be limited to new or critical requirements.
2. Logistics support resource requirements for different system alternatives should only be identified to the level required for evaluation and tradeoff of the alternatives.
3. Logistics support resources must be identified in a time frame which considers the schedule of developing required documentation (e.g.,

RPSTL, SERD) or completing a required action (e.g., initial provisioning).

4. Different levels of data documentation can be applied to the identification of logistics support resource needs. For example, early in a program, supply support needs can be identified through documentation of only a few data products (e.g., Reference Number, CAGE, Item Name, PCCN, and Usable On Code); later the total range of data products required to accomplish initial provisioning can be documented.
5. Detailed input data for identification of logistics support resource needs is generated by other systems engineering functions; for example, RAM failure rates drive the calculation of the provisioning Maintenance Replacement Rates. Therefore, analysis, documentation requirements, and timing must be coordinated between the systems engineering programs to avoid duplication of effort and to assure availability of required input data.

7.5 LMI WORKSHEETS: HOW TO USE THEM

The LMI worksheets can be used to specify information for LMI summaries identified in Appendix A of the specification and to select data products identified in Appendix B. The worksheet for the LMI summaries is Worksheet 1, Figure 1, located in Appendix A of the specification. The worksheet for the data products is Worksheet 2, Figure 2, in Appendix B. These worksheets do not have to be used. The requiring authority may have other means which may be simpler and more efficient. However, if these worksheets are used, the following paragraphs provide detailed information on how to fill them out.

7.5.1 LMI Summaries

Eight functional summaries are identified in Appendix A of the LMI specification. These summary write-ups are neither all inclusive or exclusive and are intentionally described in general terms to encourage maximum flexibility. Project offices should tailor these summaries to fit their information needs.

Any timing issues, specific level-of-detail guidance, or other information regarding a given summary should be documented in the *Specific Instructions* section of Worksheet 1. The *Specific Instructions* area allows the requiring authority to add program-specific needs or give general information regarding the summary.

Data content for each summary must be identified either in Worksheet 1, Figure 1, Appendix A, or in some other way, and put in the contract. Remember that the content of a summary is **not** limited to information identified in the LMI specification, Appendix A narratives, or Appendix B data products. If data located in Appendix B of the LMI specification is wanted in a summary, Worksheet 1 contains a place where that data is to be identified.

If data not contained in Appendix B is specified as part of one of these summaries, a definition and format for that data must be provided in the contract. Worksheet 1 provides a place for such data. The definition and format for a data product may have been identified in another document (commercial or military). If so, that document should be referenced for the appropriate definition and format. Furthermore, the systems engineering area utilizing the given document should be contacted to ensure that the same data is not already being bought.

The last part of Worksheet 1 can be used to identify whether a government provided layout for the summary will be used, or whether contractor format is acceptable. If the *Government Provided* block is checked, a specific summary layout must be provided, either as an attachment to Worksheet 1 or by some other method that can be put in the contract.

Remember, however, that although the government may dictate a specific layout for a report, allowing the contractor to propose a layout containing the necessary information and then modifying that layout as necessary is likely to be a more cost effective approach.

Following are two examples for using Worksheet 1 to obtain LMI Maintenance Planning summaries. The first example (Figure 7-10) is a simplified example that relies on the contractor to develop the layout (see Figure 7-2 for a possible summary view). The second example (Figure 7-11, Part 1 and Part 2) is more complicated. It reveals the information that is necessary if the summary layout is to be provided by the government. Note that this example shows that the more complex a summary request is, the more work is required of the requiring authority.

SUMMARY TITLE: Maintenance Planning

SPECIFIC INSTRUCTIONS: Identify the general maintenance planning philosophy and any maintenance actions that are known, including the estimated times and maintenance level at which they will be performed.

DATA **IN LMI** SPECIFICATION (Please provide the data product title):

_Item Name - 0480______

DATA **NOT IN LMI** SPECIFICATION (Please provide the data product title, its definition and its format):

General Maintenance Planning (Narrative Field) - A description identifying the broad, planned approach to be employed in sustaining the system/equipment.

Maintenance Action (Narrative Field) - A short description identifying the required action to be taken against the specified item (e.g., fault locate, repair, remove&replace, etc.)

Estimated Time (Numeric Field) - Best engineering estimate of time (in hours, decimals allowed) it will take to perform the given maintenance action.

Maintenance Level (Narrative Field) - Identifies the level of maintenance (e.g., Organizational, Intermediate, Depot, etc.) at which the maintenance action will be done.

SUMMARY LAYOUT (if applicable): Government Provided __ Contractor Provided xx

Figure 7-10. Example 1 of LMI Worksheet 1

SUMMARY TITLE: Maintenance Planning

SPECIFIC INSTRUCTIONS: Identify the general maintenance planning philosophy and any maintenance actions that are known, including the estimated times and maintenance level at which they will be performed. Maintenance actions should be broken down into Preventive and Corrective actions. Known support requirements per action shall be identified also. See attachment (following page) for specific summary layout to use.

DATA **IN LMI** SPECIFICATION (Please provide the data product title):
Item Name - 0480________ ____________________________ _______________________
Functional Group Code-0330 ____________________________ _______________________
CAGE - 0140______________ ____________________________ _______________________
Reference Number - 1050_ ____________________________ _______________________

DATA **NOT IN LMI** SPECIFICATION (Please provide the data product title, its definition and format):
General Maintenance Planning (Narrative Field) - A description identifying the broad, planned approach to be employed in sustaining the system/equipment.

Maintenance Planning Rationale (Narrative Field) - A description identifying any background information leading up to the general maintenance plan.

Maintenance Action (Narrative Field) - A short description identifying the required action to be taken against the specified item (e.g., fault locate, repair, remove&replace, etc.)

Estimated Time (Numeric Field) - Best engineering estimate of time (in hours, decimals allowed) it will take to perform the given maintenance action.

Maintenance Level (Narrative Field) - Identifies the level of maintenance (e.g., Organizational, Intermediate, Depot, etc.) at which the maintenance action will be done.

Quantity Per Action: Quantity of a given support item required on-hand to fulfill the intended maintenance action.

SUMMARY LAYOUT (if applicable): Government Provided xx Contractor Provided __

Figure 7-11, Part 1. Example 2 of LMI Worksheet 1

MAINTENANCE PLANNING SUMMARY

GENERAL PLAN:

RATIONALE:

PREVENTIVE MAINTENANCE REQUIREMENTS SUMMARY

FGC	ACTION	ESTIMATED TIME	MAINTENANCE LEVEL

CORRECTIVE MAINTENANCE REQUIREMENTS SUMMARY

FGC	ACTION	ESTIMATED TIME	MAINTENANCE LEVEL

RESOURCE REQUIREMENTS

FGC ACTION REQUIREMENTS FOR SUPPORT ITEMS:
ITEM NAME QTY/ACTION REFERENCE NUMBER CAGE

FGC ACTION REQUIREMENTS FOR SUPPORT ITEMS:
ITEM NAME QTY/ACTION REFERENCE NUMBER CAGE

Figure 7-11, Part 2. Attachment - Maintenance Planning Summary Layout

7.5.2 LMI Data Products

There are 159 data products identified in Appendix B of the LMI specification. A requiring authority may select one or more of these data products as a product deliverable using Worksheet 2 (Appendix B of the LMI specification). If multiple data product deliverables are required at different times, these worksheets can be used multiple times. For example, the requiring authority may want to use the worksheets to get data for a Long Lead Time Items List (LLTIL) and fill out the worksheets again to get data for some other provisioning list which is not required as early as the LLTIL.

The first page of Worksheet 2 includes a place to specify a specific data product deliverable (e.g., LLTIL) and *Select* codes with *Select Explanations* that can be applied on the worksheets for each data product. The remaining pages of Worksheet 2 provide an alphabetized list of the 159 data products and any associated names for a given data product that is subordinate to it. A user can select the basic data product, an associated name to the basic data product, or both. To the right of the data products are two columns:

- *Select* column - Select codes from the first page can be applied
- *Additional Information* - a general information section

Different *Select* codes can be applied to different data products. The user can select one data product for all items, another data product only for commercial items, and yet another data product only for support equipment. If necessary, the requiring authority can use the blank lines provided on the first page of Worksheet 2 to define program specific selection needs.

Use the *Additional Information* column to further clarify any documentation requirements required for a given data product. This clarification may include “level of detail” information (*Select* codes provide similar information). The level of detail should correspond to the government’s data needs based on the type of acquisition, life cycle phase, and the degree of program control desired by the program manager. Use this column to specify that a particular data product should be delivered as part of list, such as an LLTIL. Use it to address when data product(s) should be delivered (e.g., 90 days after start of work, or 30 days prior to Milestone II Review, etc.). Basically, this column can be utilized any way the requiring authority wants.

The following pages contain an example for utilizing Worksheet 2 to obtain LMI data products. This example (Figure 7-12) shows how to get data specifically for a LLTIL.

.
____
*   *
* DATA PRODUCT DELIVERABLE:_Long Lead Time Items List_________________________   *
*____   *
*   *
* This worksheet is used to select data deemed necessary by the government.   *
* Data should be used to feed down stream government process.   *
*   *
* SELECT   EXPLANATION   *
*   X   Data product required on all items   *
*   *
*   A   As applicable   *
*   *
*   T   Registered Support Equipment Only   *
*   *
*   U   Non-Registered Support Equipment Only   *
*   *
*   R   Repairables only   *
*   *
*   P   All “P” source code items   *
*   *
*   N   New “P” source code items   *
*   *
*   Y   National Stock Number items   *
*   *
*   O   “Ref” items only   *
*   *
*   F   First appearance items only   *
*   *
*   C   Commercial items   *
*   *
*   I   NDI items   *
*   *
*   D   Developmental items   *
*   *
*   L   LRU/WRA items   *
*   *
*   S   SRA/SRU items   *
*   *
*   M   Packaging, Common items   *
*   *
*   B   Packaging, Bulk items   *
*   *
*   E   Support Equipment   *
*   *
* NOTE: Other codes may be assigned by the program office as identified below.   *
* Program specific selections and explanations.   *
*   *
*_K__   _Long Lead Time Items Only_______________________________________   *
*   *
* ____   ____   *
*   *
* ____   ____   *
*   *
*____   *

Figure 7-12, Using Worksheet 2

DATA PRODUCT TITLE	SELECT	ADDITIONAL INFORMATION
ALLOWANCE ITEM CODE (AIC)		
ALLOWANCE ITEM QUANTITY		
ALTERNATE INDENTURED PRODUCT CODE (AIPC)		
ALTERNATE IPC - UUT		
AUTOMATIC DATA PROCESSING EQUIPMENT CODE		
BASIS OF ISSUE (BOI)		
QUANTITY AUTHORIZED (QTY-AUTH)		
END ITEM		
LEVEL		
CONTROL		
CALIBRATION AND MEASUREMENT REQUIREMENTS SUMMARY RECOMMENDED		
CALIBRATION INTERVAL		
CALIBRATION ITEM		
CALIBRATION PROCEDURE		
CALIBRATION REQUIRED		
CALIBRATION TIME		
CHANGE AUTHORITY NUMBER		
CLEANING AND DRYING PROCEDURE		
COMMERCIAL AND GOVERNMENT ENTITY (CAGE) CODE	K	
CAGE CODE - ADAPTER INTERCONNECTOR DEVICE		
CAGE CODE - ARN		
CAGE CODE - ARN ITEM		
CAGE CODE - ARTICLES REQUIRING SUPPORT		
CAGE CODE - ATE		
CAGE CODE - CATEGORY III SE		
CAGE CODE - CTIC		
CAGE CODE - PACKAGING DATA PREPARER		
CAGE CODE - SUPPORT EQUIPMENT		
CAGE CODE - TEST PROGRAM SET		
CAGE CODE - UUT		

CONTRACTOR FURNISHED EQUIPMENT/ GOVERNMENT FURNISHED EQUIPMENT (CFE/GFE)		
CONTRACTOR RECOMMENDED		
CONTRACTOR RECOMMENDED - DDCC		
CONTRACTOR RECOMMENDED - IRCC		
CONTRACTOR TECHNICAL INFORMATION CODE (CTIC)		
CONTROLLED INVENTORY ITEM CODE		
CRITICALITY CODE		
CUSHIONING AND DUNNAGE MATERIAL CODE		
CUSHIONING THICKNESS		
DEGREE OF PROTECTION CODE		
DEMILITARIZATION CODE (DMIL)		
DESCRIPTION/FUNCTION AND CHARACTERISTICS OF SUPPORT EQUIPMENT		
DESIGN DATA CATEGORY CODE		
DESIGN DATA PRICE		
END ITEM ACRONYM CODE (EIAC)		
ESSENTIALITY CODE		
ESTIMATED PRICE		
ESTIMATED PRICE - DDCC		
ESTIMATED PRICE - IRCC		
FIGURE NUMBER		
FRAGILITY FACTOR		
FUNCTIONAL ANALYSIS		
FUNCTIONAL GROUP CODE		
HARDNESS CRITICAL ITEM (HCI)		
HARDWARE DEVELOPMENT PRICE		
HAZARDOUS CODE		
INDENTURE CODE		
ATTACHING PART/HARDWARE		
OPTION 1		
OPTION 2		
OPTION 3		

OPTION 4		
OPTION 5		
INDENTURE FOR KITS		
OPTION 1		
OPTION 2		
OPTION 3		
INDENTURE CODE - IPC		
INDENTURED PRODUCT CODE (IPC)		
INDENTURED PRODUCT CODE (IPC) - UUT		
INPUT POWER SOURCE		
OPERATING RANGE - MINIMUM		
OPERATING RANGE - MAXIMUM		
ALTERNATING CURRENT/DIRECT CURRENT		
FREQUENCY RANGE - MINIMUM		
FREQUENCY RANGE - MAXIMUM		
PHASE		
WATTS		
PERCENT MAXIMUM RIPPLE		
INSTALLATION FACTORS OR OTHER FACILITIES		
INTEGRATED LOGISTIC SUPPORT PRICE		
INTEGRATED LOGISTIC SUPPORT REQUIREMENTS CATEGORY CODE		
INTERCHANGEABILITY CODE		
INTERMEDIATE CONTAINER CODE		
INTERMEDIATE CONTAINER QUANTITY		
ITEM CATEGORY CODE (ICC)		
ITEM DESIGNATOR CODE		
ITEM DESIGNATOR - END ARTICLE		
ITEM DESIGNATOR - GOVERNMENT		
ITEM NAME	K	
ITEM NAME - ARTICLE REQUIRING SUPPORT		
ITEM NAME - SE		
ITEM NAME CODE		
ITEM NUMBER		

JULIAN DATE - SPI NUMBER		
LINE REPLACEABLE UNIT (LRU)		
LOT QUANTITY		
FROM		
TO		
MAINTENANCE ACTION CODE (MAC)		
MAINTENANCE REPLACEMENT FACTOR (MRF)	K	
MRF - DEPOT LEVEL REPAIRABLES		
MRF - FIELD LEVEL REPAIRABLES		
MRF - CONSUMABLES		
MAINTENANCE REPLACEMENT RATE I (MRRI)		
MAINTENANCE REPLACEMENT RATE II (MRRII)		
OPTION 1		
OPTION 2		
MAINTENANCE TASK DISTRIBUTION	K	
MATERIAL	K	Provide if cause of long lead time
MATERIAL LEADTIME	K	Provide for "Materiel" identified
MATERIAL WEIGHT		
MAXIMUM ALLOWABLE OPERATING TIME (MAOT)		
MEAN TIME BETWEEN FAILURES (MTBF)		
MEAN TIME BETWEEN FAILURES (MTBF) - SUPPORT EQUIPMENT		
MEAN TIME TO REPAIR (MTTR)		
MEAN TIME TO REPAIR (MTTR) - SE		
MEASUREMENT BASE (MB)		
MEASUREMENT BASE - MEAN TIME BETWEEN FAILURES		
MEASUREMENT BASE - MEAN TIME BETWEEN FAILURES - SUPPORT EQUIPMENT		
MEASUREMENT BASE - WEAROUT LIFE		
METHOD OF PRESERVATION		
MOBILE FACILITY CODE		
NATIONAL STOCK NUMBER - CONTAINER		
FEDERAL SUPPLY CLASSIFICATION		
NATIONAL ITEM IDENTIFICATION NUMBER		

NATIONAL STOCK NUMBER AND RELATED DATA		
COGNIZANCE CODE		
MATERIEL CONTROL CODE		
FEDERAL SUPPLY CLASSIFICATION		
NATIONAL ITEM IDENTIFICATION NUMBER		
SPECIAL MATERIEL IDENTIFICATION CODE/ MATERIEL MANAGEMENT AGGREGATION CODE		
ACTIVITY CODE		
NEXT HIGHER ASSEMBLY PROVISIONING LIST ITEM SEQUENCE NUMBER (NHA PLISN)	K	
NEXT HIGHER ASSEMBLY PROVISIONING LIST ITEM SEQUENCE NUMBER INDICATOR (NHA IND)	K	
NOT REPARABLE THIS STATION (NRTS)		
OPERATOR'S MANUAL		
OPTIONAL PROCEDURE INDICATOR		
OVERHAUL REPLACEMENT RATE (ORR)	K	
PACKAGING CATEGORY CODE		
PACKING CODE		
PARAMETERS		
INPUT/OUTPUT CODE - CATEGORY III SE		
PARAMETER - CATEGORY III SE		
RANGE FROM - CATEGORY III SE		
RANGE TO - CATEGORY III SE		
ACCURACY - CATEGORY III SE		
RANGE/VALUE CODE - CATEGORY III SE		
INPUT/OUTPUT CODE - SUPPORT EQUIPMENT		
PARAMETER - SUPPORT EQUIPMENT		
RANGE FROM - SUPPORT EQUIPMENT		
RANGE TO - SUPPORT EQUIPMENT		
ACCURACY - SUPPORT EQUIPMENT		
RANGE/VALUE CODE - SUPPORT EQUIPMENT		
INPUT/OUTPUT CODE - UUT		
PARAMETER - UUT		
RANGE FROM - UUT		

RANGE TO - UUT		
ACCURACY - UUT		
RANGE/VALUE CODE - UUT		
OPERATIONAL/SPECIFICATION PARAMETER		
PASS THROUGH PRICE		
PRECIOUS METAL INDICATOR CODE (PMIC)		
PREPARING ACTIVITY		
PRESERVATION MATERIAL CODE		
PRIOR ITEM PROVISIONING LIST ITEM SEQUENCE NUMBER (PRIOR ITEM PLISN)		
PRODUCTION LEAD TIME (PLT)	K	
PROGRAM PARTS SELECTION LIST (PPSL)		
PRORATED EXHIBIT LINE ITEM NUMBER (PRORATED ELIN)		
PRORATED ELIN QUANTITY		
PROVISIONING CONTRACT CONTROL NUMBER (PCCN)	K	
PROVISIONING LIST CATEGORY CODE (PLCC)		
PROVISIONING LIST ITEM SEQUENCE NUMBER (PLISN)	K	
PROVISIONING NOMENCLATURE		
PROVISIONING PRICE CODE		
PROVISIONING REMARKS		
QUANTITY PER ASSEMBLY (QPA)		
OPTION 1	K	
OPTION 2		
OPTION 3		
QUANTITY PER ASSEMBLY/QUANTITY PER END ITEM INDICATOR		
QUANTITY PER END ITEM (QPEI)		
OPTION 1	K	
OPTION 2		
OPTION 3		
QUANTITY PER FIGURE		
QUANTITY PER TEST		

QUANTITY PER UNIT PACK		
QUANTITY PROCURED		
QUANTITY SHIPPED		
RECOMMENDED MINIMUM SYSTEM STOCK LEVEL		
RECURRING COST		
REFERENCE DESIGNATION		
OPTION 1		
OPTION 2		
OPTION 3		
OPTION 4		
OPTION 5		
REFERENCE DESIGNATION CODE (RDC)		
REFERENCE NUMBER	K	
REFERENCE NUMBER - AID		
REFERENCE NUMBER - ARN ITEM		
REFERENCE NUMBER - ARTICLES REQUIRING SUPPORT		
REFERENCE NUMBER - AUTOMATIC TEST EQUIPMENT		
REFERENCE NUMBER - CATEGORY III SE		
REFERENCE NUMBER - SUPPORT EQUIPMENT		
REFERENCE NUMBER - TPS		
REFERENCE NUMBER - UUT		
REFERENCE NUMBER (ARN) - ADDITIONAL		
REFERENCE NUMBER CATEGORY CODE (RNCC)		
REFERENCE NUMBER CATEGORY CODE - ARN		
REFERENCE NUMBER VARIATION CODE (RNVC)		
REFERENCE NUMBER VARIATION CODE - ARN		
REPAIR CYCLE TIME		
OPTION 1		
OPTION 2		
REPLACED OR SUPERSEDING PROVISIONING LIST ITEM SEQUENCE NUMBER		
REPLACED OR SUPERSEDING PROVISIONING LIST ITEM SEQUENCE NUMBER INDICATOR (RS/IND)		

REPLACEMENT TASK DISTRIBUTION		
REVISION		
REVISION - SERD		
REWORK REMOVAL RATE (RRR)		
ROTATABLE POOL FACTOR (RPF)		
SAME AS PROVISIONING LIST ITEM SEQUENCE NUMBER (SAME AS PLISN)		
SCOPE		
SCOPE - DDCC		
SCOPE - IRCC		
SERIAL NUMBER EFFECTIVITY		
SERIAL NUMBER EFFECTIVITY - FROM		
SERIAL NUMBER EFFECTIVITY - TO		
SERVICE DESIGNATOR CODE (SER)		
SERVICE DESIGNATOR CODE - SE		
SERVICE DESIGNATOR CODE - USING		
SHELF LIFE (SL)		
SHELF LIFE ACTION CODE (SLAC)		
SKILL SPECIALTY CODE FOR SUPPORT EQUIPMENT OPERATOR		
SOURCE, MAINTENANCE AND RECOVERABILITY (SMR) CODE	K	
SOURCE, MAINTENANCE AND RECOVERABILITY CODE - SE		
SPARES ACQUISITION INTEGRATED WITH PRODUCTION (SAIP)		
SPECIAL MAINTENANCE ITEM CODE (SMIC)		
SPECIAL MARKING CODE		
SPECIAL MATERIAL CONTENT CODE (SMCC)		
SPECIAL PACKAGING INSTRUCTION NUMBER		
SPECIAL PACKAGING INSTRUCTION (SPI) NUMBER REVISION		
SUPPLEMENTAL PACKAGING DATA		
SUPPORT EQUIPMENT DIMENSIONS		
SE DIMENSIONS OPERATING		

LENGTH		
WIDTH		
HEIGHT		
SE DIMENSIONS SHIPPING		
LENGTH		
WIDTH		
HEIGHT		
SE DIMENSIONS STORAGE		
LENGTH		
WIDTH		
HEIGHT		
SUPPORT EQUIPMENT EXPLANATION		
SUPPORT EQUIPMENT RECOMMENDATION DATA NUMBER (SERD NUMBER)		
SUPPORT EQUIPMENT RECOMMENDATION DATA REVISION/SUPERSEDURE REMARKS		
SUPPORT EQUIPMENT WEIGHT		
SUPPORT EQUIPMENT WEIGHT - OPERATING		
SUPPORT EQUIPMENT WEIGHT - SHIPPING		
SUPPORT EQUIPMENT WEIGHT - STORAGE		
TECHNICAL MANUAL CHANGE NUMBER (TM CHG)		
TECHNICAL MANUAL INDENTURE CODE (TM IND)		
TECHNICAL MANUAL NUMBER		
TEST ACCURACY RATIO (TAR)		
TEST ACCURACY RATIO - CATEGORY III SE		
TEST ACCURACY RATIO - UUT PARAMETER		
TOTAL ITEM CHANGES (TIC)		
TOTAL QUANTITY RECOMMENDED		
TYPE EQUIPMENT CODE		
TYPE OF CHANGE CODE (TOCC)		
TYPE OF PRICE CODE		
TYPE OF STORAGE CODE		
UNIT CONTAINER CODE		
UNIT CONTAINER LEVEL		

UNIT OF ISSUE (UI)	K	
UNIT OF ISSUE CONVERSION FACTOR (UI CONVERSION FACTOR)		
UNIT OF ISSUE/UNIT OF MEASURE CODE		
UNIT OF ISSUE/UNIT OF MEASURE PRICE (UI/UM PRICE)	K	
UNIT OF MEASURE (UM)		
UNIT OF MEASURE - SE DIMENSIONS OPERATING		
UNIT OF MEASURE - SE WEIGHT OPERATING		
UNIT OF MEASURE - SE DIMENSIONS STORAGE		
UNIT OF MEASURE - SE WEIGHT STORAGE		
UNIT OF MEASURE - SE DIMENSIONS SHIPPING		
UNIT OF MEASURE - SE WEIGHT SHIPPING		
UNIT PACK CUBE		
UNIT SIZE		
UNIT SIZE - LENGTH		
UNIT SIZE - WIDTH		
UNIT SIZE - HEIGHT		
UNIT SIZE - PACK LENGTH		
UNIT SIZE - PACK WIDTH		
UNIT SIZE - PACK DEPTH		
UNIT UNDER TEST EXPLANATION		
UNIT WEIGHT		
UNIT WEIGHT - PACK		
USABLE ON CODE (UOC)		
USABLE ON CODE - DESIGN CHANGE		
USABLE ON CODE - SUPPORT EQUIPMENT		
WEAROUT LIFE		
WORK UNIT CODE		

WORK UNIT CODE - ARTICLES REQUIRING SUPPORT		
WRAPPING MATERIAL		

7.6 ADDITIONAL INFORMATION

MIL-PRF-49506, November 11, 1996, *Logistics Management Information Performance Specification*

DoD 5000.2-R, March 15, 1996, *Mandatory Procedures for Major Defense Acquisition Programs (MDAPs) and Major Automated Information System (MAIS) Acquisition Programs*

MIL-STD-1840, *Automated Interchange of Technical Information*

MIL-STD-973, *Configuration Management*

Defense Acquisition Deskbook

Defense Federal Acquisition Regulation Supplement

Section 8: Logistic Considerations for Contracts

8.1 INTRODUCTION AND OVERVIEW OF UNIFORM CONTRACT FORMAT

Experience has shown us that properly prepared solicitations and contracts are key ingredients in the success of acquisition programs. Logistics considerations are a major consideration during research and development and during the acquisition process. They are, therefore, a large part of the solicitation and ultimately the contract. All personnel responsible for designing, developing, and acquiring systems must work together to ensure that logistics needs are adequately covered in contractual documents.

The term, “solicitation,” refers to the document that is used by the government to communicate its requirements to prospective contractors, to solicit proposals or quotations, or to unilaterally order or modify a contract. The Uniform Contract Format (UCF), outlined in Figure 8-1 below, is the format used in typical acquisition contracts to structure a solicitation, including logistics support for weapon systems. Support systems managers (SSMs), logistic elements managers (LEMs), and integrated product team (IPT) members must be thoroughly familiar with this format, and understand how the solicitation and its procedures assist them in completing the relevant sections of the UCF. SSMs, LEMs, and IPT members are involved in preparing Sections B, C, D, E, F, H, J, and L of the UCF when contracting for logistics efforts.

8.2 SYSTEM ACQUISITION

Solicitations are normally developed and issued at the beginning of each phase of the acquisition life cycle (Concept Exploration, Program Definition and Risk Reduction, Engineering and Manufacturing Development, and Production, Fielding/Deployment and Operational Support). These solicitations and the contracts that follow them are usually based on:

- the results of the previous phase,
- the present state of program development, and
- the acquisition strategy.

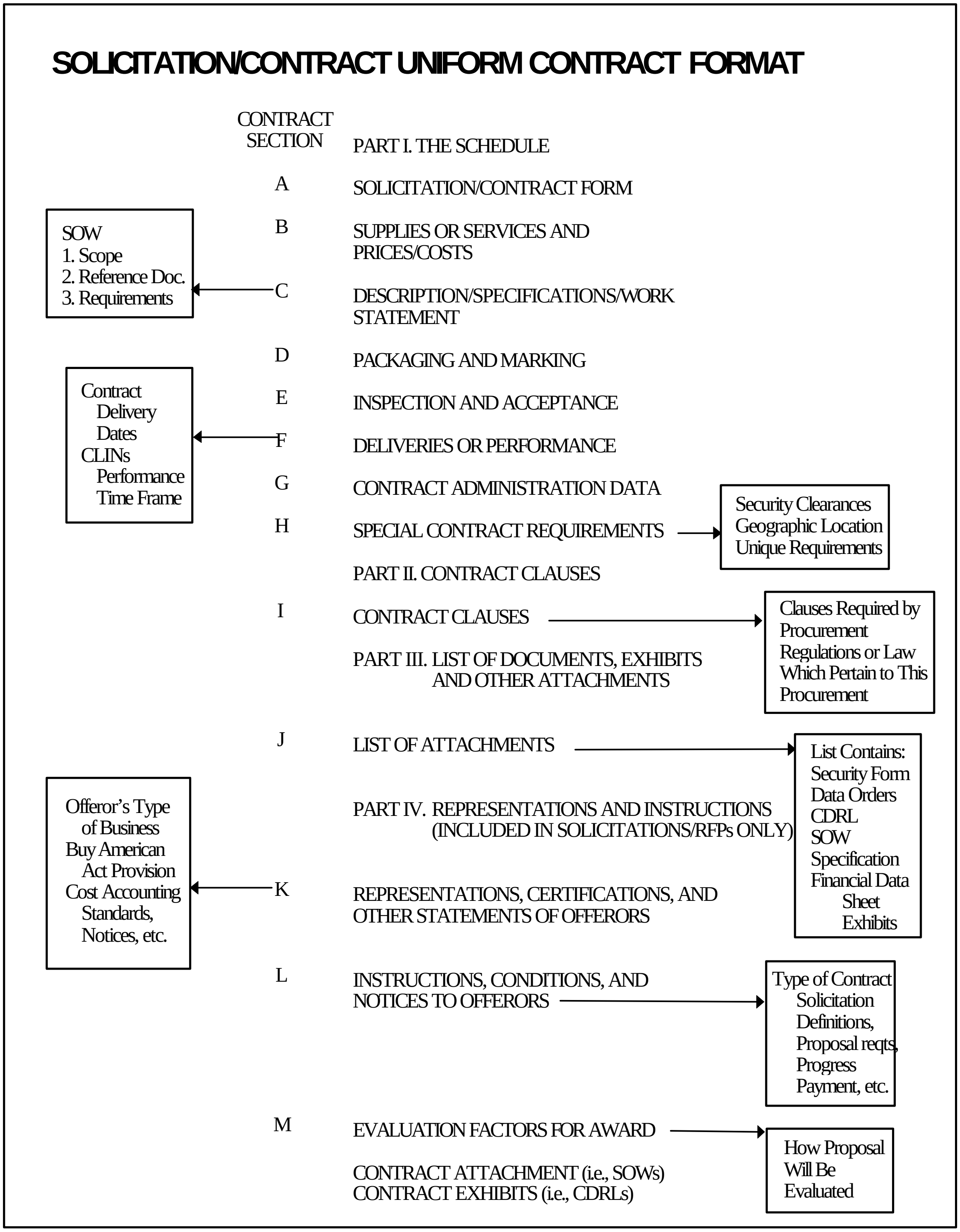

Figure 8-1. Uniform Contract Format Contents

While readiness and sustainability are primary objectives in the acquisition process, logistics needs, constraints, and activities vary from phase to phase. It is, therefore, necessary that the program manager consider supportability just as important as cost, schedule, and performance.

8.3 SOLICITATIONS AND CONTRACTS

Contracting Strategy and Business Strategy Guides for Logistics Support Input

The contracting strategy drives the selection of the specific requirements that are included in the contract. The business strategy is the specific acquisition approach for each element of support. These strategies determine the structure of Sections B, C, and H of the contract. The contracting and business strategies are translated into Section B by breaking down each strategy into requirements by year and by support element. Section B is organized by contract line item and contract year. The support system manager is responsible for ensuring that all essential requirements are included in the contract.

Since logistics needs are spread throughout the solicitation/contract, the acquisition logistician is concerned with the entire document. Figure 8-1 has shown the part and section format for a solicitation and contract as required by the Federal Acquisition Regulation. As supportability and logistics needs are defined, it is extremely important to keep the solicitation parts consistent. They must complement each other, and not contradict each other, to express requirements clearly to potential offerors and to establish enforceable contracts.

> One way to ensure the solicitation is not self contradictory is to compartmentalize the information. That is, do not put the same information in two places. That way you avoid situations where, during the review process, the information is changed in one part of the solicitation, but not in the other.

In the solicitation the objectives for logistics are to:

- Integrate logistics needs wherever support may be required.
- Identify, analyze, and resolve support deficiencies.
- Systematically identify and evaluate support system alternatives.
- Manage support acquisition throughout the contracting process.
- Develop a timely, effective support capability at an economical life cycle cost.

Remember that logistic implications must be addressed in nearly every section of the solicitation/contract. Figure 8-2 summarizes possible logistics content of each section.

LOGISTICS CONTENT OF EACH SECTION OF THE SOLICITATION OR CONTRACT

SECTION	EXAMPLE OF LOGISTICS INPUTS
A.	None
B.	All line items needed for completing required logistics deliverables by the end of the applicable acquisition phase, including option and warranty needs when applicable.
C.	1. Description (specifications), to the extent needed beyond the description of line items in Section B, of logistics end items.
	2. Work effort descriptions, considering life cycle costs, for use in statement of work translating / relating.
D.	All packaging and marking not included in Sections C.
E.	Any peculiar inspection and/or acceptance criteria applicable to the logistics line items in Section B.
F.	The desired or required time period when each logistics line item in Section B is to be delivered.
G.	Normally none, unless determined by contracting officer.
H.	1. Title and/or description and any special language needed for GFP and for controlling or incentivizing logistics, technical, cost, or schedule performance, including special design to cost, incentive, and warranty provisions.
	2. Specific paragraphs for use in any special provision for making sure logistics administration is accomplished.
I.	Normally none.
J.	1. The logistics portion of the preliminary contract work breakdown structure, including the interfaces among deliverable and non-deliverable logistics elements, and descriptions of each logistics element.
	2. Support related inputs to life-cycle-cost mathematical models.
	3. DID inputs for technical data or logistics management data needs, including configuration control data and integrated support plan.
	4. Planned or assumed concepts, ranges, schedules, etc., and inputs to assumptions.
	5. Support equipment exhibits.
	6. Provisioning requirements.
K.	Identify support related certification requirements.
L.	1. Any instruction for making sure proposals: a. Are responsive to logistics needs, b. Provide alternative support solutions, and c. Provide information required for evaluating logistics under Section M.
	2. Notification of any logistics conditions or constraints.
	3. Any historical information required for the proposals.
M.	The logistics evaluation factors for award, their order of priority, and the recommend relative order of their importance in comparison to all non-logistics evaluation factors.

Figure 8-2. Logistics in a Solicitation

8.4 LOGISTIC INPUTS TO THE SOLICITATION/CONTRACT

Before a solicitation or contract can be prepared, certain documentation must be reviewed. Such documents would include:

- Mission Need Statement
- Operational Requirements Document
- Acquisition Plan
- Preliminary Work Breakdown Structure
- Source Selection Plan

These documents, along with others appropriate to a particular acquisition effort, reflect the baseline strategies and concepts that form the framework for the program. They serve as a guide during the preparation of the solicitation and contract to ensure that industry thoroughly understands the requirements. Please understand that the discussion that follows represents those logistics requirements that generally appear in solicitations and contracts. But, because each acquisition program is unique, what is put in the solicitation/contract changes from program to program.

Complete knowledge of the total program strategies, concepts, and user needs are the prime drivers in preparing logistics inputs. Note that contractor recommendations and comments can greatly improve the effectiveness of the solicitation or contract. This fact adds great credibility to the use of a draft solicitation to industry before the final solicitation is released.

Logistics contents to the solicitation or contract serve one or more of the following purposes:

- Provide an effective acquisition logistics capability.
- Influence contractor or controllable performance characteristics.
- Motivate contractors to meet or exceed acquisition logistics objectives.
- Plan for developing follow-on phase solicitation.
- Provide for tracking performance according to acquisition logistics requirements and logistics support cost planning.
- Place controls on performance.

At this point we should look in more detail at the inputs that the logistician makes to each section of the solicitation and contract.

8.4.1 Section A: Solicitation/Contract Form

Section A provides information that the offeror or quoter can use to fill out the Request for Proposal's Standard Form 33, "Solicitation, Offer and

Award" (FAR 53.301-33) or Standard Form 1447, "Solicitation/Contract" (FAR 53.301-1447). It also identifies other pertinent data required.

8.4.2 Section B: Supplies or Services and Prices/Costs

Section B contains contract line items (CLINs) and sub-line items describing deliverable supplies, data, or services. Deliverable logistics items are listed as separate CLINs or sub-CLINs for effective tracking of cost and schedule. Logistics personnel must make sure the logistics items needed for accomplishing acquisition logistics during each acquisition phase are identified. The types and quantity of logistics CLINs/sub-CLINs should be discussed with the program manager and the contracting officer before they are finalized. This review will ensure that everyone understands the purpose of and need for each item and that the appropriate pricing methodology is applied.

The support system manager is responsible for preparing Section B's logistic support requirements. Since Section B determines the direction and emphasis of the procurement request, the support system manager must develop the logistic support contract strategy and define the logistics requirements. The strategy and requirements are derived from all previous logistic support management activities and the logistics support strategy as documented in the support plan.

Section B, along with Section C: Description/Specifications/Work Statement (discussed in detail below), represents the cornerstone of the procurement request. Sections B and C are prepared before the other sections. Section B lists all supplies, data, and services to be acquired. Specifically, Section B of the contract:

- Lists what is being procured (supplies, data, services).
- Identifies each requirement as a contract line item with a CLIN.
- Determines the direction and emphasis of the procurement request.
- Constitutes the basis for cross-referencing for all subsequent sections since all subsequent sections have to refer to the Section B CLINs.

Separate contract line items are established for:

- Each separately identifiable supply or service
- Each activity
- Each destination
- All First Article Tests
- Each accounting classification within a fixed price procurement

- Each provisioned or contingency item
- Any unfunded line item

Figure 8-3 shows a variety of logistics line items that could be applied to a solicitation and contract.

SAMPLE LOGISTICS CONTRACT LINE ITEMS (CLINs)

Trade Studies
Logistics Research and Development
Support Equipment (peculiar and common)
Supply Support (spare and repair parts, including spares acquisition integrated with production)
Training
Services
Equipment
Contractor Support
Data
Product Performance Agreements (including warranties /guarantees)
Testing
Facilities
Logistics Management Systems
Simulators
Computer Resources
Configuration Management
Technical Manuals
Packaging, Handling, Storage, and Transportation

Figure 8-3. Logistics Line Items

8.4.3 Section C: Description/Specification/Work Statement

Descriptions/Specifications

A description of the requirement—including any necessary specifications, standards, or program specifications—is incorporated in Section C when the brief description on the CLIN or sub-CLIN is not sufficient. Each military standard and specification included in the program specification or the statement of work must be current, applicable, and tailored to the program.

Statement of Work and Statement of Objectives

A statement of work (SOW) or, as an alternative, a statement of objectives (SOO) further defines the scope of work when a supply or service cannot be adequately defined in Section B and the specification. SOWs or SOOs are usually prepared using the Work Breakdown Structure described in MIL-HDBK-881. Prior to acquisition reform, a SOW was written in a very prescriptive, task-oriented manner. Now under acquisition reform, the philosophy is for a SOW to be stated in performance terms (objectives or requirements) as much as possible. Other approaches are also being considered in upper levels within the Office of the Secretary of Defense. These include issuing government-developed draft SOWs for contractors to respond to, or just providing a system specification or Operational Requirements Document without a SOW being utilized at all. Whatever approaches are deemed appropriate, it is apparent that the old way of writing SOWs will no longer suffice.

Statement of Work

The statement of work is the contractual vehicle for expressing what performance objectives or requirements a contractor must meet and the work the contractor is to perform. It is the keystone of the request for proposal (RFP), the offerors' proposals, and the resulting contract. The statement of work may be incorporated directly into Section C or it may be included as an attachment to the contract and listed in Section J.

The clarity of the statement of work has a direct effect on efficient contract administration because it defines the scope of work to be performed. Ambiguous statements of work, or statements of work with unduly restrictive requirements, result in unsatisfactory performance, delays, disputes, and higher costs.

During proposal evaluation and source selection, the statement of work plays a significant role. Failure to adequately describe the scope of work often results in needless delays and extra administration effort during the source selection process. The ability to clearly define the desired performance objectives or requirements of the end product in a clear, precise manner often affects the type of contract which will be selected. A well-defined product can often be acquired with a fixed-price contract; a product that cannot be defined precisely is usually acquired using a cost reimbursement contract.

After contract award, the statement of work becomes the standard for measuring contractor performance. As the effort progresses, both the government and the contractor constantly refer to the statement of work to determine their respective rights and obligations with regard to the contract. When a question arises concerning an apparent change in a performance requirement or an increase in the scope of work to be performed, the statement of work is the baseline document that must be used to resolve the issue. Language in the statement of work that defines the limits of the contractor's effort is of critical importance. If the limits are poorly established, it is difficult to determine if or when there has been an increase in scope, and effective negotiations on cost and schedule will be impaired, if not rendered impossible.

Statement of Objectives (SOO)

The statement of objectives (currently being used by the Air Force) states basic, top-level objectives of an acquisition and is provided in an request for proposal (RFP) in lieu of a government-written statement of work. It allows potential offerors to develop cost-effective solutions and gives them the opportunity to propose innovative alternatives to meeting the stated objectives. A statement of objectives is required for all Air Force weapon systems acquisition contracts and is strongly encouraged for modifications to existing weapon system acquisition contracts. The program manager approves SOOs.

The statement of objectives should be compatible with the mission need statement, operational requirement document, program management directive, acquisition strategy panel guidance, technical requirements documents or specifications, and the preliminary contract work breakdown structure. The statement of objectives should address product-oriented goals rather than performance-oriented requirements. It should not be longer than four pages (as a goal).

The SOO is typically appended to Part L of the RFP (Instructions, Conditions and Notices to Offerors). It does not become part of the contract.

The offerors use the statement of objectives to develop a statement of work, final contract work breakdown structure, integrated master plan, integrated master schedule, and other documents required by the RFP. Section L should include instructions that require all offerors to address all aspects of the statement of objectives in their proposals.

What is the program impact of the use of SOOs? Program offices will no longer be required to create statements of work. Any specific tasking the contractor must accomplish in the performance of the contract that is not elsewhere in the RFP should be included in section L.

8.4.4 Section D: Packaging and Marking

Section D sets forth the packaging and marking needs for deliverable items. Inputs are prepared according to DoD packaging and marking policies and are cross-referenced to Section B CLINs. The transportation, handling, and marking needs of warranted items must be identified. Consider requiring the contractor to provide a notice of warranty with the item(s) on the outside of the container, inside the container, and on the equipment item. The notice should include:

- A statement that a warranty exists.

- A description of the substance of the warranty.
- The duration of the warranty.
- Who is to be notified if the warranty is invoked.

After a review of the logistics concept, any unusual packaging or marking needs should be determined.

8.4.5 Section E: Inspection and Acceptance

Section E details the location of all inspection and acceptance points. These provisions will be cross-referenced to each CLIN, special contract provision, or SOW/SOO provisions developed. Logistics coverage in this section is limited by the number of logistics CLINs. Review is required, however, to determine the need for any unusual inspection or acceptance points for logistics items.

8.4.6 Section F: Deliveries or Performance

Delivery or performance provisions are identified for each deliverable item of supply or service listed in Section B. The provisions of Section F specify:

- Time of delivery or performance
- Place and method of delivery or performance
- Period (duration) of warranty coverage (if a warranty is listed in Section B)

The logistician must make sure that the solicitation delivery dates correlate with the support plan (acquisition logistics) and logistics network and that they support program objectives.

8.4.7 Section G: Contract Administration Data

Section G shows the interface between the contractor and the government for administrative matters. Normally logistics inputs are not required in this section; however, if necessary, the acquisition logistician may include special administrative needs here.

8.4.8 Section H: Special Contract Requirements

Section H is extremely important because it contains special and unique clauses applying to the contract. It is used for including provisions that are not appropriate to be applied in other sections, for tying multiple contracts together or for requiring special emphasis. Give careful consideration to these special clauses because of their possible effect on the cost and administration of the contract. Special provisions often result in higher prices to cover the additional risk to the offerors. These provisions must not conflict with standard FAR provisions. To prevent this conflict, all special clauses, including logistics, are reviewed by the contracting officer and legal counsel before a solicitation or contract is released. The logistics manager is responsible for preparing, and reviewing with the contracting officer and legal counsel, all logistics special clauses. The need for special logistics provisions should be considered in, but not limited to, the following areas:

- Rights in data
- Government owned items
- Incentives
- Life cycle cost
- Product performance agreements
- Logistics options
- Change provisions
- Warranties

Section H defines special contract requirements that relate to safety, human factors, radioactive materials, security, release of information to the public, labor category descriptions, payment schedules, and expected minimum and maximum costs.

The clauses included in Section H are based on the acquisition strategy, the logistics strategy, and the contract strategy. The information in the earlier parts of the procurement request, particularly Section B, will guide contracts personnel in developing a draft Section H. The logistician must assist in the selection of applicable clauses to support special logistics-related requirements for the procurement.

Special clauses can also be developed for a specific procurement. When a special clause, not a standard numbered clause previously used, is required for a particular procurement, the procurement request schedule should state the desired objective as clearly as possible to enable contracts personnel to prepare an appropriate clause for review by the command's Office of Counsel. A complete list of "H" clauses and their full texts, if required, may be obtained from the contracting officer.

> Remember: a good source for determining which "H" clauses may be required is the most recent contract issued for the procurement of the same or similar items.

Reference to clauses in the schedule must cite the title of the applicable clause rather than the clause number. The full text of standard FAR and DFARS clauses are not required in the procurement request. The request may cite the title and the FAR and DFARS number (when known) of the applicable clause. When a clause contains a blank to be completed, the procurement request schedule must specify the information to be entered in the blank.

When a FAR or DFARS clause is intended to be used verbatim, using a clause that departs from FAR or DFARS intent or modifying the wording of the clause or its prescribed application constitutes a deviation. When a FAR or DFARS clause is not prescribed for use verbatim, using a clause that is inconsistent with the intent, principle, and substance of the FAR or DFARS clause constitutes a deviation. Deviations from FAR and DFARS intent must be submitted for approval in accordance with local contracting office procedures.

8.4.9 Section I: Contract Clauses

Standard clauses listed in Part 2 of the FAR are modified, or incorporated by reference, in Section I. The logistician's concern is to make sure the general provisions that are incorporated reflect logistics concerns. Typically, there is little or no logistics input to this section.

8.4.10 Further Implications of Section H and Section I

Section H and Section I are the primary tools whereby policy and regulatory requirements are incorporated as enforceable elements of a contract. New policies and regulations are continuously being developed as outgrowths of congressional legislation, executive branch administration actions, and DoD initiatives. Section H defines special contract requirements. Section I lists general contract clauses applicable to the contract, as published in the Federal Acquisition Regulation (FAR) and DoD FAR Supplement (DFARS), and service-specific policies.

The Logistician's Role in Development of Sections H and I

In the development of Section H, the logistician's role has two major components: procurement request development responsibilities, and contract administration responsibilities. These responsibilities vary based on the contract. As a member of the procurement request development team, the logistician influences the structure of Sections H and I through input to the acquisition plan and the logistics strategy. The support system manager may have the following Sections H and I development responsibilities:

- Translate the logistics strategy into any special clause requirements.
- Assist in the development of a warranty clause.
- Define the quantity requirements for logistics supplies and services.
- Define options for logistics supplies and services.
- Define the logistics-related government furnished property for a contract.
- Define the rights-in-data clause requirements to support the system maintenance concept.

- Support the negotiation team and source selection team in evaluating the logistics impacts of contract changes proposed during negotiation.
- Serve as the logistics representative on the procurement request development team.

The Ordering Clause

The ordering clause governs the ordering of supplies or services detailed in Section B. Specifically, this clause governs the acquisition of supplies or services specified in provisioned CLINs in Section B. This clause is important to the logistician because its terms determine how flexibly logistics support CLINs can be activated.

There are several variations on the basic FAR 52.216-18 "Ordering" clause. As prescribed in 16.505(a), the following clause (Figure 8-4) is inserted in solicitations and contracts when a definite-quantity contract, a requirements contract, or an indefinite-quantity contract is contemplated.

ORDERING (APR 1984)

(a) Any supplies and services to be furnished under this contract shall be ordered by issuance of delivery orders by the individuals or activities designated in the Schedule. Such orders may be issued from ...... through ...... (insert dates).

(b) All delivery orders are subject to the terms and conditions of this contract. In the event of conflict between a delivery order and this contract, the contract shall control.

(c) If mailed, a delivery order is considered "issued" when the government deposits the order in the mail. Orders may be issued orally or by written telecommunications only if authorized in the Schedule.

(End of Clause)
(R 7-1101 1968 JUNE)

(d) Costs for provisioned items are negotiated at the time of the delivery order.

Figure 8-4. Text of Ordering Clause

Ordering Clause Options and Government Furnished Property

Support system managers, logistics element managers, and IPT members writing support requirements portions of the SOW may include ordering clause options in Section H. (Refer to FAR 52.216 - 20 and FAR 52.216 - 22 for guidance). When the government provides the contractor with government furnished property for executing the contract, this information is included in Section H under the appropriate government property clauses, i.e., FAR 52.245-2 for fixed-price contracts and FAR 52.245-5 for Government Property (Cost-Reimbursement, Time-and-Material, Or Labor-Hour Contracts). These clauses set forth the specifics of the relationship between the government and contractor.

Warranty Clauses

Since January 1985, DoD has been required to use certain express warranties in each contract for the production of a weapon system with a unit cost exceeding $100,000 or a total cost exceeding $10 million. U.S.C. §2403 describes the codification of weapon system warranty requirements. The express warranties specify that the weapon system will: (a) conform to the design and manufacturing requirements in the contract; (b) be free from all defects in materials and workmanship at the time of acceptance or delivery as specified in the contract; and (c) conform to the "essential performance requirements" (operating capabilities needed for the system to function properly), as specifically set forth in the production contract. The latter is essentially a warranty that the system will work. It is required only for a weapon system in "mature, full-scale production."

This statute makes three specific remedies available to the government in the event that one of the conditions of these warranties is breached. The government may require the contractor to correct the defect at no cost to the government; the government may correct the defect and charge the cost to the contractor; or the government may correct the defect and reduce the price to deduct the cost of repairs. The statute does not allow the alternative of reducing the price and not correcting the defect.

The contracting officer may not waive the required warranties, but may require that they provide more coverage or greater remedies than stated in the statute. If a warranty would not be cost-effective or would not be in the best interest of national defense, a waiver may be granted by the Secretary of Defense. This authority may be delegated to the Assistant Secretary level of the Department of Defense or of each military department. The policy and procedure concerning waivers is set forth in DFARS 46.770-9. If the weapon system involved is a "major defense acquisition program," prior notice of such a waiver and an explanation must be given to the Congressional committees on Armed Services and Appropriations; for other such waivers, the notice and explanation are to be included in an annual report to these committees (10 U.S.C. §2403(e)).

With reference to FAR 46.7 and DFARS 246.7, warranty provisions must be imposed on most new material systems to ensure that the deliverables: (a) conform to the design and manufacturing requirements; (b) are free from all defects in materials and workmanship at the time of acceptance or delivery; and (c) conform to the essential performance requirements. In effect, the warranty is an obligation of the contractor to repair or replace equipment found defective during the course of the warranty period. FAR and DFARS also provide policies and procedures for tailoring the required warranties to the circumstances of a particular procurement and for obtaining waivers when needed. For supplies and services—like spares and data—that do not meet the definition of a weapon system, warranties are elective provided they meet or exceed the foregoing requirements and are advantageous to the government. A warranty of technical data (extended liability) should be included in the solicitation and evaluated on its merits during the source selection. Consideration should also be given to whether non-conforming data should be replaced or subject to a price adjustment. In designing the contract warranty clauses, the support systems manager should follow these guidelines:

- Provide a realistic mechanism for readministering the warranty.
- Maximize the government's ability to use the warranty, considering PHS&T factors.

8.4.11 Section J: List of Attachments

Lists of attachments are developed to expand on other sections of the solicitation and contract. Particular attention needs to be given to the consistency of definitions, the compatibility of cost eliminating relationships, the interface of equations, the establishment of contract milestones, and the Order of Precedence clause. Areas of concern to the logistician in Section J would be:

- Logistics portion of the preliminary contract work breakdown structure
- Data requirements, both logistics data items and related data upon which logistics actions are based
- Support inputs to the life cycle cost math model
- Support equipment exhibits

8.4.12 Section K: Representations, Certifications, and Other Statements of Offerors and Quoters

This section notifies contractors that they must submit selected certifications and statements as required by the Federal Acquisition Regulation and other federal laws. Submittals like identification of the parent company, agreeing to abide by the Clean Air and Water Act, and identifying an authorized signatory for the contract are required. The logistician is not responsible for any of the information requested in this section.

8.4.13 Section L: Instructions, Conditions and Notices to Bidders, Offerors or Quoters

Section L is designed to accomplish two major tasks. First, it gives contractors the background information they will need to understand the overall scope of the program. Second, it gives specific instructions for the preparation of their proposals. The logistics manager supplies solicitation instructions on logistics matters related to these tasks. Information should be sufficiently detailed to let the offerors:

- Identify the general characteristics of the logistics scenario.
- Establish the types of maintenance support at each site.
- Set up the level of availability to be maintained.
- Make or develop estimates to set up probable frequencies or occurrence of events.
- Identify basic and alternative flows of support resources to and from each site.
- Set up manning, skill, and facility needs for each site.
- Identify concepts and needs for reliability, maintainability, supportability, and testability.
- Do availability, supportability, and cost studies to trade off alternate support, hardware, and software concepts. Figure 8-5 provides some Section L topics.

Special Topic Areas Included in Section L

1. Background information
2. Assumptions
3. Alternate proposals (offerors encouraged to submit alternatives)
4. Product performance agreements
5. Military hardware
   (Identify what information will be provided by the government on government furnished equipment and in military specifications and standards. Give directions to the offerors for tailoring specifications and standards.)
6. Commercial hardware
   (Instruct the offeror to acquire commercial repairable items from vendors who furnish adequate technical data)
7. Provisioning
8. Standardization
9. Energy management
10. Lessons learned

Figure 8-5 Section L Topics

The Logistician's Role in Development of Section L

Acquisition logistics involvement in major planning and program efforts such as life cycle cost management, design to cost management, and management of information systems should be described.

The logistician should ensure that in this section the offeror identifies where the logistics management effort is located within the overall organization structure and defines the logistics manager's functional relationship with other managers. Information which may be required includes:

- systems engineering
- system safety
- testing
- reliability
- maintainability
- support equipment
- hazardous materials management

8.4.14 Section M: Evaluation Factors for Award

> For industry, Section M is the proposal manager's primary focus. If the proposal does not do well against the evaluation criteria, it loses. Critical logistical factors must be contained in Section M to be guaranteed serious consideration by the offeror.

Section M conveys the basis for evaluation of the proposals received. Evaluation factors must be measurable, meaningful, traceable, and limited to contractor controllable items.

Remember that the solicitation you prepare will be used to evaluate the offerors' proposals. The criteria included in the solicitation must be consistent with service policy. This consistency requires tailoring the evaluation criteria or program characteristics. Define the criteria carefully in order to identify the rank order of importance of technical, logistics, costs, schedule, past performance, and other factors as set forth in the source selection plan.

If the acquisition logistics is to be meaningful, its rank and value in selection process will be clear. Fully defined criteria:

- Indicate that the government decision makers have thought out their priorities.
- Inform the offerors of the order of importance the government has attached to the major needs.

8.5 SUMMARY

The goal of this overview of the logistics inputs to solicitations and contracts has been to make you realize that the acquisition logistician has a major contribution to make to these documents. It is even more important that you realize these inputs are not made unilaterally. Considerable interface with the other parties—the program manager; the users; and representatives from engineering, contracting, and other support agencies—is necessary. Start working early with these groups through IPTs, partnering, and teaming. Sometimes we overlook data acquisition logistics during planning, and we continually live with program changes that require crisis management, but in general we can minimize the impact of these situations if we follow a few basic guidelines.

- Do thorough front-end planning.
- Clearly and concisely identify requirements in the solicitation and contract.
- Use the expert personnel resources available for initial planning and problem resolution.
- Be prepared to cope with the oversights and program changes.
- Maintain the goal of optimizing supportability with cost, schedule, and performance.
- Work through IPTs, partnering, and teaming.

Since the operating and maintenance costs of the average system are now nearly 60% of its total life cycle cost, the logistician has a tremendous responsibility. Providing thorough and proper logistics inputs to the solicitation and eventual contract is one of the major steps on the road to supportability for our future weapon systems.

8.6 ADDITIONAL INFORMATION

The Federal Acquisition Regulation

Defense Federal Acquisition Regulation Supplement

Section 9:

Integrated Product Team Setup and Involvement

9.1 ABOUT DOD INTEGRATED PRODUCT TEAMS IN GENERAL

9.1.1 The Integrated Product and Process Development Concept

Integrated product and process development (IPPD) is a management process that integrates all activities from product concept through production/field support. It uses a multi-functional team to optimize the product and its manufacturing and sustainment processes simultaneously to meet cost and performance objectives. IPPD evolved from concurrent engineering and the philosophies of quality management. It is a system engineering process integrated with sound business practices and common sense decision making.

The basic principles of IPPD are:

- Customer focus
- Concurrent development of products and processes
- Early and continuous life cycle planning
- Maximum flexibility to optimize contractor approaches
- Robust design and improved process capability
- Event-driven scheduling
- Multi-disciplinary teamwork
- Empowerment

9.1.2 Purpose of Integrated Product Teams

Integrated product teams (IPTs) are the means through which IPPD is implemented. They are its fundamental building blocks. These cross-functional teams are formed for the specific purpose of delivering a product for an external or internal customer.

IPT members should have complementary skills. They are committed to a common purpose, common performance objectives, and a common approach for which they hold themselves mutually accountable. Members of an integrated product team represent the technical, manufacturing, business, and support organizations that are critical to developing, procuring, and supporting the product. Each individual should offer his or her expertise to the team and, equally important, understand and respect the expertise of the other members of the team. Team members work together to achieve the team's objectives.

Critical to the formation of a successful IPT are the following principles:

- All functional disciplines that will influence the product throughout its lifetime should be represented on the team.
- The business unit manager, the program manager and functional managers and the integrated process team members must clearly understand the team's goals, responsibilities, and authority.
- Resource requirements like staffing, funding, and facilities must be identified.

9.1.3 Integrated Product Teams and the Acquisition Process

The IPT concept for oversight and review is intended to replace the current sequential process. The current process often produces a product at the program office level which, when reviewed at higher levels, is modified substantially or even rejected.

In the context of a DoD acquisition program there are three types of IPTs:

Overarching IPT

The Overarching IPT is formed for each program to provide assistance, and oversight as the program proceeds through the acquisition life cycle. It is formed at the Office of the Secretary of Defense (OSD) or component level and is composed of the program manager, program executive officer, and appropriate component staff, joint staff, OSD staff principals or their representatives.

Working-level IPTs

Working-level IPTs are formed at the OSD and component level to provide staff-level functional knowledge and expertise to the program. They are composed of the program manager or his representative, and the appropriate staff members who can assist the program. For major programs working-level IPTs are generally focused on a particular discipline or functional area such as supportability, testing, cost/performance or contracting. For small projects one working-level IPT may be focused on the whole effort. One exception to this rule is the integrating IPT which the program manager establishes to coordinate the activities of the other working-level IPTs. Ideally, the integrating IPT has as part of its membership one representative from each of the working-level IPTs who acts as a linch pin with his or her own working-level IPT, forming a "team of teams." Figure 9-1 provides an example of an integrating IPT.

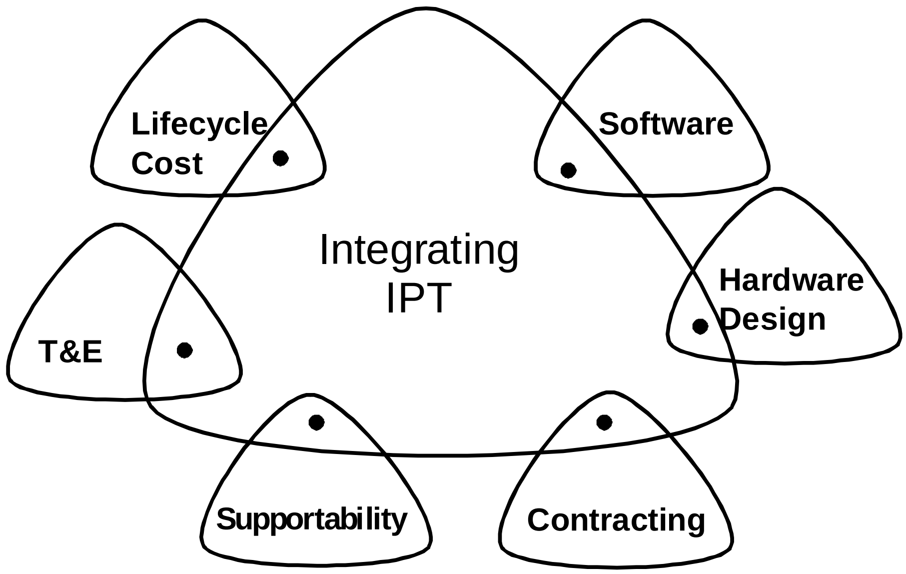

Figure 9-1. Integrating IPT

Even though these teams are focused on a particular functional area, they are still multi-disciplinary. For example, a supportability IPT should have representatives from the disciplines that will influence the supportability of the item. In other words, a supportability IPT should not be simply a re-labeled logistics management team comprised solely of logisticians.

Program IPTs

Program IPTs are formed at the program level to manage and execute the program.

9.1.4 Guidelines for IPT Operation

The following general principles provide guidelines for IPTs:

Open discussions with no secrets.

Cooperation and the coordinated sharing of information is critical. To achieve the synergy of a team effort all facts must be available for the whole team to assess. Knowledge is power (but rather than being power for the individual it must be power for the team).

Empowered team members.

To be effective, team members must be able to make and keep agreements. Team members, then, must first be qualified to speak for their superiors and then must be empowered to do so. It also follows that team members must make their fellow team members aware of any limits to their ability to speak for their principals. IPT agreements cannot be binding if they exceed the limits of a member's empowerment.

Consistent, success-oriented, proactive participation.

The members of an IPT should be drawn from those organizations that have a stake in the outcome of the project. Although smaller teams (6-10 individuals) are usually more effective than large teams, there should be no attempt to limit membership. Not having important functional areas represented on the team is worse than having a large team. As the program progresses through the acquisition process members should be added or subtracted as appropriate.

Continuous "up-the-line" communications.

An important responsibility that accompanies empowerment is the team members' responsibility to keep their leadership informed. That means that team members must have adequate time to coordinate issues with their leadership. (Surprising the boss is not an effective management technique.)

Reasoned disagreement.

Disagreements will arise in any team endeavor. If the team is to be effective, disagreements must be based on alternative plans of action rather than on unyielding opposition to one plan with no alternative being offered.

Issues raised and resolved early.

Effective teams identify issues quickly and either resolve them internally or elevate them to a decision-making level where they can be resolved. Ignoring an issue in the hope that it will go away usually guarantees that it will fester, and when it inevitably resurfaces, it will have become a major problem.

9.2 LOGISTICIANS AND IPTS

This section addresses some special considerations for functional area experts in general, and logisticians in particular, who serve on IPTs.

9.2.1 The Functional Area Experts' Role

In addition to being fully productive and active members of the team, functional area experts have a few special responsibilities because they bring special knowledge and a special point of view to the effort. The degree to which these experts are willing to share their knowledge and point of view will determine their value to the team effort. In essence, experts play an important training role on the team by freely providing their insights into the various aspects of the program. That is, by sharing their expertise, they educate their fellow team members to the not-so-obvious implications of programmatic decisions and actions that they, the experts, see.

Here are a few responsibilities that functional area experts have to the IPT:

Actively participate.

Not surprisingly, we all tend to avoid long, drawn-out meetings where some *other* experts are droning on about some particularly abstruse aspect of the program that is of interest to them. This is especially true if we believe there is little possibility that what will be covered in the meeting will have any impact on our own concerns. Unfortunately, if we are going to make a positive contribution to the team we have to be there to see and hear the other team members ideas and review the team's products (design, program plan, acquisition strategy, etc.) so that our expertise can be applied to the effort. We usually cannot anticipate when our expertise will be needed. Therefore all team members should have as a goal 100 percent attendance at all meetings.

Communicate point of view.

The value of IPTs is that conflicting, multi-disciplinary issues are resolved on the team as they arise and before they have solidified into bureaucratic positions. This resolution cannot occur if the points of view of the various disciplines on the IPT are not voiced. All team members should identify and explain the implications of an issue as they see it.

Challenge requirements.

The functional area experts must not only be willing to voice opinions but also must challenge those things that don't make sense. In their frame of reference the experts might see that what makes sense to some team members, and in some other programs, might not make sense in this particular program.

Pay attention to detail.

The devil is in the details**.** While some potential problems with a program may jump out at even the most casual observer, more often these problems are hidden in footnotes and references and can only be ferreted out through diligent attention to detail.

9.2.2 Special Considerations for Logisticians as IPT Members

The logistician's role on an IPT depends upon the type of IPT it is. On a higher level IPT not directly focused on support issues the logistician should be concerned with identifying and highlighting the long term logistical implications of the various programmatic issues that the team addresses. The logistician may then form a supportability IPT to focus on mitigating the effects of those issues on the supportability of the system.

At the program level the logistician should perform a similar role on program IPTs that are not specifically focused on supportability issues—except that the type of issues will be different. Here the logistician is more concerned with influencing the design of the system (if it is a development program) and the design of the support structure. In designing the support structure the first question to address is what support systems already exist that can support the program. This is particularly important in the case of a commercial or nondevelopmental item acquisition (an increasingly likely situation) because with these programs some (or all) of the needed support already exists. The challenge is to determine how best to use or modify the existing support capabilities. As with higher level IPTs the logistician may form a supportability IPT to address these issues.

These IPTs should be formed as the issues arise, which in most programs means very early in the program's life cycle. This is especially true of commercial or nondevelopmental item acquisitions because there will be much less time available to solve the problems. More specific issues that these IPTs might address are found in Section 9.3.2.

Total life cycle focus

With few exceptions most of the cost of a program is in the cost of ownership, i.e., the support of the system throughout its operational life. Therefore, the logistician can make major contributions to the acquisition of a cost effective system. As a member of an IPT the logistician is in a unique position. Probably every other team member is focused on addressing short term problems that will arise within the first few years of a program's life. The logistician, on the other hand, while also dealing with short term problems, must also think about the problems that will arise in the distant future. For example, increased environmental awareness and legislation has increased the difficulty and cost of demilitarization and disposal of systems. Early identification of disposal problems in the concept exploration phase of a program can help DoD avoid serious consequences at the end of the program's life cycle.

Quantifiable and testable requirements

This topic is addressed in more detail in Section 6. An important responsibility of the logistician on an IPT is to help the team create supportability performance requirements that are quantifiable and testable so that the decision-makers can gain insight into the operational suitability of the product and the logistics planners can plan for the support of the item.

Accepting trade-offs

This is an extension of the "Reasoned Disagreement" principle covered previously. Not only must IPT members provide alternative solutions if they disagree with a plan of action, but they must also accept the fact that in any program compromises must be made, and their alternative may not be accepted. This is particularly true in the logistician's case because the implications of his or her disagreements often have large and far-reaching effects on the overall program. Often the issue raised by the logistician falls into the category of deciding to accept significant upfront costs to avoid even more significant future costs.

9.3 SUPPORTABILITY IPTS

9.3.1 Who to Invite

Of course no standard recipe exists for who should be on a supportability IPT. Membership should be based on the particular needs of the program, the type of IPT (program or working-level), and the desires of the leadership. However, some general rules apply. First, the membership should be made up of representatives from those organizations or functional disciplines that will influence the product throughout its lifetime. A second, closely related approach is to include on the team a representative from every organization that can stand in the way of the program's advancement. Using this approach keeps the other team members from having to play devil's advocate themselves and ensures that problems will be reviewed early in the process. The temptation is to do the opposite and exclude those people, but in the long run inclusion is better.

In general a supportability IPT should be comprised of:

- the customer or user
- prime contractor and key suppliers or vendors
- manufacturing
- design
- support
- management

- quality
- information systems
- training

9.3.2 Questions To Ask

Here are some of the issues that a supportability IPT might address.

Programmatic Questions

The basic programmatic issue is: **Will contractor logistics support be required? If so, at what level?** To help determine the answer to these questions the following issues should be resolved:

What are the core workload requirements?

Where will the item be used and maintained? (i.e., in what operational environment—from a fixed/industrial/benign one to a mobile/ austere/hostile one—will it be used?) Will the military environment change the item's reliability characteristics? Or will the environment significantly change the manner in which the item must be repaired?

If so contractor support might not be the best approach.

How long will the system be used? (i.e., What is the system's projected service life?)

If the system will only be in the inventory for a few years then contractor support might be preferable to a lengthy and costly gearing-up of an organic logistics support structure.

How much of the software is mature? How much is customer unique? Software, never delivered 100% "bug- free," may take several years to mature. The logistics support structure should also address software maintenance of potential user requirement upgrades.

What is the expected need for system replacement or upgrade due to changing technology? These questions concern how readily an organic support structure can keep up with changes in the system and modify the support strategy. If it will be difficult or impossible, then contractor logistics support is preferred.

Operational Questions

What are the:

- Planned maintenance levels?
- Maintainer proficiency levels?

- Software maintenance plans?
- Limitations on evacuation of repairable items (battlefield, underground, rough handling)?
- Maintenance environment (weather, mud)?
- Supply support, support equipment needs, limitations?
- Training needs?
- Packaging, handling, storage and transportation needs?

Product Support Questions

What are the:

- Technical data needs?
- Repair parts availability and lead times, documentation, pricing, and distribution systems?
- Customer service, installation, checkout, and user operation and maintenance instructions?
- Requirements and provisions for manpower and personnel?
- Competitive or sole source repair and support base?
- Training and training support requirements?
- Requirements for and availability of tools, test equipment, computer support resources, calibration procedures, operations, and maintenance manuals?
- Warranty procedures and commercial repair capabilities?
- Manufacturer calibration, repair, and overhaul practices and capabilities documentation?
- Manufacturer commitments to out-year support?
- Degree of technical data package availability?
- Configuration management requirements?

Post-Deployment Questions

- Has post-production support planning been adequately considered?
- What analysis of support capability and O&S costs is planned?
- What logistics risks remain unresolved?
- Are there any unresolved safety issues?

- Will the spares delivery support the deployment schedule?
- Will all support equipment be available?
- Will spares delivery impact the production schedule?
- How will lessons learned be applied from one activated site to another?
- Is operator training verified and timely?
- Is maintenance training verified and timely?
- Do the packaging, handling, storage and transportation requirements safely and efficiently support the system in its current or intended environment?
- What plans and procedures are established to mature the supportability and correct deficiencies?
- What training processes have been developed to ensure adequate operational and maintenance support at all levels?
- Are the appropriate number of spares available to support the maintenance concept?
- How effectively is automated test equipment being utilized to support the system?
- What procedures will be used to verify adequate system reliability during field use?
- Has the industrial base been solidified to provide spares support in the out years for items left in the inventory?
- Are suppliers foreign owned?

9.3.3 Commercial Item Issues

The increased policy emphasis on satisfying materiel needs with commercial products has greatly increased the probability that a supportability IPT will be addressing the possibility of supporting a commercial item. Here are some questions that you might ask of a vendor of commercial products.

What is the reliability history of the product? In what environments?

What are the maintainability features of the design? (e.g., self-test features, accessibility, need for separate support equipment to verify failures, preventive maintenance needs, mean time between repair)

What are the existing maintenance, repair, and spare parts arrangements for the item? How are current customers supported?

Are you able to support the item for the duration of the expected military use? The Department of Defense tends to keep items in use longer than civilian users.

Will you allow the government to acquire licensing and subscription services to enable competition for maintenance?

If the nondevelopmental item is to be used as part of a system, how do you perceive the criticality of interfacing with other subsystems, software, etc. for overall system integrity? That is, if it later became necessary to replace a subsystem because the original became unsupportable, could it be done without driving a major modification or replacement of the entire system? Are special tools or test, measurement and diagnostic equipment required?

Can the proposed item be maintained according to the conditions we have given you, or will special arrangements be required? If so, what are they?

Is there a competitive market for contract repair and support of the proposed item, or is repair and support restricted to a single source?

Is the proposed equipment covered by a warranty? What are the warranty's provisions? If your product will reach the government through a prime contractor, will your warranty carry through with it? Identify at least three commercial users of your product. Also, name present military customers, if any.

What training is needed to operate and maintain your product? What training sources are available to customers?

Will there be a problem with proprietary data? If so how can we avoid it? Commercial manufacturers are often very reluctant to release technical data to anyone, so this issue must be addressed up front. Some possible approaches to avoiding this problem are:

- Determine the minimum data needed and provide a rationale for that need. While the government does not have to justify its data needs to industry, this approach does defuse the not uncommon assumption that the government always asks for data it doesn't need.
- Encourage contractor-recommended alternatives. It is quite possible that industry can formulate a win-win solution.
- Consider alternative support strategies and maintenance concepts. Total contractor logistics support or a mix of contractor and organic support may obviate the need for any data.

Are operator and maintenance manuals available and what levels of maintenance are covered?

9.3.4 Core Considerations in the Acquisition Process

The core methodology is a DOD approach to maintaining a capability within Defense depots and the industrial base to meet the readiness and sustainability requirements of the weapon systems that support the Joint Chiefs of Staff contingency scenarios. Core exists to minimize operational risks and to guarantee required readiness for these critical weapon systems. Application of the core methodology satisfies the requirements set forth in Title 10, Sec 2464; DoD Directive 4145.18; and the Deputy Under Secretary of Defense (Logistics) policy for maintaining core depot maintenance capability.

Core represents the minimum amount of maintenance capability that the DoD Components must maintain in organic depot facilities to ensure that contingency operations are not compromised because of lack of essential depot maintenance support. Core is an organic capability and is not performed in the private sector. Not all critical or mission essential weapon systems and equipment will be maintained in the ***public*** sector, but the capability to perform depot maintenance on designated weapon systems must be maintained organically. The determination of core capability requirements and the depot maintenance workloads necessary to sustain those capabilities are developed by each Service, using a jointly agreed upon methodology. The aggregation of these calculations then becomes the basis of the DoD core requirements.

The steps to identify workloads necessary to sustain core capability requirements can be summarized as follows:

- Identification of weapons systems necessary to support the JCS contingency scenario(s).
- Estimate scenario workload.
- Assessment of private sector capabilities.
- Computation of basic core.
- Adjustment for efficiency and economy.
- Add best value/last source.
- Compute total organic capability requirement.

The methodology is also used to determine the most suitable source of repair for new acquisitions at minimum risk and best value. Depot level maintenance may be accomplished by a DOD organic maintenance activity; or by a private sector activity when associated risk is acceptable. The overall objective, however, is to ensure satisfactory operation of the equipment/systems expected to be engaged during wartime through sound maintenance practices and prudent posturing decisions.

The core and acquisition processes converge during the early stages of acquisition when planning for depot support takes place and also during the source of repair decision process. Early in the life cycle, a core analysis is conducted to determine if depot support planning should commence. Later in the system's life cycle, when more precise maintenance data becomes available, the source of repair analysis is completed based upon the outcome of the core methodology (specifically, the assessment of private capability). The inherent logic dictates that when ***core capability requirements are adequately sustained and*** maintenance sources exist in the private sector that can provide the required capability and capacity with acceptable risk, reliability, and efficiency at reasonable cost, then competition and best value procedures should be used to choose a source of repair.

9.4 ADDITIONAL INFORMATION

Use of Integrated Product and Process Development and Integrated Product Teams in DoD Acquisition, Secretary of Defense Memorandum, May 10, 1995.

Rules of the Road - A Guide for Leading Successful Integrated Product Teams, Under Secretary of Defense for Acquisition and Technology, November 1995.

DoD Guide to Integrated Product and Process Development, Under Secretary of Defense for Acquisition and Technology, February 20, 1996.

Naval Air Systems Command Integrated Program Team Manual

Section 10: Notes

10.1 INTENDED USE

The purpose of this handbook is to offer guidance on acquisition logistics as an integral part of the systems engineering process. The information contained herein is applicable, in part or in whole, to all types of materiel and automated information systems and all acquisition strategies.

10.2 SUBJECT TERM (KEY WORD) LISTING

The following words allow identification of this document during retrieval searches:

Acquisition logistics
Contracting for supportability
Logistics management information
Support data
Supportability IPTs
Supportability analyses
Supportability analysis summaries
Supportability requirements

CONCLUDING MATERIAL

Custodians:
Army - TM
Navy - AS
Air Force - 10

Review Activities:
Army - AT, AV, CR, GL, MI, PT
Navy - MC, EC, SH
Air Force - 11
DLA - LS

Industry Associations:
AIA, NSIA

Preparing Activity:
Army - TM
(Project ALSS 0072)

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