NOT MEASUREMENT SENSITIVE

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25 March 1993

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MIL-STD-881A
25 April 1975

MILITARY STANDARD

WORK BREAKDOWN STRUCTURES

FOR

DEFENSE MATERIEL ITEMS

AMSC F6914 AREA MISC

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FOREWORD

1. This military standard is approved for use by all Departments and Agencies of the Department of Defense.

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: AFMC/FMA, Wright-Patterson Air Force Base, Ohio 45433, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of the document or by letter.

3. This military standard is applicable to all defense materiel items (or major modifications) (a) established as an integral program element of the Future Years Defense Program (FYDP), or (b) otherwise designated by the DoD Component or the Under Secretary of Defense (Acquisition).

4. The practices and procedures contained in this standard are applicable to systems, equipment, and other designated materiel items which are referred to as defense materiel items. Work breakdown structures (WBS) provide a consistent and visible framework for defense materiel items (as well as contracts within a program) that facilitate:

a. A more effective management and technical base for planning and assigning management and technical responsibilities within government offices responsible for the acquisition of defense materiel items and contractors furnishing the items.

b. The basis for communication throughout the acquisition process by providing the common link unifying the planning, scheduling, cost estimating, budgeting, contracting, configuration management, and performance reporting disciplines.

c. More consistent control over and reporting of the progress and status of engineering and other contractor efforts, resource allocations, cost estimates, expenditures, and procurement actions throughout the acquisition of defense materiel items.

d. Acquisition decisions which consider total life cycle effects, including development, production, activation, operational use, and phase-out.

5. The uniformity in definitions and approach for developing the top three levels of the work breakdown structure established by this standard is expected to assure compatibility of multiple-data requirements. The benefits expected from increased uniformity in the generation of work breakdown structures and their application to management practices will be realized by the improved interpretation and reconciliation of all reports prepared to this uniform framework throughout the acquisition of a defense materiel item.

6. This military standard is based on the cooperative efforts of the military services with assistance from industrial associations.

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1. SCOPE

1.1 Purpose. This standard establishes criteria governing the preparation and employment of work breakdown structures for use during the acquisition of designated defense materiel items to display and define the products to be developed or produced.

1.2 Application.

1.2.1 The work breakdown structure requirements established by this standard are associated solely with the acquisition of defense materiel items (or major modifications) that are (a) established as an integral program element of the Future Years Defense Program (FYDP), or (b) otherwise designated by the DoD Component or the Under Secretary of Defense (Acquisition). Specifically, it pertains to only those elements of research and development and investment that are applicable to contracted efforts.

1.2.2 This standard is to be used by both contractors and DoD Components (Government activities) in the development of work breakdown structures for the acquisition of defense materiel items.

1.2.3 Work breakdown structures in use on existing programs will continue to be used on these programs unless it is considered mutually advantageous to the Government and the contractor(s) to apply this standard. Approval for substitution should follow guidance in paragraph 4.1.1.

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2. APPLICABLE DOCUMENTS

2.1 Government Documents.

2.1.1 Specifications, Standards, and Handbooks. This section is not applicable to this standard.

2.1.2 Other Government Documents, Drawings, and Publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

PAMPHLETS

Contractor Cost Data Reporting (CCDR)

NAVMAT P-5241	Navy Materiel Command Pamphlet
AMC-P 715-8	Army Materiel Command Pamphlet
AFLCP 800-15	Air Force Logistics Command Pamphlet
AFSCP 800-15	Air Force Systems Command Pamphlet

Cost/Schedule Control System Criteria Joint Implementation Guide

NAVSO P3627	Assistant Secretary of the Navy (S&L) Pamphlet
AFSCP 173-5	Air Force Systems Command Pamphlet
AFCCP 173-5	Air Force Communications Command Pamphlet
AFLCP 173-5	Air Force Logistics Command Pamphlet
AMC-P 715-5	Army Materiel Command Pamphlet
DLAH 8400.2	Defense Logistics Agency Handbook
DCAA P7641.47	Defense Contract Audit Agency Pamphlet

(The above pamphlet numbers identify two single documents: Contractor Cost Data Reporting (CCDR) System (Stock Number 0518LP1003001), and Cost/Schedule Control Systems Criteria Joint Implementation Guide (Stock Number 0518LP1002010). These two documents can be ordered by stock number from the Standardization Documents Order Desk, 700 Robbins Avenue, Building #4, Section D, Philadelphia, PA 19111-5094.

2.2 Non-Government Publications. This section is not applicable to this standard.

2.3 Order of Precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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3. DEFINITIONS

3.1 General. Terms will be as defined herein and in the appendices of this document.

3.2 Program Element. A program element is the basic building block of the Future Years Defense Program (FYDP). It is a description of the mission to be undertaken and a list of the organizational entities identified to perform the mission assignment. A program element may consist of forces, manpower, materiel (both real and personal property), services, and associated costs, as applicable.

3.3 Defense Materiel Item. Defense materiel item is a term used within the DoD to identify a system or item that is usually established as an integral program element or is identified as a project within an aggregated program element.

3.4 Work Breakdown Structure. A work breakdown structure (WBS) is a product-oriented family tree composed of hardware, software, services, data and facilities which results from systems engineering efforts during the acquisition of a defense materiel item. A work breakdown structure displays and defines the product(s) to be developed and/or produced and relates the elements of work to be accomplished to each other and to the end product(s). The work breakdown structures prescribed by this standard have been organized within the seven categories of defense materiel items and consist of the upper three levels of the work breakdown structure.

3.4.1 Categories of Defense Materiel Items. The seven categories of defense materiel items identified in 3.4 are as follows:

a. Aircraft Systems
b. Electronic/Automated Software Systems
c. Missile Systems
d. Ordnance Systems
e. Ship Systems
f. Space Systems
g. Surface Vehicle Systems

3.4.2 Level Identification. The three work breakdown structure levels specified in 3.4 are as follows:

Level 1: Level 1 is the entire defense materiel item; for example, the Minuteman ICBM System or the LHA Ship System. Level 1 is usually directly identified in the DoD programming/budget system either as an integral program element or as a project or subprogram within an aggregated program element.

Level 2: Level 2 elements are major elements of the defense materiel item and are subordinate to level 1; for example, a ship, an air vehicle, a tracked vehicle, and aggregations of services (such as system test and evaluation, and systems engineering/program management) and data.

Level 3: Level 3 elements are elements subordinate to level 2 major elements; for example, an electric plant, an airframe, the power package/drive train, or type of service (such as development test and evaluation, contractor technical support, training services), or type of data (such as technical publications). Lower levels follow the same process.

3.5 Program Work Breakdown Structure. A program work breakdown structure is defined as the work breakdown structure that covers the acquisition of a specific defense materiel item and is related to contractual effort. A program work breakdown structure includes all applicable elements consisting of at least the first

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three levels of the work breakdown structure and extended by the DoD Component (program manager) and/or contractor(s). A program work breakdown structure has uniform element terminology, definition, and placement in the family tree structure.

3.6 Contract Work Breakdown Structure. A contract work breakdown structure is defined as the complete work breakdown structure for a contract. It includes the DoD approved work breakdown structure for reporting purposes and its discretionary extension to the lower levels by the contractor, in accordance with this standard and the contract work statement. It includes all the elements for the products (hardware, software, data, or services) which are the responsibility of the contractor.

3.7 Work Breakdown Structure Element. A work breakdown structure element is a discrete portion of a work breakdown structure. A work breakdown structure element may be an identifiable item of hardware, software, services, data or facilities.

3.8 Systems Engineering. Systems engineering is defined as a comprehensive, iterative technical management process to:

a. Translate an operational need into a configured system meeting that need through a systematic, concurrent approach to integrated design of the system and its related manufacturing, test, and support processes;

b. Integrate the technical inputs of the entire development community and all technical disciplines (including the concurrent engineering of manufacturing, logistics, and test) into a coordinated effort that meets established program cost, schedule, and performance objectives;

c. Ensure the compatibility of all functional and physical interfaces (internal and external) and ensure that system definition and design reflect the requirements for all system elements: hardware, software, facilities, people, and data; and

d. Characterize technical risks, develop risk abatement approaches, and reduce technical risk through early test and demonstration of system elements (ref. DoD Instruction 5000.2).

3.9 Configuration Item. A configuration item is an aggregation of hardware or software that satisfies an end-use function and is designated by the government for separate configuration management (ref. MIL-STD-973).

3.10 Acquisition. Acquisition is a term used within the DoD to denote the directed, funded effort that is designed to provide a new or improved materiel capability in response to a validated need (ref. DoD Directive 5000.1). Acquisition commences with the conceptual phase and is completed at the end of the production phase. It excludes all operating and support activities.

3.11 Integration, Assembly, Test and Checkout. See Appendix H, Work Breakdown Structure Definitions, Common Elements (ref. page H-2), for a complete definition. In those instances in which an integration, assembly, test and checkout element is used (Appendices A through G), it will include all effort of technical and functional activities associated with the design, development, and production of mating surfaces, structures, equipment, parts, materials, and software required to assemble the level 3 equipment (hardware/software) elements into a level 2 mission equipment (hardware/software) as a whole and not directly part of any other individual level 3 element.

3.12 Functional Categories. Although this standard does not address functional categories, for each work breakdown structure element there is a functional breakout. The cost of any specified work breakdown

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structure element at any level is composed of one or more functional categories. Functional categories include engineering, tooling, quality control, manufacturing, and purchased equipment, and are defined in Chapter 4 of the referenced pamphlet, Contractor Cost Data Reporting (CCDR) System. DoD regulations reference and establish requirements for functional breakouts on specified work breakdown structures. Functional categories are not work breakdown structure elements and are not to be represented as such in work breakdown structures.

3.13 Nonrecurring and Recurring. Work breakdown structure elements can contain both nonrecurring and recurring effort. Nonrecurring effort includes all design, development, test (except acceptance testing), basic and rate tools, and manufacturing support to engineering for the design, development and test effort. Recurring effort includes the manufacturing of the test and production units (including acceptance testing), sustaining engineering and sustaining tooling. The DoD approved Contractor Cost Data Reporting (CCDR) Plan establishes the requirements for reporting nonrecurring and recurring breakouts on work breakdown structures specified for contractor cost data reporting to the government. Nonrecurring and recurring definitions are given in Chapter 4 of the referenced pamphlet, Contractor Cost Data Reporting (CCDR) System.

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4. GENERAL REQUIREMENTS

4.1 Relationships. The structures and definitions contained in this standard shall be the basis for structures used for contracts requiring compliance with the Cost/Schedule Control Systems Criteria (C/SCSC), per DoD instructions, and the reporting systems of Cost Performance Reports (CPR), Contract Funds Status Reports (CFSR), Cost/Schedule Status Reports (C/SSR), and Contractor Cost Data Reporting (CCDR). This section summarizes the overall relationship between this standard and those policy issuances. Consult the DoD regulations for instructions related to the referenced documents.

4.1.1 Contractor Cost Data Reporting (CCDR) Plan. The CCDR Plan procedures in DoD regulations are the framework for work breakdown structure development and approval. Those procedures begin during the development of the Statement of Work (SOW) and before the issuance of solicitations to industry for advanced development prototype and/or engineering and manufacturing development contracts and continue through the completion of the production program. The CCDR Plan, as a key integration planning document for a program, shall be used by DoD Components to ensure that program work breakdown structures are developed in accordance with this standard. This planning process is extremely important since the resulting approved program work breakdown structure (1) defines the program and (2) is used to organize the solicitation(s) and identify for prospective contractors the upper level contract work breakdown structure. The final contract work breakdown structure, incorporating any changes negotiated with the contractor, is the basis for contract organization. The statement of work, contract line items, and reporting requirements must all be consistent with the program work breakdown structure approved in the CCDR Plan.

4.1.2 Cost/Schedule Control Systems Criteria (C/SCSC). When a contract requires that a contractor's cost and schedule management control system comply with the C/SCSC requirements identified in DoD instructions, the system is reviewed to ensure that the contract work breakdown structure is used as the framework for organization, planning, budgeting, accounting, analysis, and revision of all contract work. The C/SCSC does not establish the adequacy of the contract work breakdown structure. The contract work breakdown structure contained in the contract is based on the approved CCDR Plan (or the DoD Component approved plan, if appropriate). Contract work breakdown structure development begins before a solicitation is released to industry. After contract award, C/SCSC compliance reviews ensure that the contractor is using the contract work breakdown structure properly to manage the contract.

4.1.3 Cost Reports. The CCDR, CPR, and C/SSR forms require use of contract work breakdown structure reporting elements, and the CFSR may require contract work breakdown structure element reporting. Submission of these reports is required during performance of applicable contracts; certain CCDR forms are also required with contractor responses to solicitations. The CCDR Plan shows the CCDR submission requirements to be incorporated in solicitations and contracts and indicates other cost reporting requirements, such as CPR and CFSR. Contractual reporting is through the contract data requirements list (CDRL). During contract negotiation, any needed adjustments may be proposed by either party. As a general rule, routine reporting is at level 3 of the contract work breakdown structure (level 2 for CFSR, when applicable), except for high-cost, high-risk, or other high-interest elements that are at lower levels. The appropriate contract work breakdown structure level specified for routine reporting shall be evaluated carefully by the DoD Component with the contractor to ensure only the minimum amount of reporting necessary to achieve effective management control is required.

4.2 Work Breakdown Structure. The DoD Component shall develop a program work breakdown structure for defense materiel items prior to program initiation by selecting appropriate elements from one or more of the work breakdown structure(s) set forth in Appendices A through G of this standard that are applicable to the program. Approval of this program work breakdown structure shall be obtained in accordance with DoD regulations. From this approved program work breakdown structure the individual contract work breakdown

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structure(s) will be developed by the DoD Component and negotiated with the contractor(s). The negotiated contract work breakdown structure(s) will then be extended to lower levels by the contractor(s) to define the complete contract scope. When aggregated with the program work breakdown structure, the extended contract work breakdown structures shall form a complete work breakdown structure which will be used throughout the acquisition cycle. Figure 1 depicts the evolution and relationship of the work breakdown structure(s) to the various acquisition stages.

4.3 Program Management. The program work breakdown structure and contract work breakdown structure extensions can be used as a framework for technical and management activities. The program office should employ the program work breakdown structure and its contract work breakdown structure extensions as a coordinating medium in planning for further systems engineering, resource allocation, cost estimates, contract actions, and work execution. The reporting of progress, performance, and engineering evaluations as well as financial data, shall be based on the program work breakdown structure.

4.4 Solicitation and Proposal Action. The contract work breakdown structure used for solicitation will be structured by selecting appropriate elements from the approved program work breakdown structure. The contract line items, configuration items, contract statement of work tasks, contract specifications, and contractor responses will be expressed in terms of the work breakdown structure to enhance its effectiveness in satisfying the objectives of the particular acquisition. While the relationship of the contract work breakdown structure elements to the statement of work tasks and the contract line items should be clearly traceable, there may not be a one-to-one relationship, nor is it required.

4.5 Specifications and Drawings. The family of specifications and drawings resulting from the progressive steps of systems engineering will conform to the evolved program work breakdown structure and its extensions.

4.6 Contractor Management Control System. The contract work breakdown structure shall serve as the framework for the contractor's management control system which shall provide auditable and traceable summarizations of internal data generated by its performance measurement procedures.

4.7 Integrated Logistics Support (ILS). The integrated logistics support element will be accommodated as indicated in the upper levels of the work breakdown structure in Appendices A through G. Aggregations of work breakdown structure elements for logistics support management and reporting will be accomplished by summation of those level 2 ILS elements which are fully ILS elements (that is, training, peculiar support equipment and initial spares) plus those portions of level 2 elements identified as ILS elements at level 3 (such as support data and ILS management).

4.8 Planning, Programming and Budgeting System. The program work breakdown structure shall be used whenever it is necessary to subdivide the program element data for the planning, programming and budgeting system. The program work breakdown structure shall also be used in cost estimating for future programs and procurement actions.

4.9 Life-Cycle Cost. Life cycle cost is the total cost for the research and development, investment, operation and support, and disposition of a weapon or support system. It commences at the start of the conceptual stage and ends with the retirement/demilitarization of the system from the inventory. The work breakdown structure requirements established by this standard are associated solely with the acquisition of defense materiel items (or major modifications) and, specifically, those elements of research and development and investment that are applicable to all contracted efforts.

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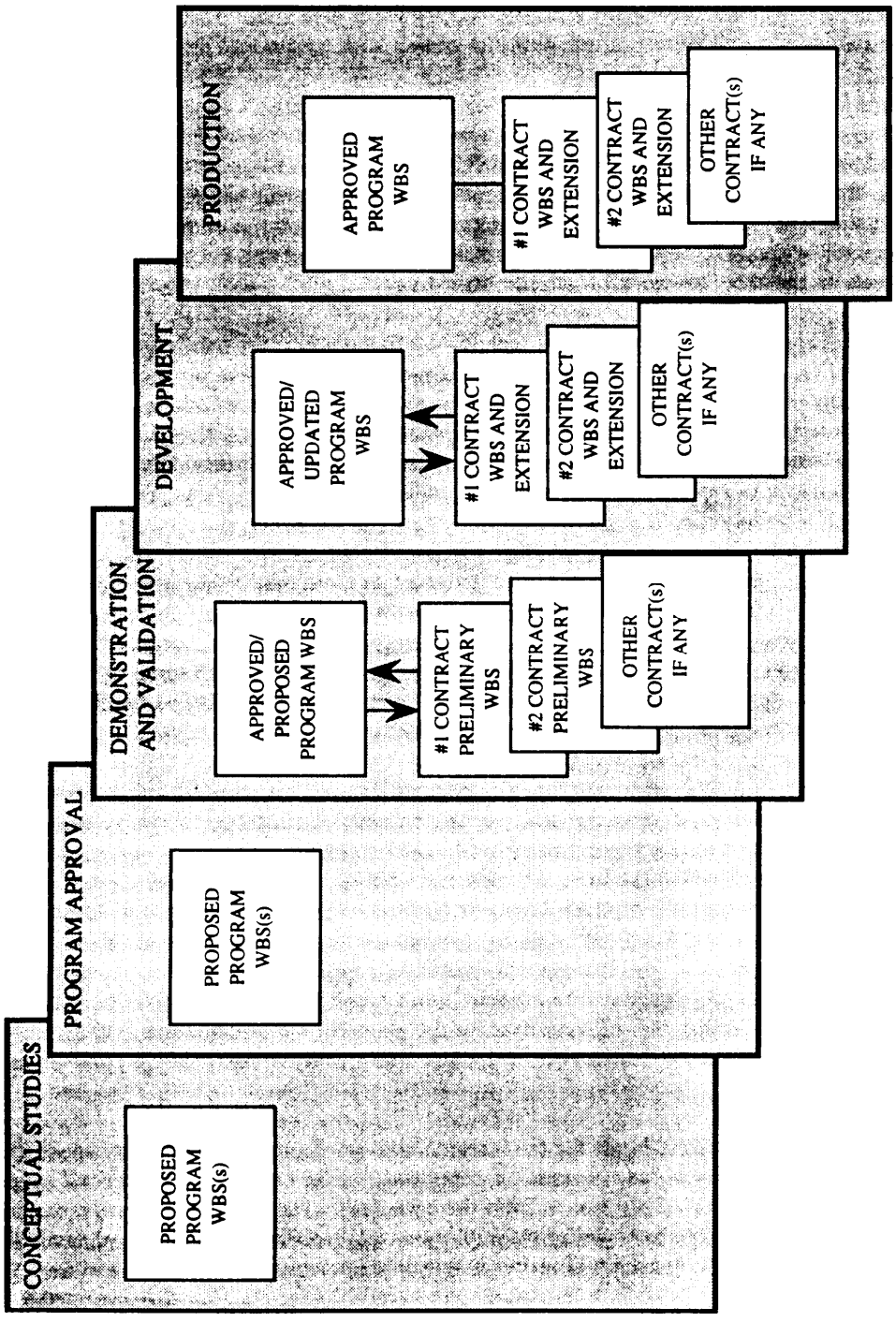

Figure 1. THE EVOLUTION OF A WORK BREAKDOWN STRUCTURE

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4.10 Procurement. The following shall be relatable to elements of the program work breakdown structure:

a. Structure of work statements
b. Contract work breakdown structures
c. Contract line items
d. Configuration items
e. Technical and management reports
f. Government-furnished items

4.11 Reporting. All reporting requirements for the program shall be consistent with the program work breakdown structure. The organization of reporting requirements shall not be construed by either the DoD Component or the contractor as determining the manner in which the defense materiel item is to be designed or produced.

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5. DETAILED REQUIREMENTS

5.1 Work Breakdown Structure. The appropriate category or categories of work breakdown structure(s) and related definitions prescribed herein shall be used in the preparation of the program work breakdown structure for the specific defense materiel item under consideration.

5.1.1 Aircraft Systems. The work breakdown structure and definitions for an aircraft system shall be as specified in Appendix A.

5.1.2 Electronic/Automated Software Systems. The work breakdown structure and definitions for an electronic/automated software system shall be as specified in Appendix B.

5.1.3 Missile Systems. The work breakdown structure and definitions for a missile system shall be as specified in Appendix C.

5.1.4 Ordnance Systems. The work breakdown structure and definitions for an ordnance system shall be as specified in Appendix D.

5.1.5 Ship Systems. The work breakdown structure and definitions for a ship system shall be as specified in Appendix E.

5.1.6 Space Systems. The work breakdown structure and definitions for a space system shall be as specified in Appendix F.

5.1.7 Surface Vehicle Systems. The work breakdown structure and definitions for a surface vehicle system shall be as specified in Appendix G.

5.2 Program Work Breakdown Structure.

5.2.1 Preparation. The program work breakdown structure that encompasses the entire acquisition of a specific defense materiel item shall be prepared by the DoD Component (Program Manager). This will be accomplished by selecting, through systems engineering and management planning processes, applicable elements from one or more of the work breakdown structure(s) specified in Appendices A through G. While the categories and elements specified in Appendices A through G normally will provide the basis for constructing a program work breakdown structure(s), deviations are permitted when a unique requirement exists which these appendices have not addressed.

5.2.1.1 The preparation of the initial program work breakdown structure is normally accomplished by the DoD Component as a result of systems engineering efforts conducted during concept formulation or its equivalent. The initial program work breakdown structure shall be developed to be available for use as the program moves into demonstration and validation and/or engineering and manufacturing development. The systems engineering effort identifies the category of defense materiel items and work breakdown structure elements considered to be most suitable to satisfy the operational needs. Therefore, in preparing a program work breakdown structure for a specific defense materiel item, a selection of the level 2 and level 3 elements from one or more of the work breakdown structures identified in Appendices A through G shall be made. Unless a unique requirement exists which the work breakdown structures as described by this standard have not addressed, only the work breakdown structure elements specified in this standard shall be utilized; and these elements shall be identified with uniform nomenclature, definition, and structural placement. Figure 2, Program Work Breakdown Structure, depicts a format for developing and documenting a program work breakdown structure. Although this structure is normally limited to the upper three levels, additional elements at lower levels may be specified.

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PRIME MISSION SYSTEM			
1	2	3	4
AIRCRAFT SYSTEM			
	AIR VEHICLE		
		AIRFRAME	
		PROPULSION	
		AIR VEHICLE APPLICATIONS S/W	
		AIR VEHICLE SYSTEM S/W	
		COMMUNICATIONS/IDENTIFICATION	
		NAVIGATION/GUIDANCE	
		CENTRAL COMPUTER	
		FIRE CONTROL	
		•	
		•	
		ETC.	
	SYSTEMS ENGINEERING/PROGRAM MANAGEMENT		
		SYSTEMS ENGINEERING	
		PROGRAM MANAGEMENT	
	SYSTEM TEST AND EVALUATION		
		DEVELOPMENT TEST AND EVALUATION	
		OPERATIONAL TEST AND EVALUATION	
		•	
		•	
		ETC.	
	TRAINING		
		EQUIPMENT	
			CLASSROOM EQUIPMENT
			COMPUTER BASED INSTRUCTION SYSTEM
			AIRCREW TRAINING DEVICE (ATD)
			•
			•
			ETC.
		SERVICES	
		FACILITIES	
	PECULIAR SUPPORT EQUIPMENT		
		TEST AND MEASUREMENT EQUIPMENT	
		SUPPORT AND HANDLING EQUIPMENT	
	COMMON SUPPORT EQUIPMENT		
	OPERATIONAL/SITE ACTIVATION		
	INITIAL SPARES AND REPAIR PARTS		

Figure 2. PROGRAM WORK BREAKDOWN STRUCTURE

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5.2.1.2 When deviation from the prescribed elements and definitions in this standard is necessary because of a unique requirement, additional or substitute elements, properly defined, may be used once DoD approval procedures have been complied with and approval has been obtained.

5.2.1.3 The program work breakdown structure is not intended to be constraining. During demonstration and validation or subsequent development efforts, changes may be proposed. Such alternatives shall be evaluated by the DoD Component in terms of the benefits offered in context with the overall program objectives. The changes adopted at the end of the demonstration and validation or subsequent effort shall be reflected in the approved program work breakdown structure. The appropriate elements of the approved structure shall be included in the negotiated contract work breakdown structure(s) and work statements for follow-on development effort.

5.3 Contract Work Breakdown Structure.

5.3.1. Preparation. Only one contract work breakdown structure shall be used in each request for proposal and the ensuing contract. The DoD Component shall structure the upper levels of the contract work breakdown structure by selecting those elements of the program work breakdown structure which apply to the contract and organizing them into a framework which supports the objectives of the program work breakdown structure. Individual subsystems/equipment elements may be extended to lower levels to provide management visibility and control. Figure 3, Work Breakdown Structure Matrix, depicts a format suitable for documenting the subdivision of a program work breakdown structure into contract work breakdown structures for each contractor/source. In the example, the program work breakdown structure level 3 element Fire Control becomes level 1 of the contract work breakdown structure, and all other level 2 common program work breakdown structure elements (ref. Appendix H) are included at level 2 of the contract work breakdown structure. A separate contract for a level 4 program work breakdown structure element, such as Aircrew Training Device, also follows the same procedure. The same contract work breakdown structure drawn from the program work breakdown structure shall be used for each phase (development and production) of a program. The work breakdown structure element System Test and Evaluation is an exception since it is not used for production.

5.3.2 Relationship to Program Work Breakdown Structure. Work breakdown structure "level" commonality between the approved program work breakdown structure and the individual contract work breakdown structure need not be maintained, provided that the approved program work breakdown structure element nomenclature and definitions are not violated. Contract work breakdown structure levels may be different from program work breakdown structure levels. For example, level 3 in the program work breakdown structure may be level 1 or 2 in the contract work breakdown structure. In addition, not all program work breakdown structure elements may be in each contract work breakdown structure. Traceable summarization of individual contract work breakdown structures into the approved program work breakdown structure shall be maintained.

5.3.3 Changes to Contract Work Breakdown Structures. When submitting and negotiating proposals, contractors may propose alternatives to the contract work breakdown structure elements selected in order to enhance effectiveness of the structure in satisfying the objectives of the particular project. Changes proposed by the contractor shall require approval following DoD regulations and procedures. After necessary adjustments are made based on a contractor's proposal and contract negotiations, the elements selected for the contract shall become the basis for further evolutionary extension by the contractor during the contracted effort. All

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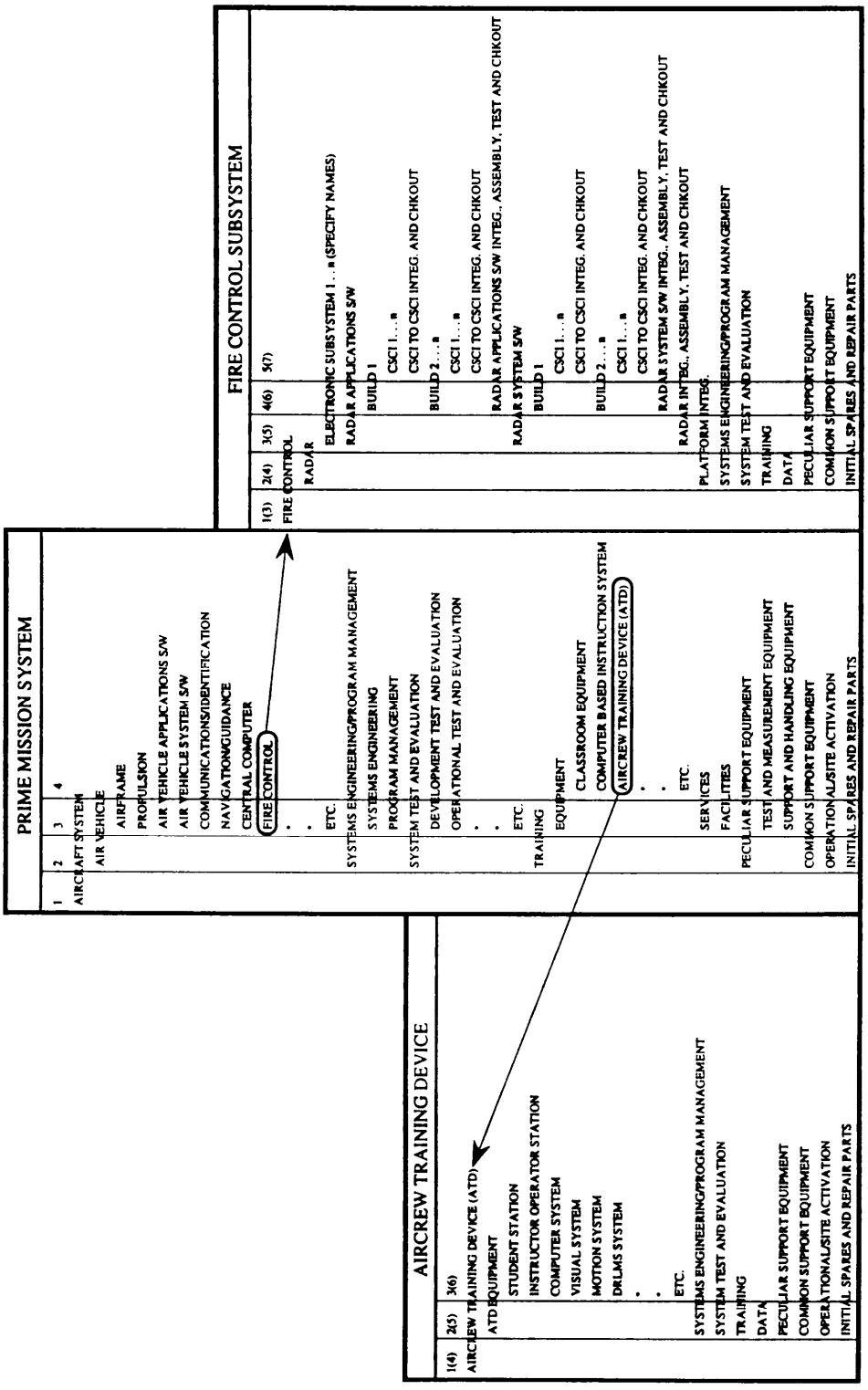

Figure 3. WORK BREAKDOWN STRUCTURE MATRIX

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extensions must sum to the contract work breakdown structure provided by the DoD Component and documented in the approved CCDR Plan.

5.3.4 Extension of Contract Work Breakdown Structure. The contract shall indicate the levels of contract work breakdown structure at which costs shall be reported to the government. Traceability of cost accumulations shall be required to those extended contract work breakdown structure levels which are used by the contractor for cost control purposes.

5.3.4.1 In the extended contract work breakdown structure, consideration shall be given to the specific contractual, technical, and managerial requirements of the defense materiel item. Lower levels may be configuration items, service elements, items of data or meaningful product or management-oriented lower indentures of a higher-level element. The contractor has complete flexibility in extending the contract work breakdown structure below the reporting requirement to reflect how work is to be accomplished, assuming lower elements to be meaningful product or management-oriented lower indentures of a higher-level element. Particular attention shall be given to ensure the correlation of lower levels of the contract work breakdown structure to the specification tree, contract line items, configuration items, data items, and work statement tasks.

5.3.4.2 The lowest level of the extended contract work breakdown structure for project planning, control, and support will be that necessary to reach manageable units of functional tasks and should reflect the way the work is actually being performed by the contractor. For configuration management, the contract work breakdown structure will be extended sufficiently to identify all configuration items. This standard does not require that the contract work breakdown structure level used for program control also be the level needed for configuration control.

5.3.5 Contractually Specified Levels. The contract work breakdown structure provided by the DoD Component shall be attached to and be a part of the solicitation documents. The contract work breakdown structure, as negotiated, shall be attached to the contract. Information as to the extended contract work breakdown structure content shall be available to the government program manager upon request.

5.4 Other Preparation Guidance.

5.4.1 General.

5.4.1.1 The definitions and terminology presented in the appendices to this standard shall be used by the DoD Component as the basis for structuring the specific terminology and definitions for each work breakdown structure element. The contractor(s) shall prepare specific definitions for the contract work breakdown structure (ref. 6.3).

5.4.1.2 Modification and changes such as redesign, rework, re-engineering, retooling, retesting, and refurbishing shall be associated with the work breakdown structure element identified in the contract and affected by the change.

5.4.1.3 The level 2 program work breakdown structure elements Systems Engineering/Program Management and System Test and Evaluation are defined to include any overall systems effort. These elements exclude subsystem or component efforts that can be associated with a hardware/software element. (For example, acceptance tests, qualification tests, and systems engineering for a particular hardware/software component shall be included as part of the effort associated with the component, and not with the level 2 elements of System Test and Evaluation and Systems Engineering/Program Management.) This does not preclude the inclusion of an element titled Systems Engineering/Program Management or System Test and Evaluation in individual contract work breakdown structure(s) even though the contract is for subsystems or components of a program.

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In this case, these efforts shall be summarized into the subsystem or component, rather than the program work breakdown structure level 2 elements of Systems Engineering/Program Management and System Test and Evaluation.

5.4.2 Software. Software shall be accommodated in the appropriate levels of the work breakdown structure. Software shall be identified with the hardware it supports.

5.4.3 Application to Other Than Major Programs. The work breakdown structure practices and procedures contained in this standard may be applied to other than major programs as specified in paragraph 1.2. A program work breakdown structure can be developed for any subsystem/program regardless of size or complexity, by proper application of the product-oriented structuring concepts set forth in this standard.

5.4.3.1 For example, given a radar subsystem within an aggregated program element which is to be managed as a system entity, the radar becomes the level 1 mission system, i.e., radar system. Subordinate to this level 1 radar system is the level 2 (mission) radar equipment and required generic elements to structure the subsystem as a complete system entity. The level 2 radar equipment is logically expanded into level 3 subsystem elements, such as transmitter, receiver, antenna, antenna pedestal, and integration, assembly, test and checkout. Common elements, such as Training, Peculiar Support Equipment, Data, and System Test and Evaluation, are identified at level 2 and extended to lower levels as required for the management and control of all elements necessary to meet the radar system mission requirements in an operational environment.

5.4.3.2 For subsystems/programs involving two or more contractors, this same technique is appropriate for applying a program work breakdown structure to individual contract work breakdown structures by contractor/source.

5.4.4 Acquisition Phase. The program work breakdown structure and contract work breakdown structure(s) shall be established initially at the award of the development contract and extended during development. A single program work breakdown structure, element nomenclature, and definition in accordance with the guidelines prescribed herein shall be maintained throughout the acquisition phases to insure traceability. For purposes of this standard, the acquisition phase will include all applicable contracted efforts.

5.4.5 Placement of Multi-Function Equipment/Software in the Work Breakdown Structure. Flexibility is required in the systems engineering and design process, therefore latitude in placement of the multi-function hardware/software in the program work breakdown structure is permitted. This latitude will be limited, however, by the following principle: multi-function hardware/software will be part of the work breakdown structure element which either includes the equipment in the element's specification or exercises the most critical performance constraint. (Critical performance constraint is that which primarily drives the design of the software.) In cases where the application of this rule results in a conflict in the selection of the proper element, the specification relationship shall take precedence.

5.4.6 Work Breakdown Structure for Subcontracts. The prime contractor shall be responsible for traceable summarizations of subcontractor data supporting its prime contract work breakdown structure elements. As required, the prime contractor shall negotiate a work breakdown structure with the subcontractor that permits the prime contractor to fulfill its work statement and contract work breakdown structure requirements, and which provides adequate control of the subcontractor.

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(14) Army applications in space, to include

6. NOTES

6.1 Intended Use. This military standard is applicable to all defense materiel items (or major modifications) (a) established as an integral program element of the Future Years Defense Program (FYDP), or (b) otherwise designated by the DoD Component or the Under Secretary of Defense (Acquisition).

6.2 Guidance for Contractual Application. The requirements of this standard may be modified when deviations from the prescribed elements and definitions in this standard are necessary because of unique requirements (see 5.2.1.1. and 5.2.1.2.).

6.3 Data Requirements. The following Data Item Description (DID) must be listed, as applicable, on the Contract Data Requirements List (DD Form 1423) when this standard is applied on a contract, in order to obtain the data, except where DoD FAR supplement 27.475-1 exempts the requirement for a DD Form 1423.

Reference Paragraph	DID Number	DID Title
5.4.1.1	DI-MGMT-81334	Contract Work Breakdown Structure and Definitions

6.4 Subject Term (Key Word) Listing.

Acquisition
Contract
Contract Funds Status Report (CFSR)
Contract Work Breakdown Structure
Contractor Cost Data Reporting (CCDR)
Cost Performance Report (CPR)
Cost/Schedule Control Systems Criteria (C/SCSC)
Cost/Schedule Status Report (C/SSR)
Defense Materiel Item
Program Management
Program Work Breakdown Structure
Systems Engineering
Work Breakdown Structure

6.5 Changes from Previous Issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

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CONCLUDING MATERIAL

Custodians:
Army - MI
Navy - NM
Air Force - 10

Review Activities:
Army - AR, AT, AV, CR, MI
Navy - AS, NW, MC, OS, SH
Air Force - 11, 14, 19, 25, 26, 70, 71, 80, 82, 84

Preparing Activity:
Air Force - 10

(Project No. MISC-0051)

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1/1 Consistent with the authority of the ASA(ALT), integrating

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APPENDIX A
WORK BREAKDOWN STRUCTURE AND DEFINITIONS
AIRCRAFT SYSTEMS

10. SCOPE

10.1 This appendix provides the aircraft system work breakdown structure. Definitions for the aircraft air vehicle are provided in this appendix. Definitions for common WBS elements applicable to the aircraft and all other defense materiel items are in Appendix H, Work Breakdown Structure Definitions, Common Elements. This appendix is a mandatory part of the standard. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS

20.1 Government Documents.

20.1.1 Specifications, Standards, and Handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

STANDARDS

MIL-STD-1374	Weight and Balance Data Reporting Forms for Aircraft (Including Rotorcraft)

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, 700 Robbins Avenue, Building #4, Section D, Philadelphia, PA 19111-5094.)

20.2 Non-Government Publications. This section is not applicable to this standard.

30. WORK BREAKDOWN STRUCTURE

30.1 Levels. The following is the work breakdown structure for an aircraft system.

Level 1	Level 2	Level 3
Aircraft System		
	Air Vehicle	
		Airframe
		Propulsion
		Air Vehicle Applications Software
		Air Vehicle System Software
		Communications/Identification
		Navigation/Guidance
		Central Computer
		Fire Control
		Data Display and Controls

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Level 1	Level 2	Level 3
		Survivability
		Reconnaissance
		Automatic Flight Control
		Central Integrated Checkout
		Antisubmarine Warfare
		Armament
		Weapons Delivery
		Auxiliary Equipment
	Systems Engineering/Program Management	
	System Test and Evaluation	
		Development Test and Evaluation
		Operational Test and Evaluation
		Mock-ups
		Test and Evaluation Support
		Test Facilities
	Training	
		Equipment
		Services
		Facilities
	Data	
		Technical Publications
		Engineering Data
		Management Data
		Support Data
		Data Depository
	Peculiar Support Equipment	
		Test and Measurement Equipment
		Support and Handling Equipment
	Common Support Equipment	
		Test and Measurement Equipment
		Support and Handling Equipment
	Operational/Site Activation	
		System Assembly, Installation and Checkout on Site
		Contractor Technical Support
		Site Construction
		Site/Ship/Vehicle Conversion
	Industrial Facilities	
		Construction/Conversion/Expansion
		Equipment Acquisition or Modernization
		Maintenance (Industrial Facilities)
	Initial Spares and Repair Parts	

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40. DEFINITIONS

40.1 Aircraft System. The aircraft system element refers to the complex of equipment (hardware/software), data, services, and facilities required to develop and produce the capability of employing those fixed or movable wing, rotary wing, or compound wing, manned/unmanned air vehicles designed for powered or unpowered (glider) guided flight.

40.1.1 Air Vehicle. The air vehicle element refers to the complete flying aircraft, including airframe, propulsion, and all other installed equipment. It includes the design, development, and production of complete units (i.e., prototype and operationally configured units which satisfy the requirements of their applicable specification(s), regardless of end use).

40.1.1.1 Airframe. The airframe element refers to the assembled structural and aerodynamic components of the air vehicle that support subsystems essential to designated mission requirements. It includes, for example, the basic structure (i.e., wing, empennage, fuselage, and associated manual flight control system), rotary wing pylons, air induction system, thrust reversers, thrust vector devices, starters, exhausts, fuel management system, inlet control system, alighting gear (i.e., tires, tubes, wheels, brakes, hydraulics, etc.), secondary power, furnishings (i.e., crew, cargo, passenger, troop, etc.), instruments (i.e., flight, navigation, engine, etc.), environmental control, life support and personal equipment, racks, mounts, intersystem cables and distribution boxes, etc., which are inherent to and nonseparable from the assembled structure, dynamic systems (i.e., transmissions, gear boxes, propellers, if not furnished as an integral part of the propulsion unit), rotor group, and other equipment homogeneous to the airframe. In addition to the airframe structure and subsystems, this element includes:

a. Integration, Assembly, Test and Checkout. The integration, assembly, test and checkout element includes all efforts as identified in Appendix H, Work Breakdown Structure Definitions, Common Elements (ref. page H-2), to provide the integration, assembly, test and checkout of all elements into the airframe to form the air vehicle as a whole. This includes all administrative and technical engineering labor to perform: integration of level 3 air vehicle and airframe elements; development of engineering layouts; determination of overall design characteristics, and determination of requirements of design review. It includes overall air vehicle design and producibility engineering; detailed production design; acoustic and noise analysis; loads analysis; and stress analysis on interfacing airframe elements and all subsystems; design maintenance effort and development of functional test procedures. It also includes coordination of engineering master drawings and consultation with test and manufacturing groups. It includes tooling planning, design, and fabrication of basic and rate tools and functional test equipments, as well as the maintenance of such equipment. It also includes production scheduling and expediting; joining or installation of structures such as racks, mounts, etc.; installation of seats, wiring ducting, engines, and miscellaneous equipment and painting. Also included are set up, conduct and review of testing assembled components or subsystems prior to installation. This element also contains all effort associated with the installation, integration, test and checkout of the avionic systems into the air vehicle including: design of installation plans; quality assurance planning and control including material inspection; installation; recurring verification tests; and integration with nonavionics airframe subsystems. Also included are: ground checkout prior to flight test; production acceptance testing and service review; quality assurance activities and the cost of raw materials, purchased parts, and purchased equipment associated with integration and assembly.

b. Nonrecurring Avionics System Integration. The nonrecurring avionics system integration element is associated with the individual avionics equipment boxes and avionics software in a functioning system. This element includes: the labor required to analyze, design, and develop the avionics suite interfaces and establish interface compatibility with non-avionics support equipment systems, aircraft systems, and mission planning systems; drawing preparation and establishment of avionics interface equipment requirements and specifications; and technical liaison and coordination with the military service, subcontractors, associated contractors, and test

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groups. Development, testing, and integration of software should be included in air vehicle applications and system software. This element excludes avionics system testing (included in System Test and Evaluation) and aircraft systems engineering efforts (included in Systems Engineering/Program Management).

All effort directly associated with the remaining level 3 WBS elements is excluded. NOTE: The structure and equipment which comprise the airframe can be identified by the use of the weight and balance reporting forms for aircraft (including rotorcraft) in MIL-STD-1374.

40.1.1.2 Propulsion. The propulsion element refers to that portion of the air vehicle that pertains to installed equipment (propulsion unit and other propulsion) to provide power/thrust to propel the aircraft through all phases of powered flight. This element includes the engine as a propulsion unit within itself (e.g., reciprocating, turbo with or without afterburner, or other type propulsion) suitable for integration with the airframe. It also includes thrust reversers, thrust vector devices, transmissions, gear boxes, and engine control units, if furnished as an integral part of the propulsion unit. This element also includes other propulsion equipment required in addition to the engine but not furnished as an integral part of the engine, such as booster units. It also includes the design, development, production, and assembly efforts to provide the propulsion unit as an entity. All effort directly associated with the elements and the integration, assembly, test and checkout of these elements into the air vehicle is excluded. All ancillary equipments that are not an integral part of the engine required to provide an operational primary power source (i.e., air inlets, instruments, controls, etc.) are excluded.

40.1.1.3 Air Vehicle Applications Software. The air vehicle application software element includes all the software that is specifically produced for the functional use of a computer system or multiplex data base in the air vehicle. This element refers to all effort required to design, develop, integrate, and checkout the air vehicle applications Computer Software Configuration Items (CSCIs), not including the nonsoftware portion of air vehicle firmware development and production (ref. ANSI/IEEE Std 610.12). This element excludes software that is an integral part of any specific subsystem and software that is related to other WBS level 2 elements. When the opportunity to collect lower level information exists, the structure and definitions in Appendix B, Electronic/Automated Software Systems, will be used.

40.1.1.4 Air Vehicle System Software. The air vehicle system software element is defined as software designed for a specific computer system or family of computer systems to facilitate the operation and maintenance of the computer system and associated programs for the air vehicle; examples include operating systems (i.e., software that controls the execution of programs), compilers (i.e., computer programs used to translate higher order language programs into relocatable or absolute machine code equivalents), and utilities (i.e., computer programs or routines designed to perform general support function required by other application software, by the operating system or by system users) (ref. ANSI/IEEE Std 610.12). This element refers to all effort required to design, develop, integrate and checkout the air vehicle system software including all software developed to support any air vehicle applications software development. It is defined as air vehicle system software required to facilitate development, integration, and maintenance of any air vehicle software build and CSCI. This excludes all software that is an integral part of any specific subsystem specification or specifically designed and developed for system test and evaluation. This element also excludes software that is an integral part of any specific subsystem, and software that is related to other WBS level 2 elements. When the opportunity to collect lower level information exists, the structure and definitions in Appendix B, Electronic/Automated Software Systems, will be used.

40.1.1.5 Communications/Identification. The communications/identification element refers to that equipment (hardware/software) installed in the air vehicle for communications and identification purposes. It includes, for example, intercoms, radio system(s), identification equipment (IFF), data links, and control boxes associated with the specific equipment. When an integral communication, navigation, and identification package is used, it will be included here. This item contains embedded software, that is, software defined in the item specification

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and provided by the supplier. When the opportunity to collect lower level information exists, the structure and definitions in Appendix B, Electronic/Automated Software Systems, will be used. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the air vehicle is excluded.

40.1.1.6 Navigation/Guidance. The navigation/guidance element refers to that equipment (hardware/software) installed in the air vehicle to perform the navigational guidance function. This element includes, for example, radar, radio, or other essential navigation equipment, radar altimeter, direction finding set, doppler compass, computer, and other equipment homogeneous to the navigation/guidance function. This item contains embedded software, that is, software defined in the item specification and provided by the supplier. When the opportunity to collect lower level information exists, the structure and definitions in Appendix B, Electronic/Automated Software Systems, will be used. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the air vehicle is excluded.

40.1.1.7 Central Computer. The central computer element refers to the master data processing unit(s) responsible for coordinating and directing the major avionic mission systems. This item contains embedded software, that is, software defined in the item specification and provided by the supplier. When the opportunity to collect lower level information exists, the structure and definitions in Appendix B, Electronic/Automated Software Systems, will be used. This item specifically excludes those computers identified by individual functions listed in or under other level 3 WBS elements. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the air vehicle is excluded.

40.1.1.8 Fire Control. The fire control element refers to that equipment (hardware/software) installed in the air vehicle which provides the intelligence necessary for weapons delivery such as bombing, launching, and firing. This element includes, for example, radars and other sensors including radomes; apertures/antennas, if integral to the fire control system, necessary for search, target identification, rendezvous and/or tracking; self-contained navigation and air data systems; dedicated displays, scopes, or sights; and bombing computer and control and safety devices. This item contains embedded software, that is, software defined in the item specification and provided by the supplier. When the opportunity to collect lower level information exists, the structure and definitions in Appendix B, Electronic/Automated Software Systems, will be used. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the air vehicle is excluded.

40.1.1.9 Data Display and Controls. The data display and controls element refers to that equipment (hardware/software) which provides visual presentation of processed data by specially designed electronic devices through interconnection (on or off-line) with computer or component equipment, and associated equipment needed to control the presentation of data. This element provides the necessary flight and tactical information to the crew for efficient management of the aircraft during all segments of the mission profile under day and night all-weather conditions. Excluded are indicators/instruments not controlled by keyboard via the multiplex data bus and panels and consoles which are included under the airframe. It includes multi-function displays, control display units, display processors, and on-board mission planning systems. This item contains embedded software, that is, software defined in the item specification and provided by the supplier. When the opportunity to collect lower level information exists, the structure and definitions in Appendix B, Electronic/Automated Software Systems, will be used. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the air vehicle is excluded.

40.1.1.10 Survivability. The survivability element refers to those equipments (hardware/software) installed in, or attached to, the air vehicle which assist in penetration for mission accomplishment. This element includes, for example, ferret and search receivers, warning devices and other electronic devices, electronic

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countermeasures, jamming transmitters, chaff, infra-red jammers, terrain-following radar, and other devices typical of this mission function. This item contains embedded software, that is, software defined in the item specification and provided by the supplier. When the opportunity to collect lower level information exists, the structure and definitions in Appendix B, Electronic/Automated Software Systems, will be used. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the air vehicle is excluded.

40.1.1.11 Reconnaissance. The reconnaissance equipment element refers to those equipments (hardware/software) installed in, or attached to, the air vehicle necessary to the reconnaissance mission. This element includes, for example, photographic, electronic, infrared, and other sensors; search receivers; recorders; warning devices; magazines; and data link. Gun cameras are excluded. This item contains embedded software, that is, software defined in the item specification and provided by the supplier. When the opportunity to collect lower level information exists, the structure and definitions in Appendix B, Electronic/Automated Software Systems, will be used. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the air vehicle is excluded.

40.1.1.12 Automatic Flight Control. The automatic flight control element refers to electronic devices and sensors, which, in combination with the flight controls subsystem (under airframe), enable the crew to control the flight path of the aircraft as well as to provide lift, drag, trim, or conversion effects. This element includes flight control computers, software, signal processors, and data transmitting elements that are devoted to processing data for either primary or automatic flight control functions. Electronic devices required for signal processing, data formatting, and interfacing between the flight control elements are included, as are the data buses, optical links, and other elements devoted to transmitting flight control data. Flight control sensors such as pressure transducers, rate gyros, accelerometers, and motion sensors are also included. Excluded from this element are the devices such as linkages, control surfaces, and actuating devices covered under the airframe WBS element. Also excluded are avionics devices and sensors such as central computers, navigation computers, avionics data buses and navigation sensors which are included under other avionics WBS elements. This item contains embedded software, that is, software defined in the item specification and provided by the supplier. When the opportunity to collect lower level information exists, the structure and definitions in Appendix B, Electronic/Automated Software Systems, will be used. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the air vehicle is excluded.

40.1.1.13 Central Integrated Checkout. The central integrated checkout element refers to that equipment (hardware/software) installed in the air vehicle for malfunction detection and reporting. This item contains embedded software, that is, software defined in the item specification and provided by the supplier. When the opportunity to collect lower level information exists, the structure and definitions in Appendix B, Electronic/Automated Software Systems, will be used. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the air vehicle is excluded.

40.1.1.14 Antisubmarine Warfare. The antisubmarine warfare element refers to that equipment (hardware/software) installed in the air vehicle peculiar to the antisubmarine warfare mission. This element includes, for example, sensors, computers, displays, etc. This item contains embedded software, that is, software defined in the item specification and provided by the supplier. When the opportunity to collect lower level information exists, the structure and definitions in Appendix B, Electronic/Automated Software Systems, will be used. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the air vehicle is excluded.

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40.1.1.15 Armament. The armament element refers to that equipment (hardware/software) installed in the air vehicle to provide the firepower functions. This element includes, for example, guns, high energy weapons, mounts, turrets, weapon direction equipment, ammunition feed and ejection mechanisms, and gun cameras. This item contains embedded software, that is, software defined in the item specification and provided by the supplier. When the opportunity to collect lower level information exists, the structure and definitions in Appendix B, Electronic/Automated Software Systems, will be used. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the air vehicle is excluded.

40.1.1.16 Weapons Delivery. The weapons delivery element refers to that equipment (hardware/software) installed in the air vehicle to provide the weapons delivery capability. This element includes, for example, launchers, pods, bomb racks, pylons, integral release mechanisms, and other mechanical or electro-mechanical equipments specifically oriented to the weapons delivery function. This element excludes the bombing/navigation system which is included in the fire control element. This item contains embedded software, that is, software defined in the item specification and provided by the supplier. When the opportunity to collect lower level information exists, the structure and definitions in Appendix B, Electronic/Automated Software Systems, will be used. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the air vehicle is excluded.

40.1.1.17 Auxiliary Equipment. The auxiliary equipment element refers to auxiliary airframe, electronics, and/or armament/weapons delivery equipment not allocable to individual element equipments, or which provide the ancillary functions to the applicable mission equipments. It includes, for example, auxiliary airframe equipment such as external fuel tanks, pods, and rotodomes. It also includes such multi-use equipment as antennas, control boxes, power supplies, environmental control, racks, mountings, etc., which are not homogeneous to the prescribed WBS elements. Auxiliary armament/weapons delivery equipment includes flares and ejection mechanisms, ejector cartridges, and other items peculiar to the mission function that are not identifiable to the armament or weapons delivery elements set forth in 40.1.1.15 and 40.1.1.16 of this appendix. This item contains embedded software, that is, software defined in the item specification and provided by the supplier. When the opportunity to collect lower level information exists, the structure and definitions in Appendix B, Electronic/Automated Software Systems, will be used. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the air vehicle is excluded.

Definitions for common WBS elements applicable to the aircraft and all other defense materiel items are in Appendix H, Work Breakdown Structure Definitions, Common Elements (ref. pages H-1 through H-10).

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APPENDIX B
WORK BREAKDOWN STRUCTURE AND DEFINITIONS
ELECTRONIC/AUTOMATED SOFTWARE SYSTEMS

10. SCOPE

10.1 This appendix provides the electronic/automated software system work breakdown structure. Definitions for the prime mission product (PMP) and platform integration are provided in this appendix. Definitions for common WBS elements applicable to the electronic/automated software system and all other defense materiel items are in Appendix H, Work Breakdown Structure Definitions, Common Elements. This appendix is a mandatory part of the standard. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS

20.1 Government Documents.

20.1.1 Specifications, Standards, and Handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

STANDARDS

MIL-STD-196	Joint Electronics Type Designation System
MIL-STD-1464	Army Nomenclature System
MIL-STD-1661	Mark and Mod Nomenclature System
MIL-STD-1812	Type Designation, Assignment and Method for Obtaining
DOD-STD-2167	Defense System Software Development

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, 700 Robbins Avenue, Building #4, Section D, Philadelphia, PA 19111-5094.)

20.2 Non-Government Publications. This section is not applicable to this standard.

30. WORK BREAKDOWN STRUCTURE

30.1 Levels. The following is the work breakdown structure for an electronic/automated software system. For any subsystem, specify by name or nomenclature, if assigned.

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Level 1	Level 2	Level 3
Electronic/Automated Software System		
	Prime Mission Product (PMP)	
		Subsystem 1...n (Specify Names)
		PMP Applications Software
		PMP System Software
		Integration, Assembly, Test and Checkout
	Platform Integration	
	Systems Engineering/Program Management	
	System Test and Evaluation	
		Development Test and Evaluation
		Operational Test and Evaluation
		Mock-ups
		Test and Evaluation Support
		Test Facilities
	Training	
		Equipment
		Services
		Facilities
	Data	
		Technical Publications
		Engineering Data
		Management Data
		Support Data
		Data Depository
	Peculiar Support Equipment	
		Test and Measurement Equipment
		Support and Handling Equipment
	Common Support Equipment	
		Test and Measurement Equipment
		Support and Handling Equipment
	Operational/Site Activation	
		System Assembly, Installation and Checkout on Site
		Contractor Technical Support
		Site Construction
		Site/Ship/Vehicle Conversion

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Level 1	Level 2	Level 3
	Industrial Facilities	
		Construction/Conversion/Expansion
		Equipment Acquisition or Modernization
		Maintenance (Industrial Facilities)
	Initial Spares and Repair Parts	

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40. DEFINITIONS

40.1 Electronic/Automated Software System. The electronic/automated software system element refers to the complex of equipment (hardware/software), data, services, and facilities required to develop and produce an electronic, automated, or software system capability such as a command and control system, radar system, communications system, information system, sensor system, navigation/guidance system, electronic warfare system, support system, etc. The decision rule used to differentiate between the Electronic/Automated Software System category and other defense materiel item categories is: When the item is a stand alone system or used on several systems, but not accounted for in these other systems, the Electronic/Automated Software System category will be used. When the opportunity to collect lower level information on electronic and software items exists, regardless of which defense materiel item category is selected, the structure and definitions in this appendix apply.

40.1.1 Prime Mission Product (PMP). The PMP element refers to the hardware and software used to accomplish the primary mission of the defense materiel item. It includes all integration, assembly, test and checkout, as well as all technical and management activities associated with individual hardware/software elements. Also included are integration, assembly, test and checkout associated with the overall PMP. When the electronic/automated software system comprises several PMPs, each will be listed separately at level 2. Also included are all whole and partial prime contractor, subcontractor, and vendor breadboards, brassboards, and qualification test units. It also includes the design, development and production of complete units (i.e., the prototype or operationally configured units which satisfy the requirements of their applicable specification(s), regardless of end use). It excludes only those "less than whole" units (e.g., test, spares, etc.) consumed or planned to be consumed in support of system level tests. This element also includes factory special test equipment, special tooling, and production planning required to fabricate the PMP. Duplicate or modified factory special test equipment delivered to the government for depot repair is excluded and should be included in the peculiar support equipment element.

40.1.1.1 Subsystem 1...n (Specify Names). This element refers to all hardware and software components of the specific electronic/automated software subsystem, including all associated special test equipment, special tooling, production planning, and all technical and management activities. The software components consist of the applications and system software required to direct and maintain the specific electronic/automated software subsystem. This element includes all in-plant integration, assembly, test and checkout of hardware components and software into an electronic/automated software subsystem including the subsystem hardware and software integration and test. Also included are the interface materials and parts required for the in-plant integration and assembly of other level 4 components into the electronic/automated software subsystem and all materials and parts or other mating equipments furnished by/to an integrating agency or contractor. It includes, for example, cables, conduits, connectors, shelters, and other devices associated with the operational electronic/automated software subsystem. It also includes the design, development, production, and assembly efforts to provide each electronic/automated software subsystem as an entity. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the PMP is excluded.

40.1.1.2 PMP Applications Software. The applications software element is defined as software that is specifically produced for the functional use of a computer system (ref. ANSI/IEEE Std 610.12). Examples are battle management, weapons control, and data base management. This element refers to all effort required to design, develop, integrate and checkout the PMP applications computer software configuration items (CSCIs), not including the nonsoftware portion of PMP firmware development and production. This excludes all software that is an integral part of any specific hardware subsystem specification.

All software that is an integral part of any specific equipment system and subsystem specification or specifically designed and developed for system test and evaluation should be identified with that system, subsystem, or

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effort. It may be appropriate to collect lower level information when it exists. In such cases, the following structure and definitions should be used:

LEVEL 4	LEVEL 5
Build 1...n (Specify Names)	CSCI 1...n (Specify Names) CSCI to CSCI Integration and Checkout
Integration, Assembly, Test and Checkout	

a. Build 1...n (Specify Names) - A software build is an aggregate of one or more CSCIs that satisfies a specific set or subset of requirements based on development of software as defined in DOD-STD-2167A. When incremental, spiral, or other software development method is used, multiple builds may be necessary to meet program requirements. A build is a separately tested and delivered product. Within builds are CSCIs. When a build is complete, a portion or all of one or more CSCIs will be completed. Therefore, a CSCI may appear in more than one build, but will be successively more functional as each build is completed.

b. Computer Software Configuration Item (CSCI) 1...n (Specify Names) - An aggregation of software or any of its discrete portions which satisfies an end use function and has been designated by the government for configuration management. CSCIs are the major software products of a system acquisition which are developed in accordance with DOD-STD-2167. This includes reusable software components, such as commercial off-the-shelf software, government furnished software, or software specifically developed for reuse. This element includes Computer Software Components (CSCs) which are functionally or logically a distinct part of a CSCI, distinguished for convenience in designing and specifying a complex CSCI as an assembly of subordinate elements. It includes the effort associated with the requirements analysis, design, coding and testing, CSCs integration and testing, CSCI formal qualification testing, and software problem resolution of each CSCI.

c. CSCI to CSCI Integration and Checkout - Includes integration and test, verification and validation and the systems engineering and technical control of the CSCIs. Integration and test is the planning, conducting and analysis of tests that verify correct and proper performance of each CSCI operating as a whole with other CSCIs. Planning includes: (1) defining test scope and objectives, (2) establishing the test approach, acceptance criteria, verification methods, order of integration, inputs, and methods to record results, and (3) establishing test locations, schedules, and responsibilities of those involved. The conducting and analysis of tests encompasses: (1) developing test procedures, (2) preparing test data and expected results, (3) executing the test procedures and recording test results, (4) reducing test results,identifying errors, and preparing test data sheets, and (5) reporting results. Verification and validation is the effort that may be accomplished to insure the performance and quality of each CSCI with other CSCIs. This element excludes the software integration and checkout associated with the individual CSCIs.

(NOTE: The defined software structure for lower level information is appropriate whether it is associated with a specific system or subsystem or considered software intensive or stand alone. Reference Appendix I, User Guide, for guidelines on developing a stand alone software work breakdown structure.)

40.1.1.3 PMP System Software. The PMP system software element is defined as software designed for a specific computer system or family of computer systems to facilitate the operation and maintenance of the computer system and associated programs, for example, operating systems, compilers, and utilities (ref. ANSI/IEEE Std 610.12). This element refers to all effort required to design, develop, integrate and checkout the PMP system software including all software developed to support any PMP applications software

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development. It is defined as PMP system software which is required to facilitate development, integration, and maintenance of any PMP software build and CSCI. This excludes all software that is an integral part of any specific hardware subsystem specification or is specifically designed and developed for system test and evaluation. The structure shown in paragraph 40.1.1.2 should be used when lower level information is desired.

40.1.1.4 Integration, Assembly, Test and Checkout. The integration, assembly, test, and checkout element includes all effort as identified in Appendix H, Work Breakdown Structure Definitions, Common Elements (ref. page H-2) to provide a complete PMP system. The integration, assembly, test and checkout element includes hardware and PMP software integration and test.

40.1.2 Platform Integration. The platform integration element refers to all effort involved in providing technical and engineering services to the platform manufacturer or integrator during the installation and integration of the PMP into the host vehicle. This element includes: the labor required to analyze, design, and develop the interfaces with other host vehicle subsystems; drawing preparation and establishment of equipment requirements and specifications; and technical liaison and coordination with the military services, subcontractors, associated contractors, and test groups. Specifically excluded from this element is all integration effort not directly associated with the host vehicle and management liaison with the military services, subcontractors, and associated contractors.

Definitions for common WBS elements applicable to the electronic/automated software system and all other defense materiel items are in Appendix H, Work Breakdown Structure Definitions, Common Elements (ref. pages H-1 through H-10).

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APPENDIX C
WORK BREAKDOWN STRUCTURE AND DEFINITIONS
MISSILE SYSTEMS

10. SCOPE

10.1 This appendix provides the missile system work breakdown structure. Definitions for the missile air vehicle and command and launch equipment are provided in this appendix. Definitions for common WBS elements applicable to the missile and all other defense materiel items are in Appendix H, Work Breakdown Structure Definitions, Common Elements. This appendix is a mandatory part of the standard. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. WORK BREAKDOWN STRUCTURE

30.1 Levels. The following is the work breakdown structure for a missile system.

Level 1	Level 2	Level 3
Missile System		
	Air Vehicle	
		Propulsion (Stages I...n, As Required)
		Payload
		Airframe
		Reentry System
		Post Boost System
		Guidance and Control
		Ordnance Initiation Set
		Airborne Test Equipment
		Airborne Training Equipment
		Auxiliary Equipment
		Integration, Assembly, Test and Checkout
	Command and Launch	
		Surveillance, Identification and Tracking Sensors
		Launch and Guidance Control
		Communications
		Command and Launch Applications Software
		Command and Launch System Software
		Launcher Equipment
		Auxiliary Equipment
	Systems Engineering/Program Management	

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Level 1	Level 2	Level 3
	System Test and Evaluation	
		Development Test and Evaluation
		Operational Test and Evaluation
		Mock-ups
		Test and Evaluation Support
		Test Facilities
	Training	
		Equipment
		Services
		Facilities
	Data	
		Technical Publications
		Engineering Data
		Management Data
		Support Data
		Data Depository
	Peculiar Support Equipment	
		Test and Measurement Equipment
		Support and Handling Equipment
	Common Support Equipment	
		Test and Measurement Equipment
		Support and Handling Equipment
	Operational/Site Activation	
		System Assembly, Installation and Checkout on Site
		Contractor Technical Support
		Site Construction
		Site Conversion
	Industrial Facilities	
		Construction/Conversion/Expansion
		Equipment Acquisition or Modernization
		Maintenance (Industrial Facilities)
	Initial Spares and Repair Parts	

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40. DEFINITIONS

40.1 Missile System. The missile system element refers to the complex of equipment (hardware/software), data, services, and facilities required to develop and produce the capability of employing a missile weapon in an operational environment to produce the destructive effect on selected targets. Examples include Trident, Peacekeeper, Tomahawk, Maverick, Sidewinder, etc.

40.1.1 Air Vehicle. The air vehicle element refers to the primary means for delivering the destructive effect to the target, including the capability to generate or receive intelligence, to navigate and penetrate to the target area and to detonate the warhead. It also includes the design, development, and production of complete units (i.e., the prototype or operationally configured units which satisfy the requirements of their applicable specification(s), regardless of end use).

40.1.1.1 Propulsion (Stages I...n, As Required). The propulsion system provides the thrust to propel the air vehicle on its intended flight. The propulsion system may be composed of one or more stages which ignite, burn, and are jettisoned sequentially over the course of missile flight. The propulsion element may be solid, liquid, or air-breathing. It includes, for example, structure (integral to the propulsion system), propellant, controls, instrumentation, and all other installed subsystem equipment integral to the rocket motor or engine as an entity within itself. It also includes the design, development, production, and assembly efforts to provide each stage as an entity. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the air vehicle is excluded.

a. Rocket Motor/Booster. A rocket motor/booster refers to the solid propulsion system which carries within it both the fuel and oxygen required for its operation. It includes, for example, an arm and firing device, solid propellant, movable nozzles, casings, integration, etc.

b. Engine. The engine includes both liquid propulsion systems and air breathing systems. The liquid propulsion engine includes, for example, the main engines, verniers/auxiliary engines, fluid supply system, liquid propellant, attitude control equipment, structure (integral to the engine), raceway, interstage, combustion section, turbines, nozzles, rotors, etc. The air breathing engine obtains oxygen from the surrounding atmosphere to support the combustion of its fuel. Ramjets and turbojets are examples of air breathing engines which may be used to provide propulsion for cruise-type missiles. This element includes the following subsystems for air breathing engines: mainframe, compressor, combustion section, air inlets/exhaust ducts, turbine nozzle assembly, turbine rotor, bearings and housings, and fuel subsystem. In addition to basic components, air breathing engine systems require various accessory components such as pumps, injectors, turbines, motors, diffusers, and igniters.

40.1.1.2 Payload. The payload element refers to the subsystem containing the warhead and its support assemblies where no reentry system exists. Normally, payload consists only of the warhead and its associated arming and fuzing equipment. However, with complex munitions containing submunitions, the payload subsystem may mimic the larger system by having its own guidance and control, fuze, safe-arm, and propulsion. This element includes, for example, arming and fuzing device, warhead, and target detection device. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the air vehicle is excluded.

40.1.1.3 Airframe. The airframe element includes the structural framework that provides the aerodynamic shape, mounting surfaces and environmental protection for the missile components which are not directly applicable to other specific level 3 air vehicle subsystems. The airframe for endo-atmospheric missiles normally includes such items as wings and fins which provide aerodynamic flight control in response to electro-mechanical signals and are attached to the missile body; and structural body assemblies including the structure, covers, such as passive nosepieces, skins, adhesives, and fairings not directly applicable to any other level 3 air

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vehicle subsystem. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the air vehicle is excluded.

40.1.1.4 Reentry System. For exo-atmospheric missiles, the reentry system is the aggregate of prime equipment items consisting of a deployment module, reentry vehicles, payload, penetration aids and ascent shroud, which provide structural support and environmental protection of nuclear payloads during the ground deployment and flight. The reentry vehicle is the aero-structure which provides reentry protection for the internally carried warheads and the arming and fusing system which provides the proper electrical signals to detonate the warhead. Where the system has the capability for independent maneuvers, the reentry vehicle will contain navigation, guidance, control, sensors, and processing systems which provide the reentry systems capability to acquire and track targets and execute the necessary flight path to the selected target. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the air vehicle is excluded.

40.1.1.5 Post Boost System. In exo-atmospheric missiles, the post boost system provides the roll rate control and the final velocity to adjust and deploy the payload. For a single warhead missile, this element includes the structure, external protection material, velocity control system, and deployment group. In the case of the multiple warhead missile, the element includes structure, axial engines, attitude control equipment, propellant storage assembly, and pressurized system. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the air vehicle is excluded.

40.1.1.6 Guidance and Control. The guidance and control element refers to the equipment used to control the missile flight to the target. Functions include acquiring and tracking targets, receiving guidance intelligence data from various sources including sensors and feedback from control commands to follow the necessary flight path to intercept the target. The inputs may also include interface status, inertial acceleration, and attitude changes. The outputs include missile control, ordnance firing commands, status, instrumentation, and timing signals. In addition, the equipment provides flight electrical power, missile electrical interconnection, and a structure to contain the guidance and control components when the structure is not part of a separately identified airframe element. For exo-atmospheric missiles, this includes missile cables, stage cables, stage connectors, airborne power supply, electronic battery, ordnance battery, ordnance initiation set, missile electronic and computer assembly, inertial measurement unit, the guidance and control software, in-flight coolant assembly, and guidance and control integration, assembly, test and checkout. For endo-atmospheric missiles, this includes seekers, mission computer, global positioning receiver, inertial platform, inertial sensors, altimeter, data link, power subsystems, windows/domes, distributive systems, autopilot, flight control actuators, guidance and control software, and guidance and control integration, assembly, test and checkout. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the air vehicle is excluded.

40.1.1.7 Ordnance Initiation Set. In exo-atmospheric missiles, the ordnance initiation set initiates all ordnance events throughout the missile and ground system (except reentry system components). Upon receipt of an electrical signal from the missile guidance and control system, the ordnance initiation set firing units convert the signal into ordnance outputs to the detonating cords. Among those ordnance events are: stage separation, motor ignition, gas generator ignition, shroud separation, etc. This element includes the through bulkhead initiators, ordnance test harnesses, and firing units/exploding bridgewires. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the air vehicle is excluded.

40.1.1.8 Airborne Test Equipment. The airborne test equipment element refers to an instrumented payload that is interchangeable with the live warhead and suitable for developmental test firing. This element includes, for example, recovery systems, special instrumentation, telemetry equipment, etc. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the air vehicle is excluded.

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40.1.1.9 Airborne Training Equipment. The airborne training equipment element refers to an exercise payload that is interchangeable with the live warhead and suitable for training firing. This element includes, for example, recovery systems, special instrumentation, telemetry equipment, etc., associated with the training mission. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the air vehicle is excluded.

40.1.1.10 Auxiliary Equipment. The auxiliary equipment element refers to that additional equipment generally excluded from other specific level 3 elements. This element includes, for example, environmental control, safety and protective subsystems, destruct systems, etc., if these were not accounted for in other WBS elements. It also includes equipment of a single purpose and function which is necessary for accomplishing the assigned mission. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the air vehicle is excluded.

40.1.1.11 Integration, Assembly, Test and Checkout. The integration, assembly, test and checkout element includes all efforts as identified in Appendix H, Work Breakdown Structure Definitions, Common Elements (ref. page H-2), to provide a complete missile.

40.1.2 Command and Launch. The command and launch element refers to the subsystems installed at a launch site or aboard launch vehicles required to store, make ready, and launch the air vehicles of the missile system. This element includes those equipments required to acquire and condition the necessary intelligence of selected targets, reach launch decisions, command the launch, and provide guidance and control where such capability is not self contained aboard the air vehicle. It also includes the design, development and production of complete units (i.e., the prototype or operationally configured units which satisfy the requirements of their applicable specification(s), regardless of end use).

40.1.2.1 Surveillance, Identification and Tracking Sensors. The surveillance, identification, and tracking sensors element refers to those sensors required to support missile systems by maintaining surveillance against incoming targets and providing the data required for targeting, launch, midcourse guidance and homing where such capability is not self-contained aboard a missile system air vehicle. For all classes of missile systems, they may include tracking of the missile system air vehicles as required for guidance and control or range safety. Subsystems used in safety, destruct, test, or training activities are not included unless they are required operational items. This element may include, for example, sensors of any spectrum (radar, optical, infrared, etc.) which are external to the air vehicle.

40.1.2.2 Launch and Guidance Control. The launch and guidance control element refers to the equipment to target air vehicles, make launch decisions, and command launch. This includes such items as the control and checkout console, data displays, secure code device, programmer group, communication control console, command message processing group, and digital data group. It also includes equipment at the launch facility/vehicle and/or the launch control center(s) (air, sea, or mobile). It also includes the launch code processing system.

40.1.2.3 Communications. The communications element refers to the equipment, not resident on the air vehicle, which distributes intelligence between the air vehicle and the command and launch equipment. This element includes inter-communication subsystems of launch sites for tactical and administrative message flow and ties between sensor, data processing, launch, and guidance control subsystems. Communications may interface with existing fixed communication facilities or communication subsystems of launch platforms which are associated systems to the missile system.

40.1.2.4 Command and Launch Applications Software. The command and launch applications software element includes all the software required to direct and perform the operations of the command and launch equipment (ref. ANSI/IEEE Std 610.12). This element refers to all effort required to design, develop, integrate, and checkout the command and launch applications computer software configuration items (CSCIs),

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not including the nonsoftware portion of command and launch firmware development and production. When the opportunity to collect lower level information exists, the structure and definitions in Appendix B, Electronic/Automated Software Systems, will be used.

40.1.2.5 Command and Launch System Software. The command and launch system software element is defined as software designed for a specific computer system or family of computer systems to facilitate the operation and maintenance of the computer system and associated programs, for example, operating systems, compilers, and utilities (ref. ANSI/IEEE Std 610.12). This element refers to all effort required to design, develop, integrate and checkout the command and launch system software including all software developed to support any command and launch applications software development. It is defined as command and launch system software which is required to facilitate development, integration, and maintenance of any command and launch software CSCI. This excludes all software that is an integral part of any specific hardware subsystem specification or specifically designed and developed for system test and evaluation. When the opportunity to collect lower level information exists, the structure and definitions in Appendix B, Electronic/Automated Software Systems, will be used.

40.1.2.6 Launcher Equipment. The launcher equipment element refers to the means to launch the missile air vehicle from stationary sites or mobile launch platforms. It includes vehicles, rail launchers, canisters, capsules, tubes, pods and devices which support, suspend or encase the air vehicle for firing. It also includes associated hardware such as umbilicals, harnesses, pyrotechnics, and electronics. This element may include storage facilities and checkout stations for readiness verification when these are integral to the launcher. It may include safety and protective elements when these are not integral to the launch platform or site facilities.

40.1.2.7 Auxiliary Equipment. The auxiliary equipment element refers to the general purpose/multi-usage ground equipment utilized to support the various operational capabilities of the command and launch equipments and are generally excluded from other specific level 3 elements. This element includes, for example, power generators, power distribution systems, environmental control, cabling, malfunction detection, fire prevention, security systems, and other common-usage items not applicable to specific elements of the ground based equipment.

Definitions for common WBS elements applicable to the missile and all other defense materiel items are in Appendix H, Work Breakdown Structure Definitions, Common Elements (ref. pages H-1 through H-10).

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APPENDIX D
WORK BREAKDOWN STRUCTURE AND DEFINITIONS
ORDNANCE SYSTEMS

10. SCOPE

10.1 This appendix provides the ordnance system work breakdown structure. Definitions for the complete round and launch system are provided in this appendix. Definitions for common WBS elements applicable to the ordnance system and all other defense materiel items are in Appendix H, Work Breakdown Structure Definitions, Common Elements. This appendix is a mandatory part of the standard. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS.

This section is not applicable to this appendix.

30. WORK BREAKDOWN STRUCTURE

30.1 Levels. The following is the work breakdown structure for an ordnance system.

Level 1	Level 2	Level 3
Ordnance System		
	Complete Round	
		Structure
		Payload
		Guidance and Control
		Fuze
		Safety/Arm
		Propulsion
		Integration, Assembly, Test and Checkout
	Launch System	
		Launcher
		Carriage
		Fire Control
		Ready Magazine
		Adapter Kits
		Integration, Assembly, Test and Checkout
	Systems Engineering/Program Management	
	System Test and Evaluation	
		Development Test and Evaluation
		Operational Test and Evaluation
		Mock-ups
		Test and Evaluation Support
		Test Facilities

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Level 1	Level 2	Level 3
	Training	
		Equipment
		Services
		Facilities
	Data	
		Technical Publications
		Engineering Data
		Management Data
		Support Data
		Data Depository
	Peculiar Support Equipment	
		Test and Measurement Equipment
		Support and Handling Equipment
	Common Support Equipment	
		Test and Measurement Equipment
		Support and Handling Equipment
	Operational/Site Activation	
		System Assembly, Installation and Checkout on Site
		Contractor Technical Support
		Site Construction
		Site Conversion
	Industrial Facilities	
		Construction/Conversion/Expansion
		Equipment Acquisition or Modernization
		Maintenance (Industrial Facilities)
	Initial Spares and Repair Parts	

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40. DEFINITIONS

40.1 Ordnance System. The ordnance system element refers to the complex of equipment (hardware/software), data, services, and facilities required to develop and produce the capability for applying munitions to a target. It includes the munitions (nuclear, biological, chemical, psychological, and pyrotechnic) and the means of launching or firing the munitions, and is represented by MK48 torpedo system, SNAKEYE bomb, Combined Effects Munitions, GATOR, Sensor Fuzed Weapon, 8-inch Howitzer, and .223 caliber ammunition. Excluded are aerospace guided missiles and land, sea, or air delivery vehicles.

40.1.1 Complete Round. The complete round element refers to all the components that are necessary for firing one shot, such as mines, bombs, rockets, torpedoes, naval guns, rifles, and artillery ammunition. It includes structural elements, warhead or payload, fuze, safety/arming devices, guidance equipment, and propellant/propulsion equipment. For artillery ammunition, the complete round consists of the projectile including structure, warhead, fuze, guidance and control (if applicable), safety/arming devices, propelling charge, and rocket motor (if applicable). It also includes the design, development, and production of complete units (i.e., the prototype or operationally configured units which satisfy the requirements of their applicable specification(s), regardless of end use).

40.1.1.1 Structure. The structure element refers to the portion of the complete round which carries the payload to the target. It is the basic housing of a bomb or rocket, casing of a projectile, body of a torpedo, or the tactical munitions dispenser containing submunitions. It also includes those structural devices which provide stability and control (i.e., fins, parachutes, anchors). All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the complete round is excluded.

40.1.1.2 Payload. The payload element refers to the subsystem that contains the warhead and its support assemblies. In some munitions, such as small arms ammunition, the payload may only be the warhead (i.e., a projectile assembly containing the kill mechanism of the round and its associated high explosives, chemicals, biological agents, nuclear devices, and pyrotechnics). With complex munitions containing submunitions, such as Combined Effects Munitions, the payload subsystem may include guidance and control, fuze, safety/arm, and propulsion as defined in 40.1.1.3, 40.1.1.4, 40.1.1.5, and 40.1.1.6 of this appendix. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the complete round is excluded.

40.1.1.3 Guidance and Control. The guidance and control element refers to the complex of electronic equipment (hardware/software) which evaluates and correlates the path of the complete round with target information, and which performs the necessary functions to enable the payload to intercept the target. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the complete round is excluded.

40.1.1.4 Fuze. The fuze element refers to the mechanical or electronic device in the complete round designed to detonate or to set forces into action to detonate the charge or primer under desired conditions. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the complete round is excluded.

40.1.1.5 Safety/Arm. The safety/arm element refers to the device in the complete round which controls the capability of initiating the explosive sequence (e.g., mechanical, hydrostatic, inertial, counters, and timers). All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the complete round is excluded.

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40.1.1.6 Propulsion. The propulsion element refers to the chemical, mechanical, or electrical devices, such as explosive powder charges, chemical precision initiation charges, electric power modules, and rocket motors which provide the forces to transport the complete round from the launch position to the target. For artillery ammunition, this element includes the cartridge case, if applicable, and primer as well as the explosive charge itself. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the complete round is excluded.

40.1.1.7 Integration, Assembly, Test and Checkout. The integration, assembly, test and checkout element includes all efforts as identified in Appendix H, Work Breakdown Structure Definitions, Common Elements (ref. page H-2), to provide a complete round.

40.1.2 Launch System. The launch system element refers to the equipment (hardware/software) for controlling or sending forth the munitions on a desired course or trajectory -- the ordnance system less the complete round. It is defined as rifles, artillery pieces, naval guns, mortar cannons, machine guns, and the equipment for launching torpedoes and rockets or dropping bombs (e.g., the launcher, fire control equipment, and the ready magazine). It includes all effort associated with the design, development, and production of complete units (i.e., the prototype or operationally configured units which satisfy the requirements of their applicable specification(s), regardless of end use).

40.1.2.1 Launcher. The launcher element refers to the structural device designed to support and hold munitions in position for firing or release (e.g., suspension and release systems, rail, rocket pods, mine racks or dispensers, and torpedo tubes). For guns and artillery, it includes tubes, recoil assemblies, breech mechanisms, mounts, and rifle stocks. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the launch system is excluded.

40.1.2.2 Carriage. The carriage element refers to the primary equipment (hardware/software) which serves as a platform to accommodate the other level 3 elements and provides mobility to the complete launch system (e.g., T-frame, hull/chassis, wheels, tires, tubes, brakes, hydraulics, and secondary power batteries/generators), which are an integral part of the carriage itself and not directly a part of other level 3 elements. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the launch system is excluded.

40.1.2.3 Fire Control. The fire control element refers to the equipment (hardware/software) for controlling the direction, volume, and time of fire or release of munitions through the use of electrical, electronic, optical, or mechanical systems, devices or aids. For rifles and small arms, it includes sighting devices and trigger mechanisms. For artillery, naval guns, and heavy mortars, it additionally includes aiming mechanisms in traverse and elevation, radar and other sensors, computers and other equipment for performing fire control computations. For air-dropped munitions, it includes gunsights, intervalometers, and other sensor and computational devices for controlling the release of the munitions. For torpedoes, it includes sonar and other sensors, computers, control consoles, and devices for presetting torpedo speed and direction. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the launch system is excluded.

40.1.2.4 Ready Magazine. The ready magazine element refers to the structure or compartment for storing ammunition or explosives in a ready-for-use condition or position (e.g., part of a gun or firearm which holds the ammunition ready for chambering and feed mechanisms for placing the ammunition in a position ready for chambering). All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the launch system is excluded.

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40.1.2.5 Adapter Kits. The adapter kits element refers to the equipment (hardware/software) for adapting the launch system to particular applications (e.g., vehicle adapter kits for adaptation to different aircraft models, kits for backpacking, etc.). All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the launch system is excluded.

40.1.2.6 Integration, Assembly, Test and Checkout. The integration, assembly, test and checkout element includes all efforts as identified in Appendix H, Work Breakdown Structure Definitions, Common Elements (ref. page H-2), to provide a complete launch system.

Definitions for common WBS elements applicable to the ordnance system and all other defense materiel items are in Appendix H, Work Breakdown Structure Definitions, Common Elements (ref. pages H-1 through H-10).

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APPENDIX E
WORK BREAKDOWN STRUCTURE AND DEFINITIONS
SHIP SYSTEMS

10. SCOPE

10.1 This appendix provides the ship system work breakdown structure. Definitions for the ship are provided in this appendix. Definitions for common WBS elements applicable to the ship and all other defense materiel items are in Appendix H, Work Breakdown Structure Definitions, Common Elements. This work breakdown structure must be used for ship acquisition pricing data, ship design, weight data, configuration management and ILS engineering data. It is permissible for the contractor's internal work breakdown structure to differ from these summary elements with the approval of the appropriate government organization. The approved internal management work breakdown structure must be traceable to and capable of being reported to the work breakdown structure and definitions defined by this appendix. This appendix is a mandatory part of the standard. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS.

This section is not applicable to this appendix.

30. WORK BREAKDOWN STRUCTURE

30.1 Levels. The following is the work breakdown structure for a ship system.

Level 1	Level 2	Level 3
Ship System		
	Ship	
		Hull Structure
		Propulsion Plant
		Electric Plant
		Command and Surveillance
		Auxiliary Systems
		Outfit and Furnishings
		Armament
		Integration/Engineering
		Ship Assembly and Support Services
	Systems Engineering/Program Management	
	System Test and Evaluation	
		Development Test and Evaluation
		Operational Test and Evaluation
		Mock-ups
		Test and Evaluation Support
		Test Facilities

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Level 1	Level 2	Level 3
	Training	
		Equipment
		Services
		Facilities
	Data	
		Technical Publications
		Engineering Data
		Management Data
		Support Data
		Data Depository
	Peculiar Support Equipment	
		Test and Measurement Equipment
		Support and Handling Equipment
	Common Support Equipment	
		Test and Measurement Equipment
		Support and Handling Equipment
	Operational/Site Activation	
		System Assembly, Installation and Checkout on Site
		Contractor Technical Support
		Site Construction
		Site Conversion
	Industrial Facilities	
		Construction/Conversion/Expansion
		Equipment Acquisition or Modernization
		Maintenance (Industrial Facilities)
	Initial Spares and Repair Parts	

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40. DEFINITIONS

40.1 Ship System. The ship system element refers to the complex of equipment (hardware/software), data, services, and facilities required to attain the capability of operating or supporting the operation of naval weapons, or performing other naval tasks at sea.

40.1.1 Ship. The ship element refers to the waterborne vehicle of a ship system. It includes all types of surface and subsurface water vehicles such as combatants, auxiliaries, amphibious, and special-purpose ships. It includes the design, development, and production of complete units (i.e., the prototype or operationally configured units which satisfy the requirements of their applicable specification(s), regardless of end use).

40.1.1.1 Hull Structure. The hull structure element refers to the assembled main hull body with all structure subdivision. This element includes, for example, shell plating, longitudinal and transverse framing, platforms and decks, superstructure, foundations, structural bulkheads, enclosures and sponsors; castings, forgings, and welds; fixed ballast; doors and closures; king-posts, masts, and service platforms; and sonar domes. It also includes compartment testing.

40.1.1.2 Propulsion Plant. The propulsion plant element refers to those major components installed primarily for propulsion and the systems necessary to make these components operable. This element includes, for example, boilers and energy converters, propulsion units, main condensers and air ejectors, shafting, bearings, propellers, combustion air supply system, uptakes, propulsion control equipment, main stream, feed water and condensate, circulating and cooling water, fuel oil service and lubricating oil system. It also includes nuclear steam generators, reactors, reactor coolant and auxiliary systems, nuclear power plant control, and radiation shielding.

40.1.1.3 Electric Plant. The electric plant element refers to the power generating and distribution systems installed primarily for ship service and emergency power and lighting. This element includes, for example, the electric power generation, power distribution switchboards, power distribution system, and lighting system.

40.1.1.4 Command and Surveillance. The command and surveillance element is defined as all equipment (hardware/software) and associated systems installed to receive information from off-ship source, to transmit to off-ship receivers, and to distribute information throughout the ship. It also includes sensing and data systems required for navigation and weapon fire control. This element includes, for example, navigation equipment, interior communication systems and equipment, gun fire control system, nonelectronic countermeasure systems, electronic countermeasure systems, missile fire control systems, antisubmarine warfare fire control and torpedo fire control systems, radar systems, radio communication systems, electronic navigation systems, space vehicle electronic tracking systems, sonar systems, electronic tactical data systems, and all associated software.

40.1.1.5 Auxiliary Systems. The auxiliary systems element is defined as those systems required for ship control, safety, provisioning, and habitability. It includes the auxiliary machinery and piping systems; the hull mechanical handling systems; and ship control surfaces such as rudders, hydrofoils, and driving planes. This element includes, for example, heating, ventilation air conditioning systems; refrigerating spaces; plant and equipment; gasoline, JP-5, all liquid cargo piping, oxygen-nitrogen and aviation lubricating oil systems; plumbing installation, saltwater service systems, fire extinguishing systems, drainage, ballast, trimming, heating, and stabilizer tank systems; fresh water system, scuppers and deck drains; fuel and diesel oil filling, venting, stowage and transfer systems; tank heating systems, compressed air system, auxiliary steam, exhaust steam and steam drains, buoyancy control system, distilling plant; and steering system, mooring, towing, anchor and aircraft handling systems, deck machinery, elevators, moving stairways, stores strikedown and stores handling equipment, operating gear for retracting and elevating units, aircraft elevators; aircraft arresting gear, barriers, and barricades; catapults and jet blast deflectors, replenishment at sea and cargo handling systems.

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U.S. Army Program Management System

40.1.1.6 Outfit and Furnishings. The outfit and furnishings element is defined as those outfit equipments and furnishings required for habitability and operability which are not specifically included in other ship elements. This element includes, for example, hull fittings; boats, boat stowage and handlings; rigging and canvas; ladders and gratings; nonstructural bulkheads and doors; painting, deck covering, hull insulation; storerooms, stowage and lockers; equipment for utility space, workshops, laboratories, test areas, alley, pantry, scullery and commissary outfit; furnishings for living spaces, offices, control centers, machinery spaces, medical, dental and pharmaceutical spaces; and nonpropulsion space shielding.

40.1.1.7 Armament. The armament element is defined as the complex of armament and related ammunition handling, stowage, and support facilities; and cargo munitions handling, stowage, and support facilities. This element includes, for example, guns, and gun mounts; ammunition handling systems and stowage; special weapons handling and storage; rocket and missile launching devices, handling systems and stowage; air launched weapons handling systems and stowage; and cargo munitions handling and stowage.

40.1.1.8 Integration/Engineering. The integration/engineering element is defined as that engineering effort and related material associated with the design, development, and rework to provide the ship as a whole exclusive of that included under the Systems Engineering/Program Management element. This element includes, for example, construction drawings, engineering calculations, weighing and weight calculation, photographs, models, and shipbuilders information drawings.

40.1.1.9 Ship Assembly and Support Services. The ship assembly and support services element is defined as those efforts and material associated with the construction which cannot be logically and practicably identified with, or related to other level 3 elements. This element includes, for example, staging, scaffolding, and cribbing; temporary utilities and services; molds, templates, jigs, fixtures, and special production tools; dry-docking, inspection, insurance, launching, and delivery.

Definitions for common WBS elements applicable to the ship and all other defense materiel items are found in Appendix H, Work Breakdown Structure Definitions, Common Elements (ref. pages H-1 through H-10).

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APPENDIX F
WORK BREAKDOWN STRUCTURE AND DEFINITIONS
SPACE SYSTEMS

10. SCOPE

10.1 This appendix provides the space system work breakdown structure. Definitions for the launch vehicle, orbital transfer vehicle, space vehicle, ground command, control, communications and mission equipment, flight support operations and services, and storage are provided in this appendix. Definitions for common WBS elements applicable to the space system and all other defense materiel items are in Appendix H, Work Breakdown Structure Definitions, Common Elements. This appendix is a mandatory part of the standard. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS.

This section is not applicable to this appendix.

30. WORK BREAKDOWN STRUCTURE

30.1 Levels. The following is the work breakdown structure for a space system.

Level 1	Level 2	Level 3
Space System		
	Launch Vehicle	
		Propulsion (Single Stage Only)
		Stage I
		Stage II...n (As Required)
		Strap-On Units (As Required)
		Shroud (Payload Fairing)
		Guidance and Control
		Integration, Assembly, Test and Checkout
	Orbital Transfer Vehicle	
		Propulsion (Single Stage Only)
		Stage I
		Stage II...n (As Required)
		Strap-On Units (As Required)
		Guidance and Control
		Integration, Assembly, Test and Checkout
	Space Vehicle	
		Spacecraft
		Payload I...n (As Required)
		Reentry Vehicle
		Orbit Injector/Dispenser
		Integration, Assembly, Test and Checkout

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Level 1	Level 2	Level 3
	Ground Command, Control, Communications and Mission Equipment	
		Sensor I...n (As Required)
		Telemetry, Tracking and Control
		External Communications
		Data Processing Equipment
		Launch Equipment
		Auxiliary Equipment
	Systems Engineering/Program Management	
	System Test and Evaluation	
		Development Test and Evaluation
		Operational Test and Evaluation
		Mock-ups
		Test and Evaluation Support
		Test Facilities
	Training	
		Equipment
		Services
		Facilities
	Data	
		Technical Publications
		Engineering Data
		Management Data
		Support Data
		Data Depository
	Peculiar Support Equipment	
		Test and Measurement Equipment
		Support and Handling Equipment
	Common Support Equipment	
		Test and Measurement Equipment
		Support and Handling Equipment
	Operational/Site Activation	
		System Assembly, Installation and Checkout on Site
		Contractor Technical Support
		Site Construction
		Site/Ship/Vehicle Conversion

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Level 1	Level 2	Level 3
	Flight Support Operations and Services	
		Mate/Checkout/Launch
		Mission Control
		Tracking and C^3
		Recovery Operations and Services
		Launch Site Maintenance/Refurbishment
	Storage	
		Planning and Preparation
		Storage
		Transfer and Transportation
	Industrial Facilities	
		Construction/Conversion/Expansion
		Equipment Acquisition or Modernization
		Maintenance (Industrial Facilities)
	Initial Spares and Repair Parts	

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40. DEFINITIONS

40.1 Space System. The space system element refers to the complex of equipment (hardware/software), data, services, and facilities required to attain and/or maintain an operational capability in space. To achieve an operational capability in space it is necessary to have the ability to develop, deliver, and maintain mission payload(s) in specific orbit. This requires the ability to develop and produce a capability for the placement, operation, and recovery of both manned and unmanned space systems. Space systems include launch vehicles, orbital transfer vehicles, shrouds, space vehicles, communications, command and control facilities and equipment, and any mission equipment or other items necessary to provide an operational capability in space.

40.1.1 Launch Vehicle. The launch vehicle element refers to the primary means for providing initial thrust to place a space vehicle into its operational environment. The launch vehicle is the prime propulsion portion of the complete flyaway (not to include the orbital transfer vehicle and space vehicle). The launch vehicle may be of a single-stage or multiple-stage configuration. This element includes, for example, the structure, propulsion, guidance and control, and all other installed equipment integral to the launch vehicle as an entity within itself. It also includes the design, development, and production of complete units (i.e., the prototype or operationally configured units which satisfy the requirements of their applicable specification(s), regardless of end use).

40.1.1.1 Propulsion (Single Stage Only). The propulsion element refers to the means for generating the launch vehicle into its operational orbit or its intended path. This element includes, for example, the engine, structure, propellant and fuel, distribution and control of propellant and fuel, starting means, safety devices, and internal environmental control when grouped as a functional entity. It also includes the design, development, production, and assembly efforts to provide the propulsion subassembly as an entity. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the launch vehicle is excluded.

40.1.1.2 Stage I. This element refers to the launch vehicle stage which provides initial lift-off propulsion for the complete launch vehicle (flyaway) and cargo. This element includes, for example, the structure, propulsion, controls, instrumentation, and all other installed subsystem equipment integral to the stage as an entity within itself. It also includes the design, development, production, and assembly efforts to provide Stage I as an entity. Strap-on units are excluded. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the launch vehicle is excluded.

40.1.1.3 Stage II...n (As Required). This element refers to the second and subsequent launch vehicle stages (if applicable) which are used to place a space vehicle into its operational environment. This element provides propulsion following separation of the first stage and subsequent stages (if applicable), and includes the structure, propulsion, controls, instrumentation, separation subsystems, and all other installed subsystem equipment integral to the stage as an entity within itself. It also includes the design, development, production, and assembly efforts to provide each stage as an entity. Strap-on units are excluded. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the launch vehicle is excluded.

40.1.1.4 Strap-On Units (As Required). In the event strap-on units are employed, this element refers to the solid or liquid propulsion assemblies that provide additional thrust or propellant to assist the launch vehicle in placing a spacecraft into its operational orbit. This element refers to a complete set of strap-on units and includes, for example, the case, nozzle, igniter, tanks, mounting structure, cordage, etc. It also includes the design, development, production, and assembly efforts to provide the strap-on units as an entity. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the launch vehicle is excluded.

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40.1.1.5 Shroud (Payload Fairing). This element refers to the protective covering and equipment which is mated to the launch vehicle and protects the cargo (i.e., orbital transfer vehicle or space vehicle/orbital transfer vehicle combination) prior to and during the launch vehicle ascent phase. This item includes the structure, instrumentation, separation, power, and thermal control subsystems, and integration, assembly, test and checkout. The structure includes, for example, the shroud structure, mechanisms and hinges. The instrumentation includes hardware and software required to measure the environment and loads being experienced by the shroud during the ascent phase until shroud separation and deployment. The separation subsystem includes, for example, the sequencers, ordnance, and other necessary mechanisms to assure a successful shroud separation from the launch vehicle and cargo. The power system provides the necessary generation, storage and distribution of electrical power and signals, hydraulic power, and any other power required by the shroud. The thermal control system maintains (within allowable limits) the temperature of the shroud and/or any mission equipment within it. The thermal control function may be accomplished either passively or actively. This includes, for example, thermal paint, insulation, and heatshield tiles.

40.1.1.6 Guidance and Control. The guidance and control equipment (hardware/software) refers to the means for generating or receiving guidance intelligence, conditioning the intelligence to produce control signals, and generating appropriate control forces. Controllers may interface with the structure by actuating moveable aero surfaces or with the propulsion system to produce control reaction forces or may independently produce reaction forces for control. If the design is such that electronics are packaged into a single rack or housing as an assembly, this rack or housing will be considered part of the guidance and control system. This element includes, for example, the guidance intelligence system, computer, sensing elements, etc. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the launch vehicle is excluded.

40.1.1.7 Integration, Assembly, Test and Checkout. The integration, assembly, test and checkout element includes all efforts as identified in Appendix H, Work Breakdown Structure Definitions, Common Elements (ref. page H-2), to provide a complete launch vehicle.

40.1.2 Orbital Transfer Vehicle. The orbital transfer vehicle refers to any transportation system which is utilized for placing spacecraft in an operational environment following launch vehicle separation/deployment. Orbital transfer vehicle includes, for example, "upper-stages" and orbital maneuvering vehicles. The orbital transfer vehicle may be of a single-stage or multiple-stage configuration. This element includes the structure, propulsion, guidance and control, all other installed equipment, and all software integral to the vehicle. It also includes the design development, and production of complete units (i.e., the prototype or operationally configured units which satisfy the requirements of their applicable specification(s), regardless of end use).

40.1.2.1 Propulsion (Single Stage Only). The propulsion element refers to the means for generating the orbital transfer vehicle into its operational orbit. This element includes, for example, the engine, structure, propellant and fuel, distribution and control of propellant and fuel, starting means, safety devices, and internal environmental control when grouped as a functional entity. It also includes the design, development, production, and assembly efforts to provide the propulsion structure as an entity. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the orbital transfer vehicle is excluded.

40.1.2.2 Stage I. This element refers to the orbital transfer vehicle stage which provides initial propulsion for the orbital transfer vehicle following separation or deployment from the launch vehicle. This includes, for example, the structure, propulsion, controls, instrumentation, separation, and all other installed subsystem equipment integral to the stage as an entity within itself. It also includes the design, development, production, and assembly efforts to provide Stage I as an entity. Strap-on units are excluded. All effort directly associated

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with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the orbital transfer vehicle is excluded.

40.1.2.3 Stage II...n (As Required). This element refers to the second orbital transfer vehicle stage and subsequent stages (as required) which are used to place a space vehicle into its operational environment. This provides propulsion following separation of the first stage, and includes the structure, propulsion, controls, instrumentation, separation subsystems, and all other installed subsystem equipment integral to the stage as an entity within itself. It also includes the design, development, production, and assembly efforts to provide each stage as an entity. Strap-on units are excluded. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the orbital transfer vehicle is excluded.

40.1.2.4 Strap-On Units (As Required). In the event strap-on units are employed, this element refers to the solid or liquid propulsion assemblies that provide additional thrust or propellant to assist the orbital transfer vehicle in placing a space vehicle into its operational orbit. This element refers to a complete set of strap-on units and includes, for example, the case, nozzle, igniter, tanks, mounting structure, cordage, etc. It also includes the design, development, production, and assembly efforts to provide the strap-on units as an entity. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the orbital transfer vehicle is excluded.

40.1.2.5 Guidance and Control. The guidance and control equipment (hardware/software) refers to the means for generating or receiving guidance intelligence, conditioning the intelligence to produce control signals, and generating appropriate control forces. Controllers may interface with the structure by actuating moveable aero surfaces or with the propulsion system to produce control reaction forces or may independently produce reaction forces for control. If the design is such that electronics are packaged into a single rack or housing as an assembly, this rack or housing will be considered part of the guidance and control element. This element includes, for example, the guidance intelligence system, computer, sensing elements, etc. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the orbital transfer vehicle is excluded.

40.1.2.6 Integration, Assembly, Test and Checkout. The integration, assembly, test and checkout element includes all efforts as identified in Appendix H, Work Breakdown Structure Definitions, Common Elements (ref. page H-2), to provide a complete orbital transfer vehicle.

40.1.3 Space Vehicle. The space vehicle element refers to a complete vehicle, or group of vehicles placed into space (operational orbit environment). This element includes spacecraft, payload, reentry vehicle and orbit injection/dispenser and integration, assembly, test and checkout. It also includes the design, development, and production of complete units (i.e., the prototype or operationally configured units which satisfy the requirements of their applicable specification(s), regardless of end use).

40.1.3.1 Spacecraft. The spacecraft element refers to the principal operating space vehicle which serves as a housing or platform for carrying a payload and other mission-oriented equipments in space. This element includes, for example, structure, power, attitude determination and control, and other equipments characteristic of spacecraft. It also includes all design, development, production, and assembly efforts to provide the spacecraft as an entity. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the space vehicle is excluded.

40.1.3.2 Payload. The payload element refers to that equipment provided for special purposes in addition to the normal equipment integral to the spacecraft or reentry vehicle. It includes, for example, experimental equipment placed on board the vehicle, flight crew equipment (space suits, life support, and safety equipment),

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communications, displays and instrumentation, telemetry equipment and other equipments that are specifically mission-oriented to collect data for future planning and projection purposes. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the space vehicle is excluded.

40.1.3.3 Reentry Vehicle. The reentry vehicle element refers to the principal operating vehicle specifically designed to safely reenter the atmosphere in order to land a payload (experimental equipment or crew). This element includes, for example, navigation and guidance, power supply, command and control, attitude control, environmental control, propulsion, and other equipments homogeneous to the reentry vehicle. It also includes all design, development, production, and assembly efforts to provide the reentry vehicle as an entity. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the space vehicle is excluded.

40.1.3.4 Orbit Injector/Dispenser. The orbit injector/dispenser element refers to the function of placing orbiting objects in the planned orbital path. This element includes, for example, the structure, propulsion, instrumentation and stage interface, separation subsystem, and other equipment necessary for integration with other level 3 elements. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the space vehicle is excluded.

40.1.3.5 Integration, Assembly, Test and Checkout. The integration, assembly, test and checkout element includes all efforts as identified in Appendix H, Work Breakdown Structure Definitions, Common Elements (ref. page H-2), to provide a complete space vehicle.

40.1.4 Ground Command, Control, Communications and Mission Equipment. The ground command, control, communications and mission equipment element refers to the ground hardware/software equipment used for: communicating between control and tracking facilities, monitoring the health and status of space vehicles, commanding the space vehicle's hardware, adjusting the space vehicle's orbit as required for space vehicle health or mission purpose. It includes the design, development, and production of complete units (i.e., the prototype or operationally configured units which satisfy the requirements of their applicable specification(s), regardless of end use). Examples of two configurations for the ground command, control, communications and mission equipment are: the parabolic dish-based antenna system and the phased array-based antenna system. If a ground site has multiple antenna configurations, each will have its own separate command and control equipment, communications equipment, data processing equipment and test equipment.

40.1.4.1 Sensor I...n (As Required). This element includes those hardware and software elements/components which comprise the sensor system. Typical hardware normally includes the antenna, platform/pedestal, radome, transmission equipment, reception equipment and other sensor subsystems. It also includes the design, development, production, and assembly efforts to provide each sensor as an entity.

40.1.4.2 Telemetry, Tracking and Control. The telemetry, tracking and control element refers to the hardware/software elements that facilitate launch decisions and command and control of the aerospace vehicle. This element includes, for example, supplementary means for guidance of those aerospace vehicles not having completely self-contained guidance and control and means to command destruct. It also includes control and check-out consoles, data displays, and mission records.

40.1.4.3 External Communications. The external communications element includes, for example, the hardware/software components that allow the ground station to communicate with any external data link or source (i.e.,telephone (analog) lines, digital data lines, nonsatellite radio receivers). While the terrestrial data lines may connect to radio of other satellite communications stations, the external communications subsystem

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ends where these links physically connect to the secure communications, modulation/demodulation (modem) or coder/decoder equipment.

40.1.4.4 Data Processing Equipment. The data processing equipment includes the hardware/software components that provide the activities and means to condition data generated at the launch site or aboard the space vehicle, or data received from associated systems to accommodate the needs of command and control or mission data processing. This element includes, for example, central processing unit (computer), peripheral equipment, and the software required to operate the data processing equipment.

40.1.4.5 Launch Equipment. The launch equipment element refers to the means to launch the aerospace vehicle from stationary sites. This element may include storage facilities and checkout stations for readiness verification when these are integral to the launcher. It may also include safety and protective elements when these are not integral to the launch platform or facilities.

40.1.4.6 Auxiliary Equipment. The auxiliary equipment element refers to the general purpose/multi-usage ground equipment utilized to support the various operational capabilities of the command and launch equipments. This element includes, for example, power generators, power distribution systems, environmental control, cabling, malfunction detection, fire prevention, security systems, and other common-usage items not applicable to specific elements of the ground based equipment.

40.1.5 Flight Support Operations and Services. The flight support operations and services element refers to the mate/checkout/launch; mission control; tracking; and command, control and communications (C^3); recovery operations and services; and launch site maintenance/refurbishment. This element supports the launch vehicle, orbital transfer vehicle, and/or space vehicle during an operational mission.

40.1.5.1 Mate/Checkout/Launch. This element refers to preflight operations and services subsequent to production and/or storage, and the actual launch of the complete system and payload. It includes effort and materials to conduct equipment receiving and checkout at launch site, preflight assembly and checkout, pre/post flight data reduction and analysis, and any prelaunch flight control/mission control planning.

40.1.5.2 Mission Control. The mission control element includes, for example, the personnel and material required to operate individual mission control centers and to perform ground command and control with the space vehicles. It includes the mission control centers such as, Constellation Command Center, the Battle Management/Command Control Center (BM/C^3), the Space Asset Support System Control Center, and the Space Transportation Control Center. (It excludes the tracking and communications centers; these are included in WBS element 40.1.5.3.)

40.1.5.3 Tracking and C^3. The tracking and C^3 element refers to the personnel and material required to perform the functions of telemetry, tracking, controlling, and data retrieval for the mission control systems. These systems may be located on the ground or in space, such as, the Satellite Control Facility; the Remote Tracking Station; the Tracking, Data, Relay Satellite System; and other ground/space tracking systems. (It excludes the initial acquisition of the tracking and C^3; acquisition of these systems are included in WBS element 40.1.4.)

40.1.5.4 Recovery Operations and Services. The recovery operations and services element refers to all contractor effort and material necessary to effect recovery of the space vehicle or other mission equipment. This element includes, for example, the launch site recovery forces, reentry site recovery forces, logistics support to recovery forces, logistics support to the recovery operations, communications, and transportation of recovered equipment to assigned facilities.

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40.1.5.5 Launch Site Maintenance/Refurbishment. The launch site maintenance/refurbishment element refers to the organization maintenance/management of launch vehicle facilities, mission equipment, and support at the launch base. This element includes the requirements to clean up and refurbish each launch site after each launch.

40.1.6 Storage. The storage element refers to those costs of holding portions of the space system while awaiting use of the system. These periods of holding are those resulting from schedule changes and/or technological problems exogenous to the portion of the space system being stored, prepared for storage, or recovered from storage.

40.1.6.1 Planning and Preparation. The planning and preparation element refers to all planning and preparation costs for the storage of all systems/subsystems associated with the launch vehicle, orbital transfer vehicle, and space vehicle equipment. It includes the generation of any storage/maintenance instructions and documents necessary for the storage and maintenance of repairable systems/subsystems.

40.1.6.2 Storage. The storage element refers to the storage and maintenance cost incurred while the systems/subsystems of the launch vehicle, orbital transfer vehicle, and space vehicle equipment are in storage.

40.1.6.3 Transfer and Transportation. The transfer and transportation element refers to transfer and storage costs incurred when the systems/subsystems of the launch vehicle, orbital transfer vehicle, and space vehicle equipment are required to be transferred from one location and stored in another location. This item also includes costs of relocating systems/subsystems from one storage area to another storage area when necessitated by mission requirements.

Definitions for common WBS elements applicable to the space system and all other defense materiel items are in Appendix H, Work Breakdown Structure Definitions, Common Elements (ref. pages H-1 through H-10).

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APPENDIX G
WORK BREAKDOWN STRUCTURE AND DEFINITIONS
SURFACE VEHICLE SYSTEMS

10. SCOPE

10.1 This appendix provides the surface vehicle system work breakdown structure. Definitions for the primary vehicle and secondary vehicle are provided in this appendix. Definitions for common WBS elements applicable to the surface vehicle and all other defense materiel items are in Appendix H, Work Breakdown Structure Definitions, Common Elements (ref. pages H-1 through H-10). This appendix is a mandatory part of the standard. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS.

This section is not applicable to this appendix.

30. WORK BREAKDOWN STRUCTURE

30.1 Levels. The following is the work breakdown structure for a surface vehicle.

Level 1	Level 2	Level 3
Surface Vehicle System		
	Primary Vehicle	
		Hull/Frame
		Suspension/Steering
		Power Package/Drive Train
		Auxiliary Automotive
		Turret Assembly
		Fire Control
		Armament
		Body/Cab
		Automatic Loading
		Automatic/Remote Piloting
		Nuclear, Biological, Chemical
		Special Equipment
		Navigation
		Communications
		Integration, Assembly, Test and Checkout
	Secondary Vehicle	Same as Primary Vehicle
	Systems Engineering/Program Management	

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Level 1	Level 2	Level 3
	System Test and Evaluation	
		Development Test and Evaluation
		Operational Test and Evaluation
		Mock-ups
		Test and Evaluation Support
		Test Facilities
	Training	
		Equipment
		Services
		Facilities
	Data	
		Technical Publications
		Engineering Data
		Management Data
		Support Data
		Data Depository
	Peculiar Support Equipment	
		Test and Measurement Equipment
		Support and Handling Equipment
	Common Support Equipment	
		Test and Measurement Equipment
		Support and Handling Equipment
	Operational/Site Activation	
		System Assembly, Installation and Checkout on Site
		Contractor Technical Support
		Site Construction
		Site Conversion
	Industrial Facilities	
		Construction/Conversion/Expansion
		Equipment Acquisition or Modernization
		Maintenance (Industrial Facilities)
	Initial Spares and Repair Parts	

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40.0 DEFINITIONS

40.1 Surface Vehicle System. The surface vehicle system element refers to the complex of equipment, data, services, and facilities required to develop and produce a vehicle system with the capability to navigate over the surface. Surface vehicle category includes vehicles primarily intended for general purpose applications and those intended for mating with specialized payloads. This element includes cargo and logistics vehicles, mobile work units and combat vehicles. It also includes combat vehicles serving as armored weapons platforms, reconnaissance vehicles, and amphibians.

40.1.1 Primary Vehicle. The primary vehicle element refers to the mobile element of the system embodying means for performing operational missions. This element includes means of propulsion and structure for adaptation of mission equipment or accommodations for disposable loads. It also includes the design, development, and production of complete units (i.e., the prototype or operationally configured units which satisfy the requirements of their applicable specification(s), regardless of end use).

40.1.1.1 Hull/Frame. The hull/frame element refers to the vehicle's primary load bearing component which provides the structural integrity to withstand the operational loading stresses generated while traversing various terrain profiles. This element could be a simple wheeled vehicle frame or a more complicated combat vehicle hull which satisfies not only the structural requirements but also provides armor protection. It includes all structural subassemblies and appendages which attach directly to the primary structure. This element, for example, includes towing and lifting fittings, bumpers, hatches and grilles. It also includes provision to accommodate other subsystems such as mountings for suspension, weapons, turret, truck body, cab, special equipment loads, etc. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the primary vehicle is excluded.

40.1.1.2 Suspension/Steering. The suspension/steering element refers to the means for generating tractive efforts, thrust, lift, and steering forces generally at or in proximity to the earth's surface and adapting the vehicle to the irregularities of the surface. This element includes, for example, wheels, tracks, brakes, and steering gears for traction and control functions; and rudder thrust devices and trim vanes for amphibians. It also includes springs, shock absorbers, skirts, and other suspension members. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the primary vehicle is excluded.

40.1.1.3 Power Package/Drive Train. The power package/drive train element refers to the means for generating power and delivering power in the required quantities and driving rates to the driving member. This element includes for example, engine-mounted auxiliaries such as air ducting and manifolds, controls and instrumentation, exhaust systems, and cooling means. It also includes such power transport components as clutches, transmission, shafting assemblies, torque converters, differentials, final drivers, and power takeoffs. It may include brakes and steering when these are integral to power transmission rather than in the suspension/steering element. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the primary vehicle is excluded.

40.1.1.4 Auxiliary Automotive. The auxiliary automotive element refers to the group of subsystems (hardware/software) which provide services to all of the primary vehicle subsystems, as distinguished from the special equipment subsystems, and which outfit the chassis. This element includes, for example, the vehicle electrical or electronics system, on-board diagnostics/prognostics system, fire extinguisher system and controls, chassis mounted accessories such as the winch and power take-off, tools and on-vehicle equipment. When otherwise not provided for, it includes crew accommodations. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the primary vehicle is excluded.

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40.1.1.5 Turret Assembly. The turret assembly element refers to the structure and equipment installations required to provide the fighting compartment element of combatant vehicles. This element includes turret armor and radiological shielding, turret rings, slip rings, attachments and appendages such as hatches and cupolas, and accommodations for personnel, weapons, and command and control. It excludes fire control and stabilization system. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the primary vehicle is excluded.

40.1.1.6 Fire Control. The fire control element refers to that equipment (hardware/software) installed in the vehicle which provides intelligence necessary for weapons delivery such as launching and firing. This element includes, for example, radars and other sensors necessary for search, recognition and/or tracking; controls and displays; sights or scopes; range finders, computers, computer programs, turret and gun drives, and stabilization systems. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the primary vehicle is excluded.

40.1.1.7 Armament. The armament element refers to the means for combatant vehicles to deliver fire on hostile targets and for logistics and other vehicles to exercise self-defense. This element includes, for example, the main gun, launchers, and secondary armament. Fire control systems are excluded. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the primary vehicle is excluded.

40.1.1.8 Body/Cab. The body/cab element refers to the major component to be mated to a chassis to provide a complete vehicle having a defined mission capability. This element includes accommodations for personnel, cargo, and such subsystems as need to be placed in proximity to operators. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the primary vehicle is excluded.

40.1.1.9 Automatic Loading. The automatic loading element consists of that equipment (hardware/software) providing the means to select ammunition from a stored position in the vehicle and transferring to and loading the armament system. This element also includes the means to eject spent cases and misfired rounds. Components include all ammunition storage racks, transfer/lift mechanisms, ramming and ejecting mechanisms as well as specialized hydraulic and electrical controls. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the primary vehicle is excluded.

40.1.1.10 Automatic/Remote Piloting. The automatic/remote piloting element refers to that equipment (hardware/software) installed in the vehicle which is used to plan and control vehicle speed and direction either autonomously or via tele-operation. This includes equipment which senses, processes and displays imagery data such as stereo vision systems, laser scanners, multiple sensor fusion algorithms and processors, image enhancement algorithms and processors, etc. This also includes equipment which performs intelligence analysis and planning functions such as automated route planners, image understanding algorithms and processors, computer aided driving algorithms and processors, etc. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the primary vehicle is excluded.

40.1.1.11 Nuclear, Biological, Chemical. The nuclear, biological, chemical element refers to those subassemblies or components which provide nuclear, biological, chemical protection and survivability to the vehicle crew, either individually or collectively, during a nuclear, biological, chemical attack. This includes a positive pressure system; micro-climate cooling; air conditioning and purification system; ventilated face piece (mask); nuclear, biological, chemical detection and warning devices; decontamination kits; and chemical

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resistant coatings. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the primary vehicle is excluded.

40.1.1.12 Special Equipment. The special equipment element refers to that special equipment (hardware/software) to be mated to a chassis or a chassis/body/cab assembly to enable the achievement of a special mission capability. It includes all items required to convert basic vehicle configurations to special-purpose configurations. This element includes, for example, blades, booms, winches, robotic arms or manipulators, etc., to equip wreckers, recovery vehicles, supply vehicles and other field work units. It also includes the furnishings and equipment for command, shop, medical and other special-purpose vehicles. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the primary vehicle is excluded.

40.1.1.13 Navigation. The navigation element refers to that equipment (hardware/software) installed in the vehicle which permits the crew to determine vehicle location and to plot the course of the vehicle. It includes navigation systems such as dead reckoning, inertial, and global positioning systems. Landmark recognition algorithms and processors are also included. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the primary vehicle is excluded.

40.1.1.14 Communications. The communications element refers to that equipment (hardware/software) which provides the means within the system for commanding, controlling, and transmitting information to vehicle crews and other personnel exterior to operating vehicles. This element includes radio frequency equipment, microwave and fiber optic communication links, networking equipment for multiple vehicle control, and intercom and external phone systems. It also includes the means for supplementary communication such as visual signaling devices. It may include navigation system and data displays when these are not integral with the equipment of crew stations of the turret assembly or the driver's automotive display of a cab. All effort directly associated with the remaining level 3 WBS elements and the integration, assembly, test and checkout of these elements into the primary vehicle is excluded.

40.1.1.15 Integration, Assembly, Test and Checkout. The integration, assembly, test and checkout element includes all efforts as identified in Appendix H, Work Breakdown Structure Definitions, Common Elements (ref. page H-2), to provide a complete surface vehicle.

40.1.2 Secondary Vehicle. The secondary vehicle element refers to those vehicles required to supplement, expand, or otherwise contribute to the capabilities of primary vehicles to provide the vehicle system with the required operational characteristics. Secondary vehicles are not necessarily self-contained operational units capable of operating outside the system. This element includes, for example, cargo and tank trainers of truck-trailers systems, carriers and tanker units of articulated train-type systems, and transporters as employed in systems when the primary vehicle had limited roadability. It also includes the design, development, and production of complete units (i.e., the prototype or operationally configured units which satisfy the requirements of their applicable specification(s), regardless of end use). The work breakdown structure and definitions for secondary vehicle will be the same as specified for the primary vehicle.

Definitions for common WBS elements applicable to the surface vehicle and all other defense materiel items are in Appendix H, Work Breakdown Structure Definitions, Common Elements (ref. pages H-1 through H-10).

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APPENDIX H
WORK BREAKDOWN STRUCTURE DEFINITIONS
COMMON ELEMENTS

10. SCOPE

10.1 This appendix provides the work breakdown structure and definitions for common WBS elements applicable to all types of systems. This appendix is a mandatory part of the standard. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS

20.1 Government Documents.

20.1.1 Specifications, Standards, and Handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications (DODISS) and supplement thereto, cited in the solicitation.

STANDARDS

MIL-STD-499	Engineering Management
MIL-STD-1388-1	Logistic Support Analysis
MIL-STD-1464	Army Nomenclature System
MIL-STD-1661	Mark and Mod Nomenclature System
MIL-STD-1812	Type Designation, Assignment and Method for Obtaining

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, 700 Robbins Avenue, Building #4, Section D, Philadelphia, PA 19111-5094.)

20.1.2 Other Government Documents, Drawings, and Publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

DOD 5010.12-L Acquisition Management Systems and Data Requirements Control List (AMSDL)

(Copies of DOD 5010.12-L are available from the Standardization Documents Order Desk, 700 Robbins Avenue, Building #4, Section D, Philadelphia, PA 19111-5094.

20.2 Non-Government Publications. This section is not applicable to this standard.

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30. DEFINITIONS

30.1 Integration, Assembly, Test and Checkout. In those instances in which an integration, assembly, test and checkout element is used (Appendices A through G), it will include all effort of technical and functional activities associated with the design, development, and production of mating surfaces, structures, equipment, parts, materials, and software required to assemble the level 3 equipment (hardware/software) elements into a level 2 mission equipment (hardware/software) as a whole and not directly part of any other individual level 3 element. Integration, assembly, test and checkout includes all effort associated with the following:

a. The development of engineering layouts, determination of overall design characteristics, and determination of requirements of design review

b. The set up, conduct and review of testing assembled components or subsystems prior to installation

c. The detailed production design, producibility engineering planning (PEP), and manufacturing process capability, including the process design development and demonstration effort to achieve compatibility with engineering requirements and the ability to produce economically and consistent quality

d. Inspection activities related to receiving, factory and vendor liaison

e. Design maintenance effort

f. Quality planning and control

g. Tooling (initial production facilities, factory support equipment) including its planning, design and fabrication

h. Administrative engineering

i. The joining or mating and final assembly of level 3 equipment elements to form a complete prime mission equipment when the effort is performed at the manufacturing facility

j. Integration of software (including the loading and verification of firmware)

k. The conduct of production acceptance testing

Integration, assembly, test and checkout excludes all systems engineering/program management and system test and evaluation which are associated with the overall system.

When an integration, assembly, test and checkout element is utilized at lower levels of the contract work breakdown structure, it will be summarized into the next higher level equipment (hardware/software) work breakdown structure element and should never be summarized directly into a level 3 integration, assembly, test and checkout element.

30.2 Systems Engineering/Program Management. The systems engineering/program management element is defined as the systems engineering and technical control as well as the business management of particular systems and programs. This element encompasses the overall planning, directing, and controlling of the definition, development, and production of a system or program, including functions of logistics engineering and integrated logistics support (ILS) management, e.g., maintenance support, facilities, personnel, training, testing,

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and activation of a system. Systems engineering/program management effort that can be associated specifically with the equipment (hardware/software) element is excluded. Systems engineering/program management elements to be reported and their levels will be specified by the requiring activity. Examples of systems engineering/program management elements and their definitions are provided as follows:

a. Systems Engineering. The systems engineering element is defined as the technical and management efforts of directing and controlling a totally integrated engineering effort of a system or program as described in MIL-STD-499. This element encompasses the systems engineering effort to define the system and the integrated planning and control of the technical program efforts of design engineering, specialty engineering, production engineering, and integrated test planning. This element includes but is not limited to: the systems engineering effort to transform an operational need or statement of deficiency into a description of system requirements and a preferred system configuration; and the technical planning and control effort for planning, monitoring, measuring, evaluating, directing and replanning the management of the technical program. It specifically excludes the actual design engineering and the production engineering directly related to the WBS element with which it is associated. Examples of systems engineering efforts include:

1) System definition, overall system design, design integrity analysis, system optimization, system/cost effectiveness analysis, and intra-system and inter-system compatibility assurance, etc.; the integration and balancing of reliability, maintainability, producibility, safety, human health, environmental protection, and survivability; security requirements, configuration management and configuration control, quality assurance program, value engineering, preparation of equipment and component performance specifications, design of test and demonstration plans; determination of software development or software test facility/environment requirements;

2) Preparation of the Systems Engineering Management Plan (SEMP), specification tree, program risk analysis, system planning, decision control process, technical performance measurement, technical reviews, subcontractor and vendor reviews, work authorization, and technical documentation control;

3) Reliability engineering defined as the engineering process and series of tasks required to examine the probability of a device or system performing its mission adequately for the period of time intended under the operating conditions expected to be encountered;

4) Maintainability engineering defined as the engineering process and series of tasks required to measure the ability of an item or system to be retained in or restored to a specified condition of readiness, skill levels, etc., using prescribed procedures and resources at specific levels of maintenance and repair;

5) Human factors engineering defined as the engineering process and the series of tasks required to define, as a comprehensive technical and engineering effort, the integration of doctrine, manpower and personnel integration, materiel development, operational effectiveness, human characteristics, skill capabilities, training, manning implication, and other related elements into a comprehensive effort; and,

6) Logistics Support Analysis (LSA) element defined by MIL-STD-1388-1 as the selective application of scientific and logistic engineering tasks, efforts and analysis undertaken during the acquisition process, as part of the systems engineering and design effort, to assist in complying with supportability and other ILS objectives; it includes, but is not limited to, the generic tasks required for support element determination and the analysis required to identify and verify its adequacy.

All programs, where applicable, include: value engineering, configuration management, human factors, maintainability, reliability, survivability/vulnerability, system safety, environmental protection, standardization, systems analysis, logistics support analysis, etc.

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For ships this includes the Extended Ship Work Breakdown Structure (ESWBS) Configuration Management (811), Human Factors (892), Standardization (893), Value Engineering (894), and Reliability and Maintainability (895) elements.

b. Program Management. The program management element is defined as the business and administrative planning, organizing, directing, coordinating, controlling, and approval actions designated to accomplish overall program objectives which are not associated with specific hardware elements and are not included in systems engineering. Examples of these activities are:

1) Cost, schedule, performance measurement management, warranty administration, contract management, data management, vendor liaison, subcontract management, etc.

2) ILS element management defined as the logistics tasks management effort and technical control, and the business management of the elements of ILS. The logistics management function encompasses the Integrated Support Plan (ISP), ILS Management Team (ILSMT) participation, ILS evaluation and supportability assurance required to produce an affordable and supportable defense materiel system. This element includes the planning and management of all the functions of logistics and logistic support analysis, e.g., maintenance support planning; support facilities planning; other ILS requirements determination; support equipment; supply support; Packaging, Handling, Storage, and Transportation (PHST); provisioning requirements determination and planning; training system requirements determination; computer resource determination; organizational, intermediate, and depot maintenance determination management; and data management.

For ships this includes the Extended Ship Work Breakdown Structure (ESWBS) Project Management (897); Data Management (896); ILS Engineering, Maintenance (851); ILS Engineering, Support and Test Equipment (852); and ILS Engineering, Supply Support (853) elements.

30.3 System Test and Evaluation. The system test and evaluation element refers to the use of prototype, production, or specifically fabricated hardware/software to obtain or validate engineering data on the performance of the system during the development phase (normally funded from RDT&E) of the program. This element includes the detailed planning, conduct, support, data reduction and reports (excluding the Contract Data Requirements List (CDRL) data) from such testing, and all hardware/software items which are consumed or planned to be consumed in the conduct of such testing. It also includes all effort associated with the design and production of models, specimens, fixtures, and instrumentation in support of the system level test program. NOTE: Test articles which are complete units (i.e., functionally configured as required by specifications) are excluded from this work breakdown structure element. All formal and informal testing up through the subsystem level which can be associated with the hardware/software element are excluded. Acceptance testing is also excluded. These excluded efforts are to be included with the appropriate hardware or software elements.

30.3.1 Development Test and Evaluation. The development test and evaluation element refers to that test and evaluation conducted to: (a) demonstrate that the engineering design and development process is complete; (b) demonstrate that the design risks have been minimized; (c) demonstrate that the system will meet specifications; (d) estimate the system's military utility when introduced; (e) determine whether the engineering design is supportable (practical, maintainable, safe, etc.) for operational use; (f) provide test data with which to examine and evaluate trade-offs against specification requirements, life cycle cost, and schedule; and (g) perform the logistics testing efforts to evaluate the achievement of supportability goals, the adequacy of the support package for the system, (e.g., deliverable maintenance tools, test equipment, technical publications, maintenance instructions, and personnel skills and training requirements, etc.). Development test and evaluation includes all contractor in-house effort and is planned, conducted and monitored by the developing agency of the DoD Component.

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All programs, where applicable, include models, tests and associated simulations such as wind tunnel, static, drop, and fatigue; integration ground tests; test bed aircraft and associated support; qualification test and evaluation (QT&E), development flight test, test instrumentation, environmental tests, ballistics, radiological, range and accuracy demonstrations, test facility operations, test equipment (including its support equipment), chase and calibrated pacer aircraft and support thereto, and logistics testing.

For aircraft, include avionics integration test composed of the following: (a) test bench/laboratory, including design, acquisition, and installation of basic computers and test equipments which will provide an ability to simulate in the laboratory the operational environment of the avionics system/subsystem; (b) air vehicle equipment, consisting of the avionics and/or other air vehicle subsystem modules which are required by the bench/lab or flying test bed in order to provide a compatible airframe avionics system/subsystem for evaluation purposes; (c) flying test bed, including requirements analysis, design of modifications, lease or purchase of test bed aircraft, modification of aircraft, installation of avionics equipment and instrumentation, and checkout of an existing aircraft used essentially as a flying avionics laboratory; (d) avionics test program, consisting of the effort required to develop test plans/procedures, conduct tests, and analyze hardware and software test results to verify the avionics equipments' operational capability and compatibility as an integrated air vehicle subsystem; and (e) software, referring to the effort required to design, code, de-bug, and document software programs necessary to direct the avionics integration test.

For engines, include engine military qualification tests and engine preliminary flight rating tests.

For ships, include model basin, hydrostatic, fatigue, shock, special sea tests and trials, etc., including the Extended Ship Work Breakdown Structure (ESWBS) Trials Agenda Preparation, Data Collection & Analysis (842); Dock and Sea Trials (9823); and Hull Vibration Survey (9825) elements.

30.3.2 Operational Test and Evaluation. The operational test and evaluation element refers to that test and evaluation conducted by agencies other than the developing command to assess the prospective system's military utility, operational effectiveness, operational suitability, logistics supportability (including compatibility, inter-operability, reliability, maintainability, logistic requirements, etc.), cost of ownership, and need for any modifications. Initial operational test and evaluation conducted during the development of a weapon system will be included in this element. This element encompasses such tests as system demonstration, flight tests, sea trials, mobility demonstrations, on-orbit tests, spin demonstration, stability tests, qualification operational test and evaluation (QOT&E), etc., and support thereto, required to prove the operational capability of the deliverable system. It includes contractor support (e.g., technical assistance, maintenance, labor, material, etc.) consumed during this phase of testing. It also includes performing the logistics testing efforts to evaluate the achievement of supportability goals and the adequacy of the support for the system (e.g., deliverable maintenance tools, test equipment, technical publications, maintenance instructions, personnel skills and training requirements, and software support facility/environment elements).

30.3.3 Mock-ups. The mock-ups element refers to the design engineering and production of system or subsystem mock-ups which have special contractual or engineering significance, or which are not required solely for the conduct of one of the above elements of testing.

30.3.4 Test and Evaluation Support. The test and evaluation support element refers to all support elements necessary to operate and maintain systems and subsystems during test and evaluation which are not consumed during the testing phase and are not allocated to a specific phase of testing. This element includes, for example, repairable spares, repair of reparables, repair parts, warehousing and distribution of spares and repair parts, test and support equipment, test bed vehicles, drones, surveillance aircraft, tracking vessels, contractor technical support, etc. Operational and maintenance personnel, consumables, special fixtures, special instrumentation,

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etc., which are utilized and/or consumed in a single element of testing and which should therefore be included under that element of testing are excluded.

30.3.5 Test Facilities. The test facilities element refers to those special test facilities required for performance of the various developmental tests necessary to prove the design and reliability of the system or subsystem. This element includes, for example, test tank test fixtures, propulsion test fixtures, white rooms, test chambers, etc. The brick and mortar-type facilities identified as industrial facilities are excluded.

30.4 Training. The training element is defined as the deliverable training services, devices, accessories, aids, equipment, and parts used to facilitate instruction through which personnel will acquire sufficient concepts, skills, and aptitudes to operate and maintain the system with maximum efficiency. This element includes all effort associated with the design, development, and production of deliverable training equipment as well as the execution of training services. This element and its subelements exclude the overall planning, management, and task analysis function inherent in the WBS element Systems Engineering/Program Management.

30.4.1 Equipment. The equipment element is defined as those distinctive deliverable end items of training equipment, assigned by either a contractor or military service, required to meet specific training objectives. This element includes: operational trainers, maintenance trainers and other items such as cutaways, mock- ups, and models.

30.4.2 Services. The services element is defined as the deliverable services, accessories, and aids necessary to accomplish the objectives of training. This element includes, for example, training course materials; contractor-conducted training including in-plant and service training; and the materials and curriculum required to design, execute and produce a contractor developed training program. It also includes the material, courses, and associated documentation (primarily the computer software, courses and training aids). This element excludes the deliverable training data associated with the WBS element Support Data.

30.4.3 Facilities. The facilities element refers to the special construction necessary to accomplish training objectives. It also includes the modification or rehabilitation of existing facilities used to accomplish training objectives. The installed equipment used for the purpose of acquainting the trainee with the system or establishing trainee proficiency is excluded. The brick and mortar-type facilities identified as industrial facilities are also excluded.

30.5 Data. The data element refers to all deliverable data required to be listed on a Contract Data Requirements List, DD Form 1423. The data requirements will be selected from the Acquisition Management Systems and Data Requirements Control List (DoD 5010.12-L). This element includes only such effort that can be reduced or will not be incurred if the data item is eliminated. If the data are government peculiar, include the efforts for acquiring, writing, assembling, reproducing, packaging and shipping. It also includes the effort for transforming into government format with reproduction and shipment if data are identical to that used by the contractor, but in a different format.

30.5.1 Technical Publications. The technical publications element is defined as technical data which provides instructions for the installation, operation, maintenance, training, and support of a system or equipment which is formatted into a technical manual. A technical manual normally includes operation and maintenance instructions, parts lists or parts breakdown, and related technical information or procedures exclusive of administrative procedures. This data may be presented in any form (regardless of the form or method of recording). Technical orders that meet the criteria of this definition may also be classified as technical manuals. This element includes the data item descriptions set forth in categories selected from the DoD 5010.12-L.

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For ships include Extended Ship Work Breakdown Structure (ESWBS) ILS Engineering, Technical Manuals and Other Data (856) element.

30.5.2 Engineering Data. The engineering data element is defined as recorded information (regardless of the form or method of recording) of a scientific or technical nature (including computer software documentation). Engineering data does not include computer software or financial, administrative, cost or pricing, or management data or other information incidental to contract administration.

a. Engineering data is required to define and document an engineering design or product configuration (sufficient to allow duplication of the original items) and is used to support production, engineering and logistics activities. This element includes, for example, all final plans, procedures, reports, and documentation pertaining to systems, subsystems, computer and computer resource programs, component engineering, operational testing, human factors, reliability, availability, and maintainability, and other engineering analysis, etc.

b. A technical data package (reprocurement package) includes all engineering drawings, associated lists, process descriptions, and other documents which define the physical geometry, material composition, performance procedures.

This element excludes the LSAR and support data delivered under 30.5.4 of this section.

For ships include Extended Ship Work Breakdown Structure (ESWBS) Design Support, Ship's Selected Records (8302); Design Support, Services, Reproduction (8303); and ILS Engineering, Engineering Drawings and Specifications (855) elements.

30.5.3 Management Data. The management data element is defined as those data items necessary for configuration management, cost, schedule, contractual data management, program management, etc., required by the government in accordance with functional categories selected from the DODISS and DoD 5010.12-L. This element includes contractor cost reports, cost performance reports, contractor fund status reports, schedules, milestones, networks, integrated support plans, etc.

For ships include Extended Ship Work Breakdown Structure (ESWBS) Contract Data Requirements (988) element.

30.5.4 Support Data. The support data element is defined as those data items designed to document the support planning in accordance with functional categories selected from DoD 5010.12-L. This element includes, for example, LSA documentation and LSA record maintenance and delivery, supply, general maintenance plans and reports, training data, transportation, handling, packaging information, facilities data, data to support the provisioning process and all other support data, and software supportability planning and software support transition planning documents.

30.5.5 Data Depository. The data depository element is defined as a facility designated to act as custodian in establishing and maintaining a master engineering specification and drawing depository service for government approved documents that are the property of the U.S. Government. This element represents a distinct entity of its own and includes all effort of drafting, clerical, filing, etc., required to provide the service. As custodian for the government, the contractor is authorized by approved change orders to maintain these master documents at the latest approved revision level. When documentation is called for on a given item of data retained in the depository, the charges (if charged as direct) will be to the appropriate data element. All similar effort for the contractor's internal specification and drawing control system, in support of its engineering and production activities, is excluded.

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30.6 Peculiar Support Equipment. The peculiar support equipment element is defined to include the design, development, and production of those deliverable items and associated software required to support and maintain the system or portions of the system while not directly engaged in the performance of its mission, and which have application peculiar to a given defense materiel item. This element includes, for example, vehicles, equipment, tools, etc., used to fuel, service, transport, hoist, repair, overhaul, assemble, disassemble, test, inspect, or otherwise maintain the mission equipment. It also includes any production of duplicate or modified factory test or tooling equipment delivered to the government for use in maintaining the system (factory test and tooling equipment initially used by the contractor in the production process but subsequently delivered to the government will be included as cost of the item produced). It also includes any additional equipment or software that will be required to maintain or modify the software portions of the system. This element and its subelements specifically exclude the overall planning, management and task analysis functions inherent in the work breakdown structure element systems engineering/program management, and the common support equipment presently in the DoD inventory or commercially common within the industry which is bought by the using command and not by the acquiring command.

30.6.1 Test and Measurement Equipment. The test and measurement equipment element is defined as peculiar or unique testing and measurement equipment which allows an operator or maintenance function to evaluate operational conditions of a system or equipment by performing specific diagnostics, screening or quality assurance effort at an organizational, intermediate, or depot level of equipment support. It includes test measurement and diagnostic equipment, precision measuring equipment, automatic test equipment, manual test equipment, automatic test systems, test program sets, appropriate interconnect devices, automated load modules, tap(s), and related software, firmware and support hardware (power supply equipment, etc.) used at all levels of maintenance. It includes packages which enable a line or shop replaceable unit, printed circuit boards, or similar items to be diagnosed using automatic test equipment.

30.6.2 Support and Handling Equipment. The support and handling equipment element is defined as the deliverable tools and handling equipment used for support of the mission system. It typically includes ground support equipment, vehicular support equipment, powered support equipment, nonpowered support equipment, munitions material handling equipment, materiel handling equipment, and software support equipment (hardware/software).

30.7 Common Support Equipment. The common support equipment element refers to those items required to support and maintain the system or portions of the system while not directly engaged in the performance of its mission, and which are presently in the DoD inventory for support of other systems. This element includes all efforts required to assure the availability of this equipment for support of the particular defense materiel item. It also includes the acquisition of additional quantities of this equipment if caused by the introduction of the defense materiel item into operational service.

30.7.1 Test and Measurement Equipment. The test and measurement equipment element is defined as common testing and measurement equipment which allows an operator or maintenance function to evaluate operational conditions of a system or equipment by performing specific diagnostics, screening or quality assurance effort at an organizational, intermediate, or depot level of equipment support. It includes test measurement and diagnostic equipment, precision measuring equipment, automatic test equipment, manual test equipment, automatic test systems, test program sets, appropriate interconnect devices, automated load modules, tap(s), and related software, firmware and support hardware (power supply equipment, etc.) used at all levels of maintenance. It includes packages which enable a line or shop replaceable unit, printed circuit boards, or similar items to be diagnosed using automatic test equipment.

30.7.2 Support and Handling Equipment. The support and handling equipment element is defined as the deliverable tools and handling equipment used for support of the mission system. It typically includes ground

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support equipment, vehicular support equipment, powered support equipment, nonpowered support equipment, munitions material handling equipment, materiel handling equipment, and software support equipment (hardware/software).

30.8 Operational/Site Activation. The operational/site activation element refers to the real estate, construction, conversion, utilities, and equipment to provide all facilities required to house, service, and launch prime mission equipment at the organizational and intermediate level. This element includes conversion of site, ship, or vehicle; system assembly, checkout, and installation (of mission and support equipment) into site facility or ship to achieve operational status. It also includes contractor support in relation to operational/site activation.

30.8.1 System Assembly, Installation, and Checkout on Site. The system assembly, installation, and checkout on site element refers to the materials and services involved in the assembly of mission equipment at the site. This element includes, for example, installation of mission and support equipment in the operations or support facilities and the complete system checkout or shakedown to insure achievement of operational status. Where appropriate, specify by site, ship or vehicle.

30.8.2 Contractor Technical Support. The contractor technical support element refers to all materials and services provided by the contractor related to activation. This element includes repair of reparables, standby services, final turnover, etc.

30.8.3 Site Construction. The site construction element refers to the real estate, site planning/preparation, construction, and other special-purpose facilities necessary to achieve system operational status. This element also includes the construction of utilities, roads, and interconnecting cabling.

30.8.4 Site/Ship/Vehicle Conversion. The site/ship/vehicle conversion element refers to all materials and services required to provide for the conversion of existing sites, ships, or vehicles to accommodate the mission equipment and selected support equipment directly related to the specific system. This element includes operations, support, and other special purpose (e.g., launch) facilities conversion necessary to achieve system operational status. Where appropriate, specify by site, ship, or vehicle.

30.9 Industrial Facilities. The industrial facilities element refers to the construction, conversion, or expansion of industrial facilities for production, inventory, and contractor depot maintenance required when that service is for the specific system. This element includes, for example, equipment acquisition or modernization, where applicable, and maintenance of these facilities or equipment. This element also includes industrial facilities for hazardous waste management to satisfy environmental standards.

30.9.1 Construction/Conversion/Expansion. The construction/conversion/expansion element refers to the real estate and preparation of system peculiar industrial facilities for production, inventory, depot maintenance, and other related activities.

30.9.2 Equipment Acquisition or Modernization. The equipment acquisition or modernization element refers to production equipment acquisition, modernization, or transferal of equipment for the particular system. (Pertains to government owned and leased equipment under facilities contract.)

30.9.3 Maintenance (Industrial Facilities). The maintenance (industrial facilities) element refers to the maintenance, preservation, and repair of industrial facilities and equipment.

30.10 Initial Spares and Repair Parts. Initial spares and repair parts element is defined as the deliverable spare components, assemblies and subassemblies used for initial replacement purposes in the materiel system equipment end item. This element includes the repairable spares and repair parts required as initial stockage to

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support and maintain newly fielded systems or subsystems during the initial phase of service, including pipeline and war reserve quantities, at all levels of maintenance and support. This element excludes development test spares and spares provided specifically for use during installation, assembly and checkout on site. The lower level WBS breakouts should be by subsystem.

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APPENDIX I
USER GUIDE

10. SCOPE

10.1 This appendix presents a User Guide for preparing, understanding and presenting a work breakdown structure (WBS). The guide discusses the requirement for a work breakdown structure, provides a general understanding for developing a program work breakdown structure, shows how to develop and implement a contract work breakdown structure, and presents examples of work breakdown structures for various applications. The primary objective of this guide is to achieve a consistent application of the work breakdown structure. This appendix is not a mandatory part of the standard. The information contained herein is intended for guidance only.

10.2 The foundation for the requirement and development of the work breakdown structure is described in DoDD 5000.1, DoDI 5000.2, and DoD 5000.2-M. These documents identify responsibilities in the acquisition process from the Office of the Secretary of Defense to the DoD Component field activities. The requirement to prepare a work breakdown structure is generally discussed in the context of planning and monitoring a defense materiel system program.

10.3 This guide is directed primarily at the preparation of a work breakdown structure for a defense materiel item. This includes all defense materiel items (or major modifications) (a) established as an integral program element of the Future Years Defense Program (FYDP); or (b) otherwise designated by the DoD Component or the Under Secretary of Defense (Acquisition).

10.3.1 The guidance is also appropriate for use with any work breakdown structure developed at any phase during the acquisition process, including concept exploration and definition, demonstration and validation, engineering and manufacturing development, and production.

10.3.2 This guide provides the framework for preparing a complete work breakdown structure. The guidelines are directed at both contractors and DoD Components (Government activities) in the development of work breakdown structures for the acquisition of defense materiel items.

20. APPLICABLE DOCUMENTS

20.1 Government Documents.

20.1.1 Specifications, Standards, and Handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications (DODISS) and supplement thereto, cited in the solicitation.

STANDARDS

MIL-STD-196	Joint Electronics Type Designation System
DOD-STD-2167	Defense System Software Development

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MIL-STD-881 and as further detailed by the ... LCC and/or WBS element(s) specified on M

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, 700 Robbins Avenue, Building #4, Section D, Philadelphia, PA 19111-5094.)

20.1.2 Other Government Documents, Drawings, and Publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

PAMPHLETS

Contractor Cost Data Reporting (CCDR)

NAVMAT P-5241	Navy Materiel Command Pamphlet
AMC-P 715-8	Army Materiel Command Pamphlet
AFLCP 800-15	Air Force Logistics Command Pamphlet
AFSCP 800-15	Air Force Systems Command Pamphlet

Cost/Schedule Control System Criteria Joint Implementation Guide

NAVSO P3627	Assistant Secretary of the Navy (S&L) Pamphlet
AFSCP 173-5	Air Force Systems Command Pamphlet
AFCCP 173-5	Air Force Communications Command Pamphlet
AFLCP 173-5	Air Force Logistics Command Pamphlet
AMC-P 715-5	Army Materiel Command Pamphlet
DLAH 8400.2	Defense Logistics Agency Handbook
DCAA P7641.47	Defense Contract Audit Agency Pamphlet

(The above pamphlet numbers identify two single documents: Contractor Cost Data Reporting (CCDR) System (Stock Number 0518LP1003001), and Cost/Schedule Control Systems Criteria Joint Implementation Guide (Stock Number 0518LP1002010). These two documents can be ordered by stock number from the Standardization Documents Order Desk, 700 Robbins Avenue, Building #4, Section D, Philadelphia, PA 19111-5094.)

20.2 Non-Government Publications. This section is not applicable to this standard.

30. DEFINITIONS

30.1 Program Work Breakdown Structure. A program work breakdown structure is defined as the work breakdown structure that covers the acquisition of a specific defense materiel item and is related to contractual effort. A program work breakdown structure includes all applicable elements consisting of at least the first three levels of the work breakdown structure and extended by the DoD Component (program manager) and/or contractor(s). A program work breakdown structure has uniform element terminology, definition, and placement in the family tree structure.

Level 1: Level 1 is the entire defense materiel item; for example, an aircraft system, such as a helicopter, bomber, transport aircraft, fighter aircraft or reconnaissance aircraft. Level 1 is usually directly identified in the DoD programming/budget system either as an integral program element or as a project or subprogram within an aggregated program element.

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Level 2: Level 2 elements are major elements of the defense materiel item; for example, air vehicle which includes all hardware and software elements, aggregations of system level services (e.g., system test and evaluation, and systems engineering/program management) and data.

Level 3: Level 3 elements are elements subordinate to level 2 major elements; for example, propulsion, fire control, navigation guidance, armament, or type of service (e.g., development test and evaluation, contractor technical support, training services), or types of data (e.g., technical publications). Lower levels follow the same process.

30.2 Contract Work Breakdown Structure. A contract work breakdown structure is defined as the complete work breakdown structure for a contract. It includes the DoD approved work breakdown structure for reporting purposes and its discretionary extension to the lower levels by the contractor, in accordance with this standard, and the contract work statement. It includes all the elements for the products (hardware, software, data, or services) which are the responsibility of the contractor.

40. BACKGROUND

40.1 Purpose. When the decision is made to develop and acquire a new or updated system, several factors are considered when planning or monitoring efforts. One of these factors is determining the work breakdown structure to use for the system. A work breakdown structure is a product-oriented family tree, composed of hardware, software, services, data and facilities, which results from systems engineering efforts during the development and production of a defense materiel item, and which completely defines the program. A work breakdown structure displays and defines the product(s) to be developed or produced and relates the elements of work to be accomplished to each other and to the end product. Therefore, the work breakdown structure plays a significant role in planning and assigning management and technical responsibilities and in monitoring and controlling the progress and status of engineering efforts, resource allocations, cost estimates, expenditures, and cost and technical performance.

40.2 Work Breakdown Structure Applications. The work breakdown structure provides a framework for specifying the objectives of the program by first defining the program in terms of hierarchically related product-oriented elements and the work processes required for their completion. Each element of the work breakdown structure provides logical summary points for assessing technical accomplishments and for measuring the cost and schedule performance accomplished in attaining the specified technical objectives.

For each work breakdown structure element, the detailed objectives are defined as well as the specific work tasks assigned to each contractor organization element and the resources, materials, and processes required to attain the objectives. As resources are employed and work progresses on the task, current technical, schedule, cost, and estimate at completion data are reported. The data may then be summarized to provide successive levels of management with the appropriate report on planned, actual, and current projected status of the elements for which they are responsible. Management will thus be better able to maintain visibility of status and to apply efforts to assure desired performance.

40.2.1 Technical Management. The work breakdown structure provides a framework for defining the technical objectives of the program. Together with the contract statement of work, the work breakdown structure aids in establishing an indentured data listing (specification tree), defining configuration items, and planning support tasks.

40.2.1.1 Contract Statement of Work. The statement of work (SOW) is the document which describes in clear understandable terms what products are to be delivered or services to be performed by the contractor. Preparation of an effective SOW requires an understanding of the products and services that are needed to

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satisfy a particular requirement. A SOW prepared in explicit terms will facilitate effective contractor evaluation after contract award. The SOW becomes the standard for measuring contractor performance. Therefore, the SOW must clearly define the work to be performed. In preparing the SOW for a system acquisition, the use of a standardized work breakdown structure as a template for constructing the SOW will help streamline the process. Use of the work breakdown structure will also provide the framework and facilitate a logical arrangement of the SOW elements, provide a convenient checklist to ensure all necessary elements of the program are addressed, and direct the contractor to meet specific contract reporting needs.

40.2.1.2 Indentured Data Listing. An indentured data listing (specification tree), developed by systems engineering, structures the performance parameters for the system or systems being developed. It subdivides the system(s) into its component elements and identifies the performance objectives of the system(s) and its elements. The performance characteristics are explicitly identified and quantified. Completed, the indentured data listing represents a hierarchy of performance requirements for each component element of the system for which design responsibility is assigned. Because specifications may not be written for each product on the work breakdown structure, the indentured data listing may not match the work breakdown structure completely.

40.2.1.3 Configuration Management. Configuration management is the process of managing the technical configuration of items being developed whose requirements must be specified and controlled (ref. MIL-STD-973). In establishing the requirement for configuration management on a program, the DoD Component needs to designate which contract deliverables are subject to configuration management controls. A contract deliverable designated for configuration management is called a Configuration Item. For software, this item is called a computer software configuration item (CSCI). Configuration management involves defining the baseline configuration for the configuration items, controlling the changes to that baseline, and accounting for all approved changes. The framework for designating the configuration items on a program is the work breakdown structure which needs to be extended sufficiently to clearly define all elements subject to configuration management.

40.2.2 Financial Management. The work breakdown structure assists management in measuring cost and schedule performance. By breaking the total product into successively smaller entities, management can ensure that all required products are identified in terms of cost and schedule performance goals. The planning of work by work breakdown structure elements serves as the basis for estimating and scheduling resource requirements. The assignment of performance budgets to scheduled segments of contract work and identified to responsible organization units produces a time phased plan against which actual performance can be compared and appropriate corrective action taken when deviations from plan are identified. This integrated approach to work planning also simplifies the identification of potential cost and schedule impacts of proposed technical changes.

40.2.2.1 Contract Budgeting. Funds management involves periodic comparison of actual costs with time phased budgets, analysis of performance variances, and follow-up corrective action, as required. When work breakdown structure product elements and the supporting work are scheduled, a solid base for time phased budgets is made. Assignment of planned resource cost estimates to scheduled activities (tasks) and summarization by work breakdown structure element by time period results in a time phased program/contract budget, which becomes the performance measurement baseline.

40.2.2.2 Cost Estimating. Use of the work breakdown structure for cost estimating facilitates program and contract management. The work breakdown structure aids the DoD program office to plan, coordinate, control, and estimate the various program activities that DoD and the contractors are conducting. It provides a common framework for tracking the estimated and actual costs during the performance of each contract. The data from the various program contracts support the DoD program manager in evaluating contractor performance, preparing budgets, and preparing program life-cycle costs, e.g., as programs move through the various phases

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of the acquisition process (conceptual design, development, and production) the actual experience to date and the estimates for the remaining phases provide the basis for reassessment of the total program costs.

40.2.2.3 Data Bases. Cost information collected by work breakdown structure element can be used for pricing and negotiating contracts and contract changes, and for follow-on procurement. DoD is accumulating a growing cost data base of similar work breakdown structure elements from different programs. Such historical cost data can be used to develop learning curves and for regression analysis and other techniques to estimate the cost requirements for like elements of new programs. Actual cost data collected by DoD on each program can be compared to the original estimates to identify trends and to establish the validity of estimating techniques. Contractors will similarly benefit from such data bases. Since contractors tend to provide similar products on similar programs, the cost history accumulated on their programs can assist them in estimating and bidding future contracts and budgeting new work.

40.3 Relationship to Other Contract Requirements. The work breakdown structure is the basis for communication throughout the acquisition process. It provides the common link unifying the planning, scheduling, cost estimating, budgeting, contracting, configuration management, and performance reporting disciplines. The structure and definitions contained in this standard will be the basis for structures used for contracts requiring compliance with the Cost/Schedule Control Systems Criteria (C/SCSC), and reports placed on contract such as Contractor Cost Data Reporting (CCDR), Cost Performance Reports (CPR), Contract Funds Status Reports (CFSR), and Cost/Schedule Status Reports (C/SSR). This capability permits the contractor to evaluate progress in terms of contract performance. Consult the referenced documents for program applicability and specific requirements per paragraph 20.1.2 in this appendix.

50. DETAILED REQUIREMENTS

50.1 Scope. Work is effort performed by people to transform or create products to solve identified problems in order to verifiably meet specified objectives. Just as the organizational structure hierarchically structures the people who perform work, so the work breakdown structure hierarchically structures the products to be produced on which the people work. Examples of these products include equipment (hardware/software), data, services and facilities for such systems as missile systems, helicopter systems, automated software systems, etc.

Work breakdown structure elements depict products in a manner in which technical accomplishment can be incrementally verified and measured and provide the conceptual framework for integrated planning and control of the work. For example, program management benefits all hardware, software, and data products in indeterminable proportion. From a management control perspective, such work is essentially indirect to the hardware, software, and data products, but direct to the contract or program. As a result, when program management is separately identified within the framework of the work breakdown structure, the work performed can be verified and measured. It is for these reasons that the work breakdown structure is a valuable tool.

50.2 Purpose. The development of any work breakdown structure is intended to achieve a clear understanding and statement of the technical objectives and the end item(s) (or end product(s)) of the work to be performed. The process of identifying these objectives assists in structuring the product elements during the work breakdown structure development. Objectives derived from the overall program objective are identified in such a way that products support economically and technically identifiable subsystems of the program objectives. This process may be repeated until the component level is reached. In this manner, subsystems support a total system capability.

In order to use the work breakdown structure as a framework for structuring the technical objectives of a program, in addition to its use as a management tool for cost and schedule control, it is important that the work

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breakdown structure be product oriented. Its elements should represent identifiable work products whether they be equipment (hardware/software), data or relatable service products. Because any work breakdown structure is a product structure, not an organization structure, complete definition of the effort encompasses the work to be performed by all participants.

50.3 Acquisition Process. The work breakdown structure is developed during the acquisition process of a defense materiel item. Government and industry view this process from different perspectives, but the ultimate objective is consistent. Figure I-1 provides an overview of the work breakdown structure development process. The DoD acquisition process is where this standard is utilized. Figures I-2 and I-3 depict the overall process from both the DoD and industry perspective and how the WBS flow relates to this process.

50.4 Preparing a Program Work Breakdown Structure. The DoD program manager is responsible for developing and maintaining the program work breakdown structure. The DoD program manager will structure a program work breakdown structure for a defense materiel item prior to program initiation by selecting appropriate elements from one or more of the work breakdown structure(s) set forth in appendices A through G. The result will initially map the program work breakdown structure. Although the appendices relate to specific categories of defense materiel items, any item from any appendix may be used which is applicable to the program, as long as the integrity of the level of placement is maintained.

50.4.1. Develop Program Work Breakdown Structure. The program work breakdown structure should be developed early in the conceptual stages of the program and be based initially on the work breakdown structures identified in appendices A through G. The program work breakdown structure evolves during conceptual design from an iterative analysis of the program objective, functional design criteria, program scope, technical performance requirements, proposed methods of performance, including acquisition strategy, as well as drawings, process flow charts, and other technical documentation. It is important the documentation describe the DoD plan to build, integrate, and field the system. The Cost Analysis Requirements Document (CARD) will be the recording document for this program plan. Ultimately, the program work breakdown structure must be approved through the CCDR plan process. Through this process, the levels of reporting and elements for appropriate RFP selection are determined.

50.4.2 Program Work Breakdown Structure Element Selection Requirements. The program work breakdown structure elements must be selected by the DoD Component and be structured in such a way that products and services may be readily summarized into the program work breakdown structure. The program work breakdown structure and contract work breakdown structure extensions will be used as a framework for technical and management activities. The DoD Component will employ the program work breakdown structure and its contract work breakdown structure extensions as a coordinating medium in planning for further systems engineering, resource allocation, cost estimates, contract actions, and work execution. The reporting of progress, performance, and engineering evaluations, as well as financial data, will be based on the program work breakdown structure. Figure I-4 provides an example of a top level program work breakdown structure.

50.4.3 Levels of Program Work Breakdown Structure. The program work breakdown structure contains the top three levels expanded to identify elements with a significant degree of technical or cost risk. When program work breakdown structure levels are stipulated to an excessively low level of a program, the contractor's normal method of operation may be hampered, or excessive reporting requirements may result. The SOW and CDRLs are the place to clearly communicate all program requirements. Figure I-5 provides an expanded program work breakdown structure which incorporates elements necessary for contract visibility and control. This program WBS is based on Appendix A and uses those WBS elements applicable to the system.

50.4.4 Considerations in Constructing a WBS. The following should be kept in mind when constructing a work breakdown structure:

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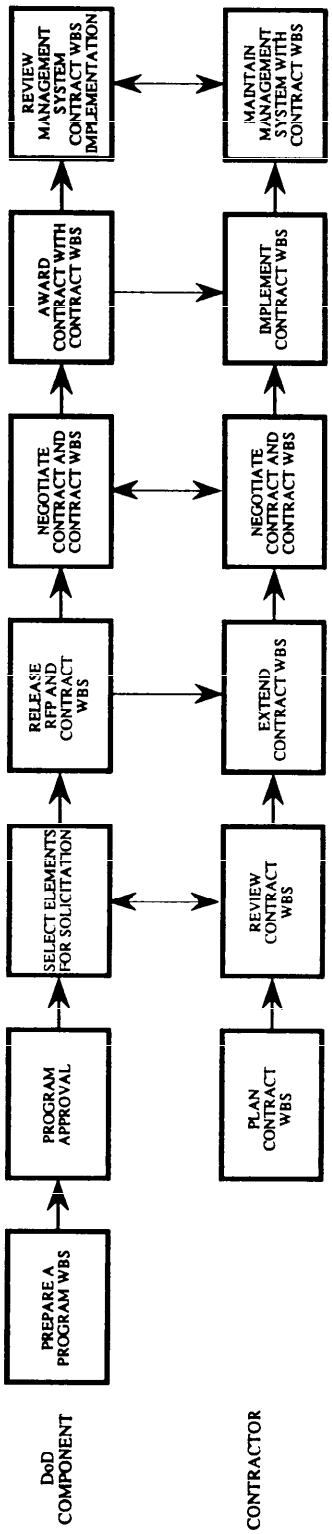

Figure I-1. WORK BREAKDOWN STRUCTURE DEVELOPMENT PROCESS

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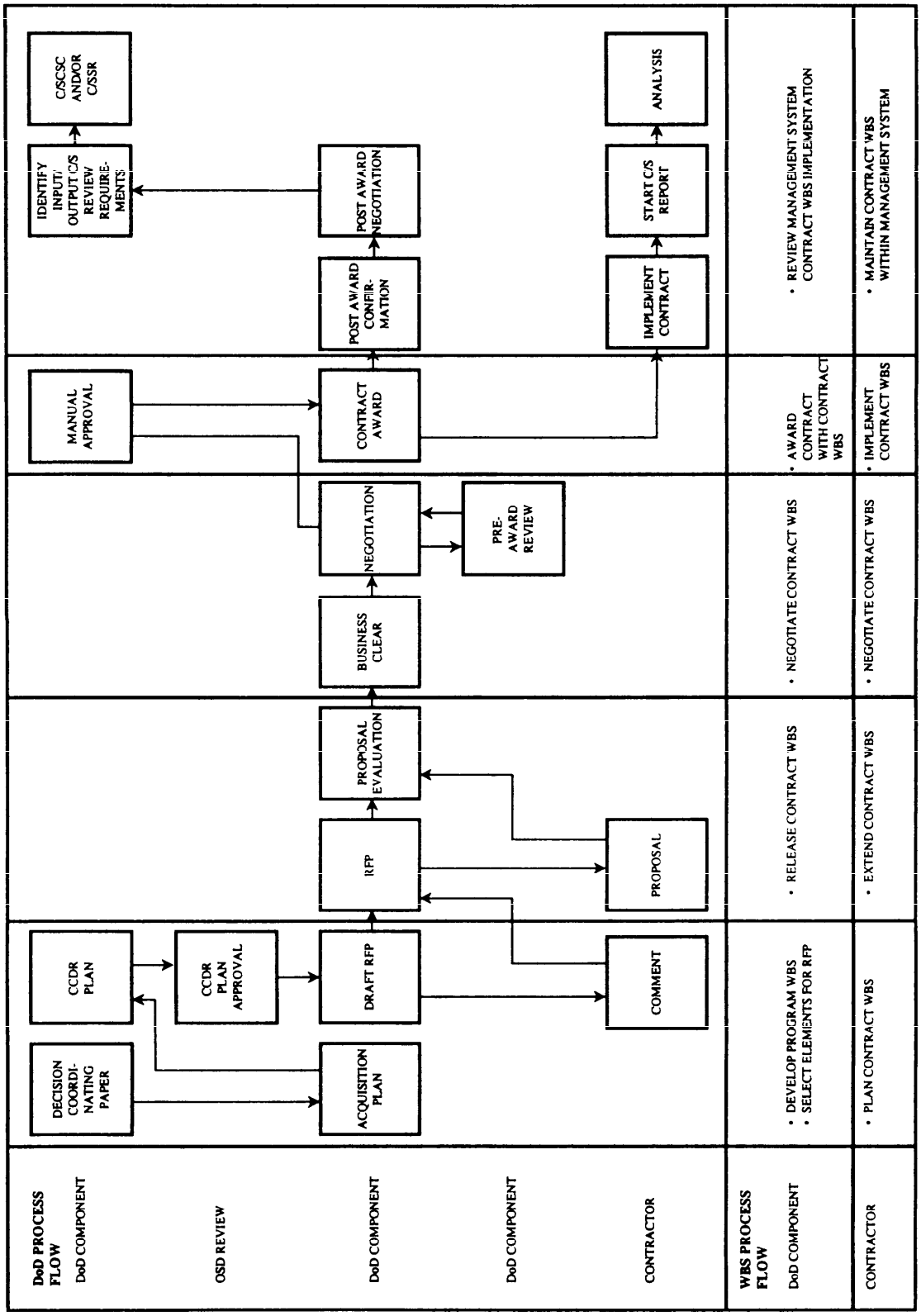

Figure I-2. DoD PROCESS FLOW

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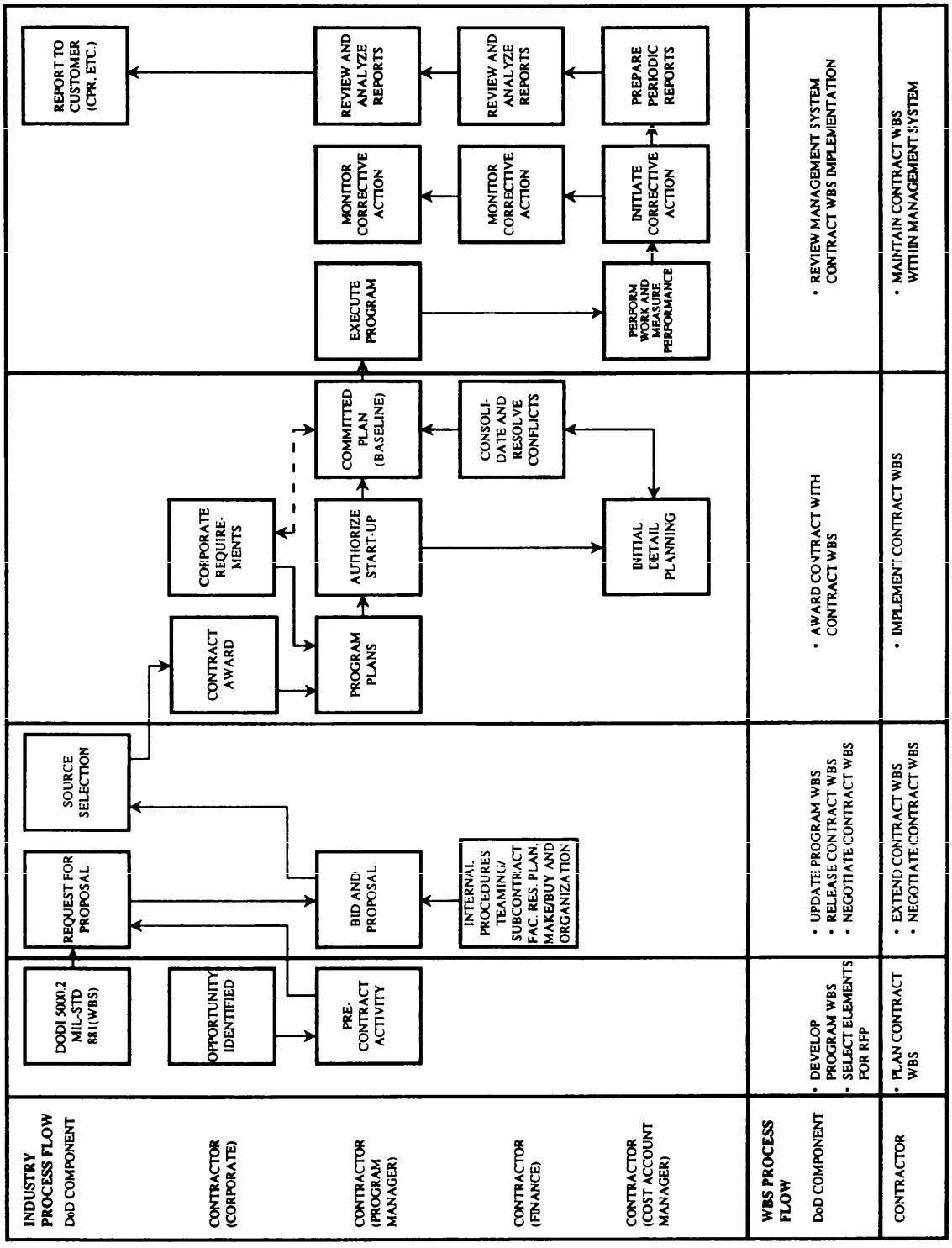

Figure I-3. INDUSTRY PROCESS FLOW

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b. Conceptual exploration/definition. The requirements process has a

PROGRAM WBS		
1	2	3
FX AIRCRAFT		
	AIR VEHICLE	
		AIRFRAME
		PROPULSION (SK-PW-52D)
		COMMUNICATIONS/IDENTIFICATION
		NAVIGATION/GUIDANCE
		FIRE CONTROL
		AUTOMATIC FLIGHT CONTROL
		CENTRAL COMPUTER
		ELECTRONIC WARFARE
		WEAPON DELIVERY EQUIPMENT
		ARMAMENT
	SYSTEM TEST AND EVALUATION	
		DEVELOPMENT TEST AND EVALUATION
		OPERATIONAL TEST AND EVALUATION
		MOCKUPS
		TEST AND EVALUATION SUPPORT
		TEST FACILITIES
	SYSTEMS ENGINEERING/PROGRAM MANAGEMENT	
		SYSTEMS ENGINEERING
		PROGRAM MANAGEMENT
		INTEGRATED LOGISTIC SUPPORT
	PECULIAR SUPPORT EQUIPMENT	
		TEST AND MEASUREMENT EQUIPMENT
		SUPPORT AND HANDLING EQUIPMENT
	COMMON SUPPORT EQUIPMENT	
	TRAINING	
		MAINTENANCE TRAINERS
		AIRCREW TRAINING DEVICE
		TRAINING COURSE MATERIALS
	DATA	
		TECHNICAL PUBLICATIONS
		ENGINEERING DATA
		MANAGEMENT DATA
		SUPPORT DATA
		DATA DEPOSITORY
	OPERATIONAL/SITE ACTIVATION	
		CONTRACTOR TECHNICAL SUPPORT
	INITIAL SPARES AND REPAIR PARTS	

Figure I-4. TOP LEVEL PROGRAM WORK BREAKDOWN STRUCTURE

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PROGRAM WBS			
1	2	3	4
FX AIRCRAFT			
	AIR VEHICLE		
		AIRFRAME	
			WING
			FUSELAGE
			EMPENNAGE
			FLIGHT CONTROLS SUBSYSTEM
			HYDRAULIC SYSTEM
			ENVIRONMENTAL CONTROL
			CREW STATION SYSTEM
			LANDING AND ARRESTING GEAR SYSTEM
			INTEG., ASSEMBLY, TEST AND CHKOUT
		PROPULSION (SK-PW-52D)	
		COMMUNICATIONS/IDENTIFICATION	
			RADIO SYSTEM
			DATA LINK
			COMMUNICATIONS SYSTEM SOFTWARE
		NAVIGATION/GUIDANCE	
		FIRE CONTROL	
			RADAR
			COMPUTER
			CONTROLS AND DISPLAYS
			SYSTEM SOFTWARE
		AUTOMATIC FLIGHT CONTROL	
		CENTRAL COMPUTER	
			COMPUTER
			SYSTEM SOFTWARE
		ELECTRONIC WARFARE	
		WEAPON DELIVERY EQUIPMENT	
		ARMAMENT	
	SYSTEM TEST AND EVALUATION		
		DEVELOPMENT TEST AND EVALUATION	
			WIND TUNNEL ARTICLES AND TEST
			STATIC ARTICLES AND TEST
			FATIGUE ARTICLES AND TEST
			CONTRACTOR FLIGHT TESTS
		OPERATIONAL TEST AND EVALUATION	
		MOCKUPS	
		TEST AND EVALUATION SUPPORT	
		TEST FACILITIES	
	SYSTEMS ENGINEERING/PROGRAM MANAGEMENT		
		SYSTEMS ENGINEERING	
		PROGRAM MANAGEMENT	
		INTEGRATED LOGISTIC SUPPORT	
	PECULIAR SUPPORT EQUIPMENT		
		TEST AND MEASUREMENT EQUIPMENT	
		SUPPORT AND HANDLING EQUIPMENT	
	COMMON SUPPORT EQUIPMENT		
	TRAINING		
		MAINTENANCE TRAINERS	
		AIRCREW TRAINING DEVICE	
		TRAINING COURSE MATERIALS	
	DATA		
		TECHNICAL PUBLICATIONS	
		ENGINEERING DATA	
		MANAGEMENT DATA	
		SUPPORT DATA	
		DATA DEPOSITORY	
	OPERATIONAL/SITE ACTIVATION		
		CONTRACTOR TECHNICAL SUPPORT	
	INITIAL SPARES AND REPAIR PARTS		

Figure I-5. EXPANDED PROGRAM WORK BREAKDOWN STRUCTURE

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a. Many elements of a program are not products. A signal processor, for example, is clearly a product, as are mock-ups, and Computer Software Configuration Items (CSCIs). Design engineering, requirements analysis, test engineering labor, aluminum, and direct costs, etc., are not products. Design engineering, test engineering, and requirements analysis are all engineering functional efforts; aluminum is a material resource; and direct cost is an accounting classification. As such, none of these elements are appropriate as work breakdown structure elements (ref. Chapter 4 of Contractor Cost Data Reporting (CCDR) System for functional category definitions).

b. Program phases (e.g., design, development, production), and types of funds (e.g., Research, Development, Test and Evaluation) are inappropriate elements of a work breakdown structure.

c. Rework, retesting and refurbishing should be treated as work on the appropriate work breakdown structure element affected, not as separate elements of a work breakdown structure.

d. Nonrecurring and recurring classifications are not work breakdown structure elements. The reporting requirements of Contractor Cost Data Reporting (CCDR) will segregate each work breakdown structure element into its nonrecurring and recurring parts (ref. Chapter 4 of Contractor Cost Data Reporting (CCDR) System).

e. Cost saving efforts such as total quality management initiatives, could cost, warranty, etc., are not work breakdown structure elements. These efforts should be included in the cost of the item they affect and not captured separately.

f. The organizational structure of the program office or the contractor should not be the basis for development of a work breakdown structure. The work breakdown structure should always retain its product orientation.

g. Costs for meetings, travel, computer support, etc., are to be included with the work breakdown structure elements for which they are associated. They are not to be treated as separate work breakdown structure elements.

h. The use of generic terms in a work breakdown structure is improper. The system(s) name and/or nomenclature is required. The work breakdown structure elements should be clearly named to indicate the character of the product to avoid semantic confusion. For example, if the Level 1 system is Fire Control, then the Level 2 item (prime mission product) is Fire Control Radar. The name or nomenclature for the electronic subsystem should be developed using MIL-STD-196, when appropriate. Figure I-6 provides a reference on how to use MIL-STD-196 to identify the nomenclature for electronic systems.

i. Tooling (e.g., special test equipment, and factory support equipment such as: assembly tools, dies jigs, fixtures, master forms, handling equipment, etc.) should be included in the cost of the equipment being produced. It is a functional cost (ref. CCDR System, Chapter 4) not a work breakdown structure element. If the tooling cannot be assigned to an identified subsystem or component, it should be included in the cost of integration, assembly, test, and checkout. Any additional quantities produced for equipment support or maintenance in the field should be included and reported under Peculiar Support Equipment. This same philosophy applies to software. For example, when a software development facility/environment is created to support the development of software, the effort associated with this element is considered part of the CSCI it supports; or if more than one CSCI is involved, it should be included in integration, assembly, test and checkout.

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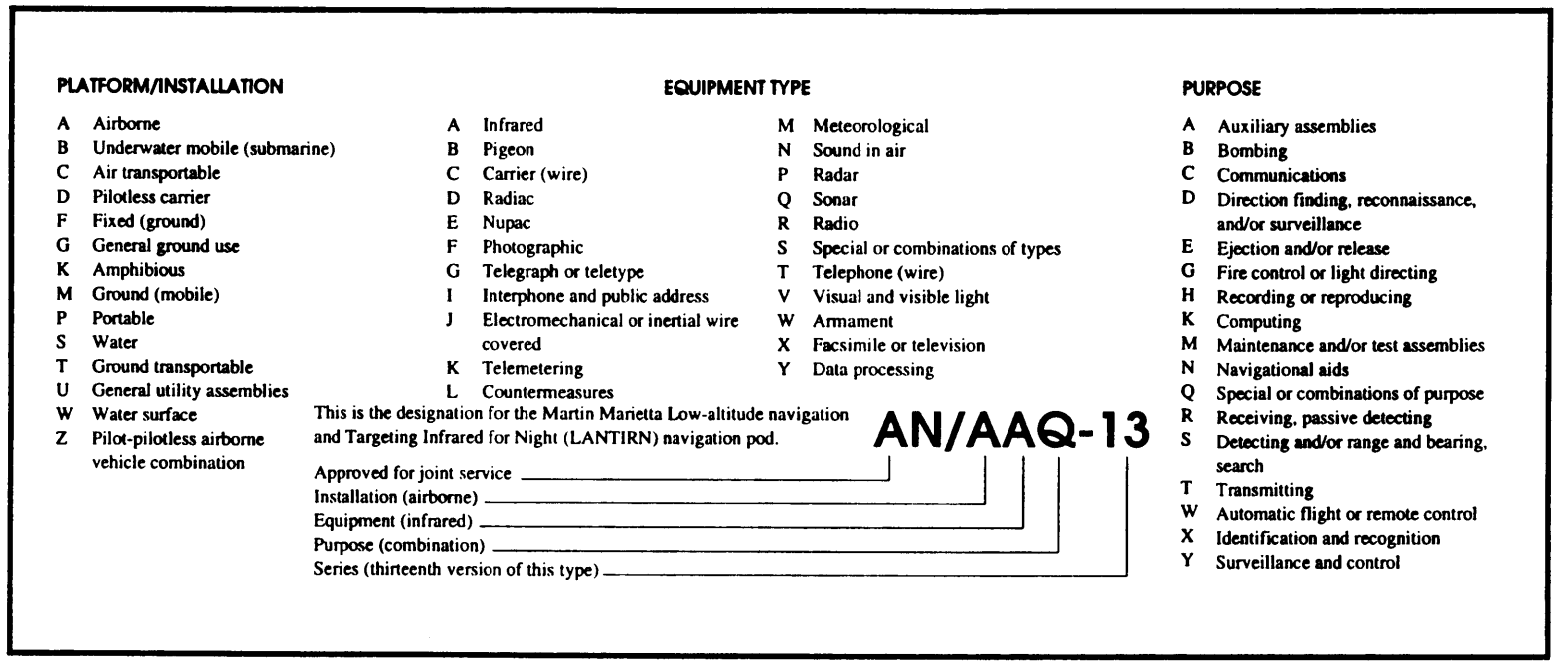

Figure I-6. EXAMPLE OF TYPE DESIGNATOR FOR ELECTRONIC EQUIPMENT

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j. Software that is being developed to reside on specific equipment must be identified as a subset of that equipment.

k. The definition of integration, assembly, test, and checkout is on page H-2. This definition should be read carefully before the work breakdown structure is developed. Note that integration, assembly, test, and checkout includes production acceptance testing (including first article test) of R&D and production units, but excludes all systems engineering/program management, and system test and evaluation which are associated with the overall system. Each appendix identifies integration, assembly, test and checkout separately with the exception of the aircraft system appendix (Appendix A). For aircraft systems, the integration, assembly, test, and checkout is a subelement of (and included in) the airframe work breakdown structure element to be consistent with the historical data sets that are maintained on airframe.

l. This standard does not identify Level 3 elements for the systems engineering/program management work breakdown structure element. This allows the government and contractor flexibility to identify efforts that are important to the specific program. The definition given provides typical systems engineering/program management efforts.

m. System test and evaluation always separately identifies those tests performed in the development of a system (i.e., development test and evaluation), and those tests performed by the operational user (i.e., operational test and evaluation).

Figure I-7 provides an example of both a correct and an incorrect work breakdown structure.

50.4.5 Software in the Work Breakdown Structure. This standard recognizes the importance of software within the DoD environment. Software is identified in each appendix. In addition, Appendix B, Electronic/Automated Software Systems, describes software in more detail. The software definitions are consistent with policies and practices discussed in DoD-STD-2167.

50.4.5.1 Contracts with Hardware/Software. Software that is being developed to reside on specific equipment must be identified as a subset of that equipment. Multi-function software will be identified as a subset of the equipment work breakdown structure element which either includes the software in the element specification or exercises the most critical performance constraint. Figure I-8 provides an example of how software should be addressed as part of a specific equipment. In cases where the application of this rule results in a conflict in the selection of the proper element, the specification relationship will take precedence. For example, an aircraft's electronic equipment typically has software included in each of the subsystem elements. Software that resides and interfaces with more than one equipment, i.e., applications software, and overall system software which facilitates the operation and maintenance of the computer systems and associated programs (e.g., operating systems, compilers, and utilities) will be called out at the appropriate work breakdown level with the program (ref. ANSI/IEEE Std 610.12 for definitions of applications and system software).

It is incorrect to summarize all software on a program or contract in a work breakdown structure (ref. Figure I-7). By separating these elements from the hardware they support, performance measurement and management control over each equipment is difficult to maintain since the true cost of each equipment is not readily available. Rather than a separate summarization, software should be identified with the hardware it supports. (When needed, contractor management systems can use an identifier for each software element to produce internal summaries for software management purposes.)

50.4.5.2 Software-Only Contracts. Separately contracted or stand alone software will include the software, data, services, facilities required to develop and produce a software product for a command and control system, radar system, information system, etc. Where software is considered stand alone (i.e., does not reside or

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CORRECT

PROGRAM WBS

1	2	3	4
FX AIRCRAFT			
	AIR VEHICLE		
		AIRFRAME	
			WING
			FUSELAGE
			EMPENNAGE
			FLIGHT CONTROLS SUBSYSTEM
			HYDRAULIC SYSTEM
			ENVIRONMENTAL CONTROL
			CREW STATION SYSTEM
			LANDING AND ARRESTING GEAR SYSTEM
			INTEG., ASSEMBLY, TEST AND CHKOUT
		PROPULSION (SK-PW-52D)	
		COMMUNICATIONS/IDENTIFICATION	
			RADIO SYSTEM
			DATA LINK
			COMMUNICATIONS SYSTEM SOFTWARE
		NAVIGATION/GUIDANCE	
		FIRE CONTROL	
			RADAR
			COMPUTER
			CONTROLS AND DISPLAYS
			SYSTEM SOFTWARE
		AUTOMATIC FLIGHT CONTROL	
		CENTRAL COMPUTER	
			COMPUTER
			SYSTEM SOFTWARE
		ELECTRONIC WARFARE	
		WEAPON DELIVERY EQUIPMENT	
		ARMAMENT	
	SYSTEM TEST AND EVALUATION		
		DEVELOPMENT TEST AND EVALUATION	
			WIND TUNNEL ARTICLES AND TEST
			STATIC ARTICLES AND TEST
			FATIGUE ARTICLES AND TEST
			CONTRACTOR FLIGHT TESTS
		OPERATIONAL TEST AND EVALUATION	
		MOCKUPS	
		TEST AND EVALUATION SUPPORT	
		TEST FACILITIES	
	SYSTEMS ENGINEERING/PROGRAM MANAGEMENT		
		SYSTEMS ENGINEERING	
		PROGRAM MANAGEMENT	
		INTEGRATED LOGISTIC SUPPORT	
	PECULIAR SUPPORT EQUIPMENT		
		TEST AND MEASUREMENT EQUIPMENT	
		SUPPORT AND HANDLING EQUIPMENT	
	COMMON SUPPORT EQUIPMENT		
	TRAINING		
		MAINTENANCE TRAINERS	
		AIRCREW TRAINING DEVICE	
		TRAINING COURSE MATERIALS	
	DATA		
		TECHNICAL PUBLICATIONS	
		ENGINEERING DATA	
		MANAGEMENT DATA	
		SUPPORT DATA	
		DATA DEPOSITORY	
	OPERATIONAL/SITE ACTIVATION		
		CONTRACTOR TECHNICAL SUPPORT	
	INITIAL SPARES AND REPAIR PARTS		

INCORRECT

PROGRAM WBS

1	2	3	4	5
FX AIRCRAFT				
	AIR VEHICLE			
		AIRFRAME		
			DESIGN ENGINEERING	
			FABRICATION	
			ASSEMBLY	
		PROPULSION (SK-PW-52D)		
		COMMUNICATIONS/IDENTIFICATION		
			MANUFACTURING	
			ENGINEERING	
			QUALITY ASSURANCE	
			MATERIAL	
		NAVIGATION/GUIDANCE		
		FIRE CONTROL		
			NONRECURRING	
			RECURRING	
		AUTOMATIC FLIGHT CONTROL		
		CENTRAL COMPUTER		
		ELECTRONIC WARFARE		
		WEAPON DELIVERY EQUIPMENT		
		ARMAMENT		
		SOFTWARE		
			COMMUNICATIONS/IDENTIFICATION SOFTWARE	
			FIRE CONTROL SOFTWARE	
			NAVIGATION/GUIDANCE SOFTWARE	
			AUTOMATIC FLIGHT CONTROL SOFTWARE	
			CENTRAL COMPUTER SOFTWARE	
			ELECTRONIC WARFARE SOFTWARE	
	SYSTEM TEST AND EVALUATION			
		PRODUCTION ACCEPTANCE TEST		
		FIRST ARTICLE TEST		
		DEVELOPMENT TEST AND EVALUATION		
		OPERATIONAL TEST AND EVALUATION		
		MOCKUPS		
		TEST AND EVALUATION SUPPORT		
		TEST FACILITIES		
	SYST	EERING/P	MANAGE	
		TRAINI	RSE MATERIA	
	DATA			
		TECHNICAL PUBLICATIONS		
		ENGINEERING DATA		
		MANAGEMENT DATA		
		SUPPORT DATA		
		DATA DEPOSITORY		
	OPERATIONAL SITE ACTIVATION			
		CONTRACTOR TECHNICAL SUPPORT		
	INITIAL SPARES AND REPAIR PARTS			

WRONG
These are work efforts, not products.

WRONG
These items are functional, not products (Ref. CCDR).

WRONG
Nonrecurring and recurring items are not WBS elements (Ref. CCDR).

WRONG
Software should be included with hardware it supports.

WRONG
These are not system level tests but should be included in the Airframe WBS element.

Figure I-7. COMPARISON OF CORRECT AND INCORRECT PROGRAM WBSs

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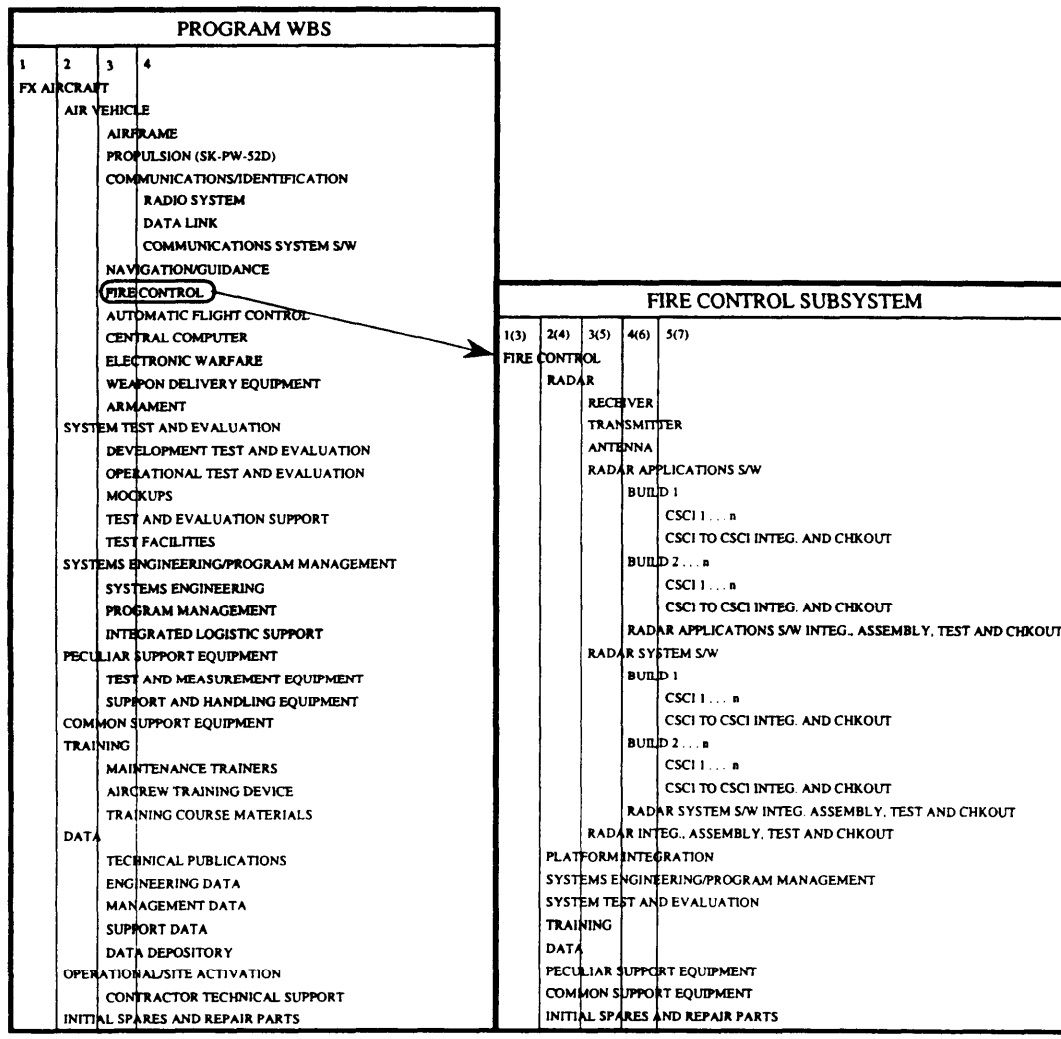

Figure I-8. SOFTWARE AS PART OF A SYSTEM/SUBSYSTEM

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support a specific equipment, a pure software upgrade, etc.), the DoD Component will use the same work breakdown structure format as identified in Appendix B, Electronic/Automated Software Systems, adjusted to reflect the appropriate levels of the work breakdown structure. Figure I-9 provides an example of a work breakdown structure for stand alone software.

50.4.6 WBS Dictionary. When developing a program work breakdown structure, the DoD Component will also develop a WBS Dictionary (ref. page 14, para. 5.4.1.1). The program work breakdown structure dictionary lists and defines the work breakdown structure elements. Although initially prepared for the program work breakdown structure by the DoD Component, it is expanded by the contractors as they develop and extend their contract work breakdown structure. The WBS Dictionary should be based on the generic definitions in this standard, made to be program specific to define the products being acquired.

The dictionary lists elements to show their hierarchical relationship to each other and describes each work breakdown structure element and the resources and processes required to produce it; it also provides a link to the detailed technical definition documents. The work breakdown structure dictionary should be revised to reflect changes and should be maintained in a current status throughout the life of the program.

50.4.7 Program Work Breakdown Structure Approval. Final approval of the program work breakdown structure is achieved through approval of the CCDR plan process. Changes may be required due to program restructuring or changes with the way the contractor will meet the technical requirements. Changes are approved following the CCDR Plan procedures in DoD regulations.

50.5 Preparing a Contract Work Breakdown Structure. The individual work breakdown structure elements will be selected from the program work breakdown structure by the DoD Component for inclusion in a Request for Proposal (RFP). This will be accomplished by selecting the appropriate program work breakdown structure elements for the products that will be required by each contract. Contracts for WBS elements that are at Level 3 or below in the Program Work Breakdown Structure will be moved to Level 2 and all other applicable Level 2 Common WBS elements will be included. The result is the contract work breakdown structure. Figure I-10 depicts the development and relationship of the Program Work Breakdown Structure with the Contract Work Breakdown Structure. Each RFP includes the contract work breakdown structure, and the initial WBS Dictionary prepared by the DoD Component. The RFP should instruct potential contractors to extend the selected contract work breakdown structure elements to define the complete contract scope.

50.5.1 RFP Solicitation Requirements. The contract line items, configuration items, contract work statement tasks, contract specifications, and contractor responses will be relatable to the work breakdown structure to enhance its effectiveness in satisfying the objectives of the particular acquisition. It is important to develop the program work breakdown structure and the CCDR plan with the development of the SOW so as to form consistency in document structure. When aggregated with the program work breakdown structure, the extended contract work breakdown structure will form a complete work breakdown structure of the program for use throughout the acquisition cycle.

50.5.2 Extend Contract Work Breakdown Structure. The Contractor extends the contract work breakdown structure in the RFP and submits the complete contract work breakdown structure with its proposal. The proposal submitted should be based on the work breakdown structure in the RFP. Contractors may suggest changes to the RFP contract work breakdown structure elements when a change is needed to meet an essential requirement of the RFP or to enhance the effectiveness of the contract work breakdown structure in satisfying program objectives. The contractor should extend the contract work breakdown structure to the appropriate level which satisfies the critical visibility requirements and does not overburden the contractor management system.

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PROGRAM/CONTRACT WBS				
1	2	3	4	5
STAND ALONE SOFTWARE				
	PRIME MISSION PRODUCT (PMP)			
		APPLICATIONS SOFTWARE		
			BUILD 1 . . . n	
				CSCI 1 . . . n
				CSCI TO CSCI INTEG. AND CHKOUT
			APPLICATIONS S/W INTEG., ASSEMBLY, TEST AND CHKOUT	
		SYSTEM SOFTWARE		
			BUILD 1 . . . n	
				CSCI 1 . . . n
				CSCI TO CSCI INTEG. AND CHKOUT
			SYSTEM S/W INTEG., ASSEMBLY, TEST AND CHKOUT	
		INTEGRATION, ASSEMBLY, TEST AND CHKOUT		
	SYSTEMS ENGINEERING/PROGRAM MANAGEMENT			
	SYSTEM TEST AND EVALUATION			
		DEVELOPMENT TEST AND EVALUATION		
		OPERATIONAL TEST AND EVALUATION		
		MOCK-UPS		
		TEST AND EVALUATION SUPPORT		
		TEST FACILITIES		
	TRAINING			
		EQUIPMENT		
		SERVICES		
		FACILITIES		
	DATA			
		TECHNICAL PUBLICATIONS		
		ENGINEERING DATA		
		MANAGEMENT DATA		
		SUPPORT DATA		
		DATA DEPOSITORY		
	PECULIAR SUPPORT EQUIPMENT			
		TEST AND MEASUREMENT EQUIPMENT		
		SUPPORT AND HANDLING EQUIPMENT		
	COMMON SUPPORT EQUIPMENT			
	OPERATIONAL/SITE ACTIVATION			
		SYSTEM ASSEMBLY, INSTALLATION AND CHKOUT		
		CONTRACTOR TECHNICAL SUPPORT		
		SITE CONSTRUCTION		
		SITE/SHIP/VEHICLE CONVERSION		
	INDUSTRIAL FACILITIES			
		CONSTRUCTION/CONVERSION/EXPANSION		
		EQUIPMENT ACQUISTION OR MODERNIZATION		
		MAINTENANCE (INDUSTRIAL FACILITIES)		
	INITIAL SPARES AND REPAIR PARTS			

Figure I-9. STAND ALONE SOFTWARE

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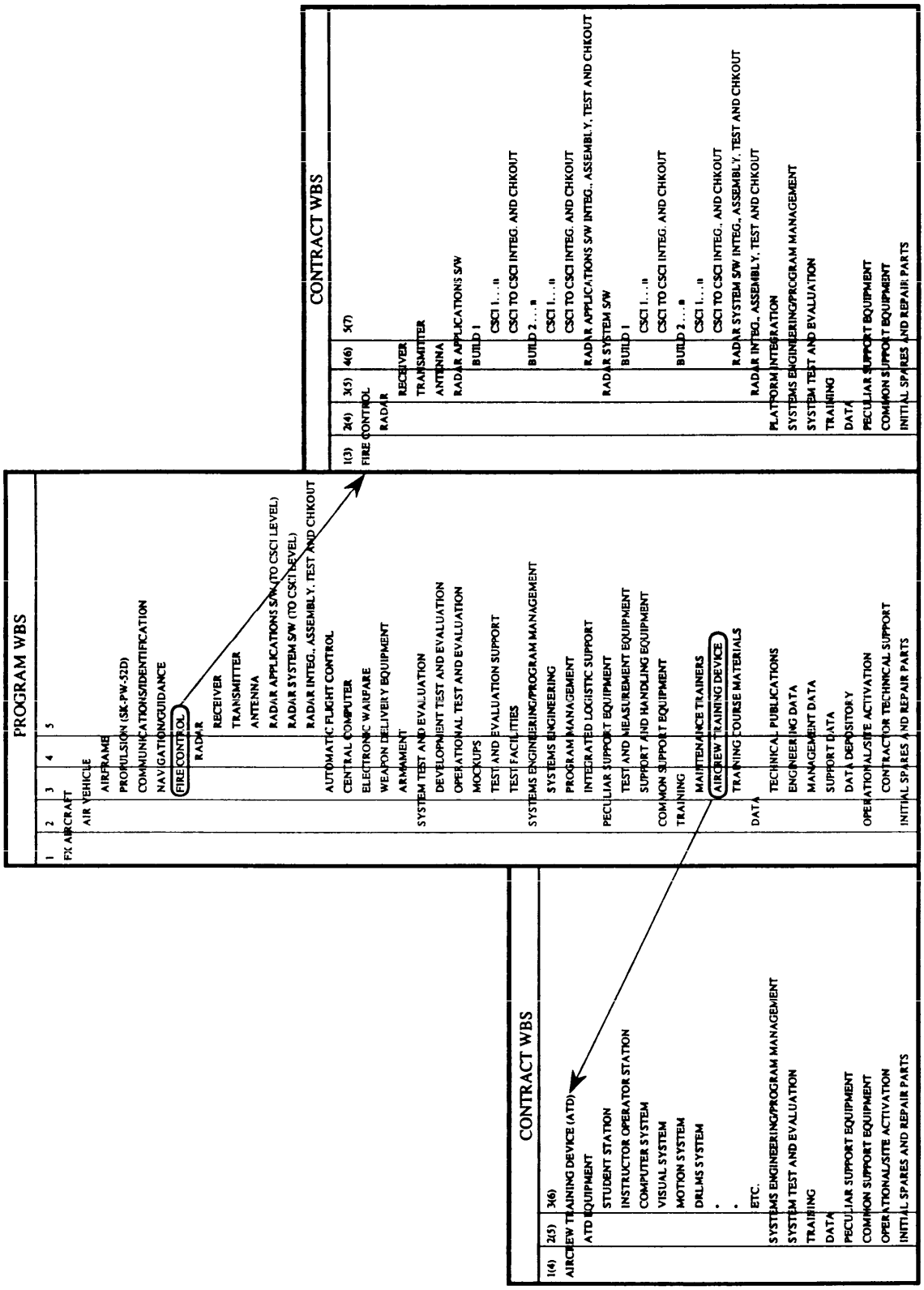

Figure I-10. RELATIONSHIP OF PROGRAM WBS WITH CONTRACT WBS

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50.6 Implementation of Contract Work Breakdown Structure. After contractors are selected, contract WBSs are negotiated as part of contract negotiations. The proposed contract work breakdown structure included in the successful proposal serves as the basis for negotiating an approved contract work breakdown structure. The contractor may have proposed alternate approaches to better accomplish the contract objectives. The alternatives, if accepted by the DoD Component, may impact the proposed program work breakdown structure. Revisions will be required to the program work breakdown structure and the contract work breakdown structure to reflect these changes. After adjustments and contract negotiations, the elements selected for the contract will become the basis for contractor extension during the contracted effort. All extensions must sum to the contract work breakdown structure reporting level in the contract.

50.6.1 Contract Work Breakdown Structure Approval and Contract Award. Following approval of the negotiated contract, including the contract work breakdown structure, the contract is awarded. The contract identifies the requirement for providing the WBS Dictionary through the contract data requirements list (CDRL). While strong efforts should be placed on early and accurate work breakdown structure planning, work breakdown structure revisions may result from expansion or contraction of program/contract scope and the movement of a program through its various stages. Normally, changes to the work breakdown structure should not be made after contracts are awarded and work is underway unless major rescoping of the program occurs. Users of this guide should understand that the sequence shown in preceding paragraphs may be iterative as the program evolves, contracts are awarded, and the work effort progresses through major program phases. Whenever the work breakdown structure is revised, the ability to crosswalk and track back to the previous work breakdown structure must be maintained.

50.6.2 Implementation with Subcontractors. Contractors may require the use of the work breakdown structure by subcontractors to permit fulfillment of contractual requirements and provide adequate control of the subcontract. Such subcontractors, whose work accounts for a major segment of the subcontracted portion of the prime contract, will be delineated in contracts at the time of award. It will be the prime or associate contractor's responsibility to incorporate into the contract with the affected subcontractors the work breakdown structure requirements. Figure I-11 provides an example of a prime work breakdown structure and its relationship to a subcontract work breakdown structure.

50.6.3 Maintain Contract Work Breakdown Structure. The contractor maintains the contract work breakdown structure, including change traceability. Only DoD Component approved changes may be incorporated in accordance with the contract terms. The contract will indicate the levels of contract work breakdown structure at which costs will be reported to the government. Traceability of cost accumulations will be required to those extended contract work breakdown structure levels which are used by the contractor for cost control purposes. In the extended contract work breakdown structure, consideration will be given to the specific contractual, technical, and managerial requirements of the defense materiel item. The contractor has complete flexibility in extending the contract work breakdown structure below the reporting requirement to reflect how work is to be accomplished, assuming lower elements to be meaningful product or management-oriented lower indentures of a higher-level element.

50.7 Relationship with Contractor Management System. As the end product is subdivided into smaller subproducts at lower work breakdown structure levels, the work effort required by each element can be identified to functional organization units. At some point within the work breakdown structure, the contractor will assign management responsibility for technical, schedule, and cost performance. The cost management system will provide the necessary visibility of the lower levels of the work breakdown structure as it interfaces with the organization. At the juncture of the work breakdown structure element and organization unit, cost accounts are usually established and performance is planned, measured, recorded and controlled. To do so, the technical requirements for the work and work product must be specified, the work scheduled, budgeted, and

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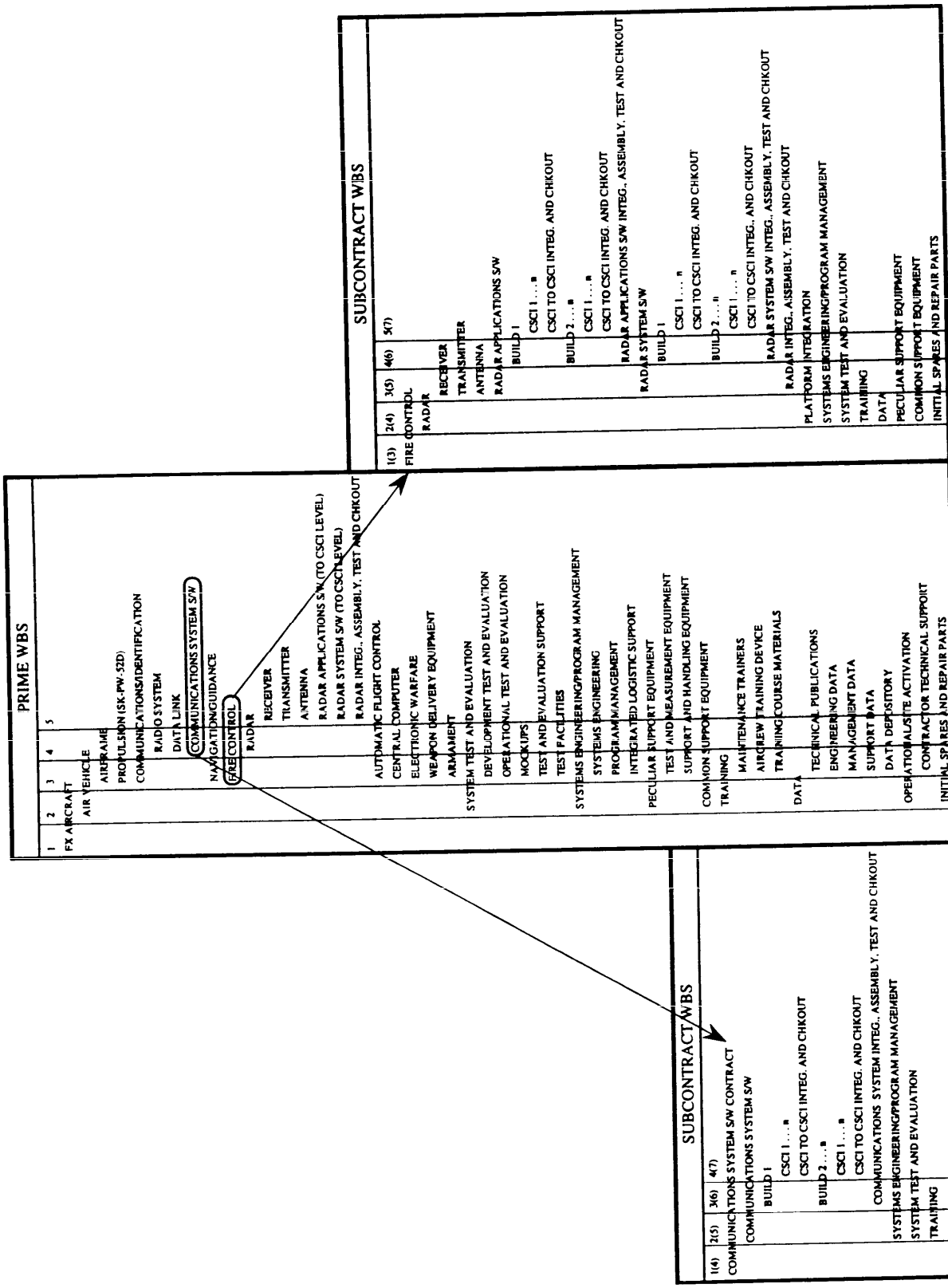

Figure I-11. PRIME WBS TO SUBCONTRACT WBS

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performed, and product attainment of specified technical requirements verified. The responsible manager is called a cost account manager.

50.7.1 Contractor Organizational Structure. People performing work are organized to facilitate effective management. Whether the organization is designed along program, function, natural work teams or matrix lines, the organizational structure reflects the way the people who will accomplish the work have been organized. To assign specific work tasks, the organizational structure must be linked effectively with the work breakdown structure. This linkage can occur at any level of the work breakdown structure. Figure I-12 depicts the linkage between the work breakdown structure and the contractor's organizational structure.

50.7.2 Process-Oriented Breakdown Structure. One way to assess contractor performance is through the review of selected process or subprocess data. When contractors are structured using Integrated Product Teams (IPTs) this data is often needed to guide and evaluate manufacturing and other process improvement initiatives. Both development and production activities have data which can be gathered to determine process/subprocess improvement. Figures I-13 and I-14 provide some examples of development and production activities and their processes. Figure I-15 depicts the linkage between the work breakdown structure and the process-oriented breakdown within the contractor's cost management system. Visibility to specific processes can be attained through job coding (.FAB) without extending the work breakdown structure to extremely low levels.

50.7.3 Cost Account Level. To provide the responsible (cost account) manager with the technical, schedule, and cost information needed to manage the organization's work on the work breakdown structure element for which the manager is responsible, the management control system must be keyed to the same work breakdown structure element and organization unit. The appropriate work breakdown structure level at which a cost account is established is primarily a function of the magnitude of the program and the type of product. The responsible organization level is a function of the management span of control and upper management's desire to delegate technical, schedule, and cost responsibility for product/contract work breakdown structure elements to lower management levels. In identifying cost accounts, the contractor must be allowed to establish organizational responsibilities at meaningful and appropriate levels, otherwise the contractor's existing management control systems and responsibility assignments may be affected adversely. For example, when software is a major component of cost and DoD wants it identified separately, care must be taken to not unnecessarily complicate the contractor work breakdown structure and contractor management system. To meet these needs, special reporting requirements are specified in the SOW. In this example, Figure I-16 shows how the cost management system with job coding (.SW_) and the work breakdown structure can provide needed detail and visibility without extending the work breakdown structure to extremely low levels.

Virtually all aspects of the contractor's management control system, including technical definition, budgets, estimates, schedules, work assignments, accounting, progress assessment, problem identification, and corrective actions, come together at the cost account. Performance visibility is directly relatable to the level and content of the cost account. NAVSO P3627, AFSCP 173-5, AFCCP 173-5, AFLCP 173-5, AMC-P 715-5, DLAH 8400.2, and DCAA P7641.47 contains a detailed explanation of the cost account and related performance measurement concepts.

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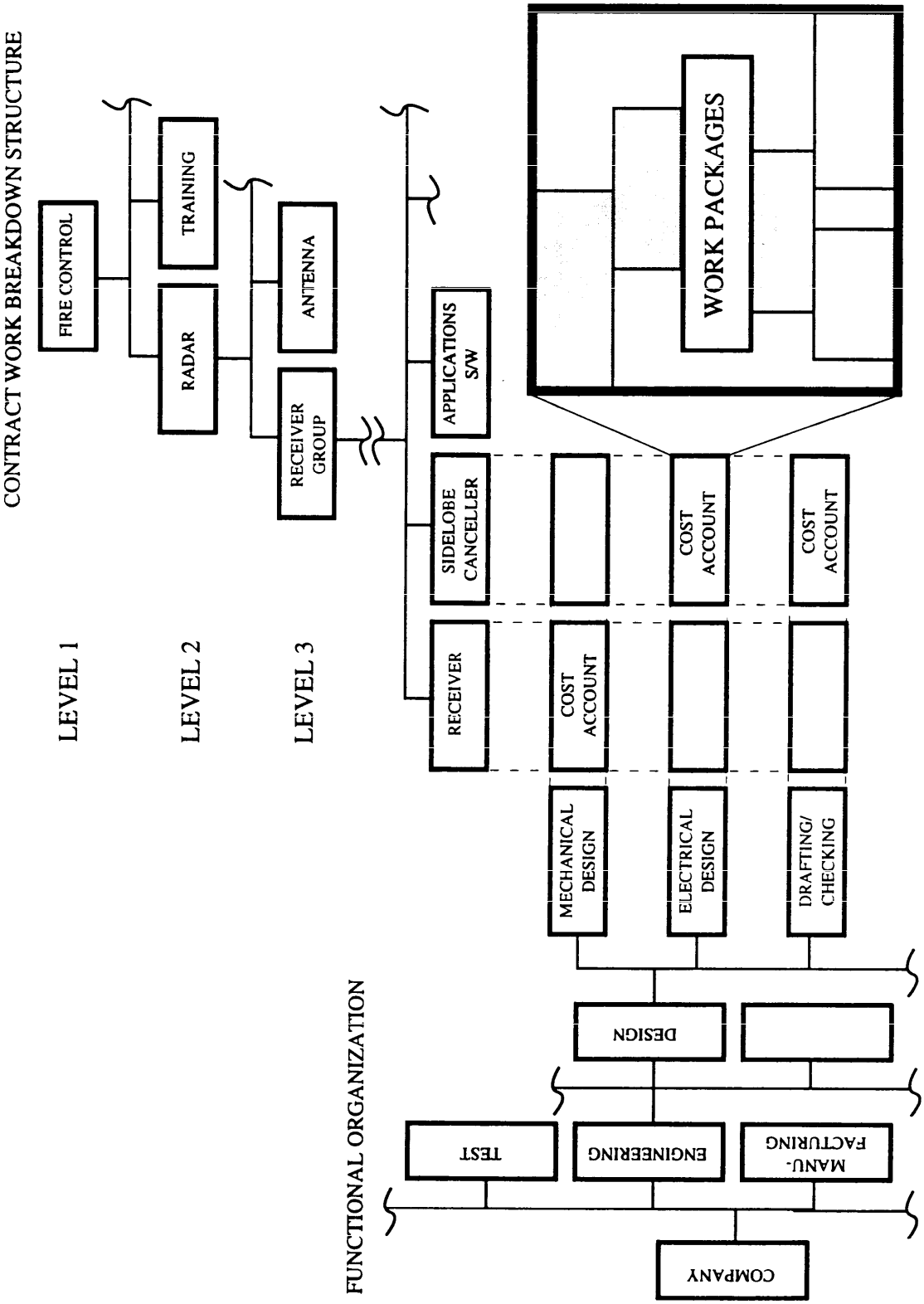

Figure I-12. TRANSLATION FROM FUNCTION TO PRODUCT

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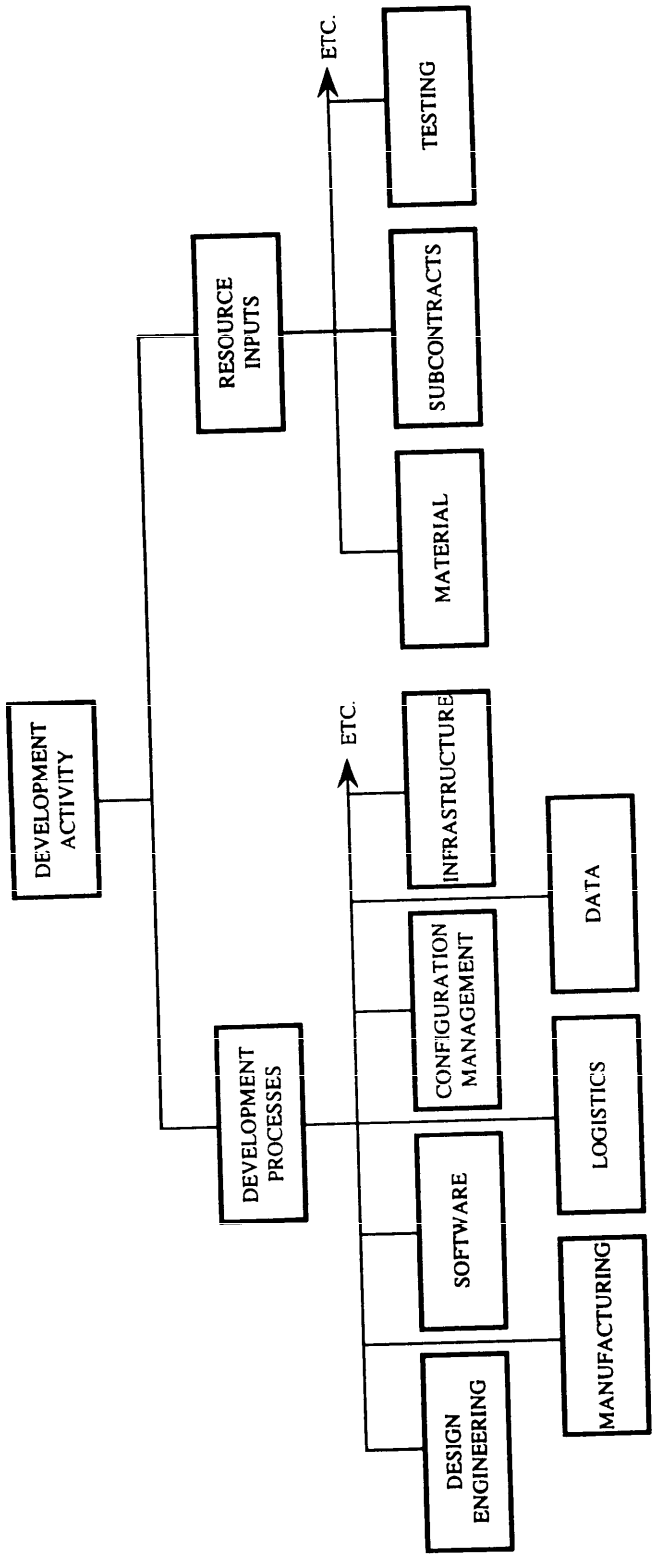

Figure I-13. DEVELOPMENT ACTIVITIES AND PROCESSES

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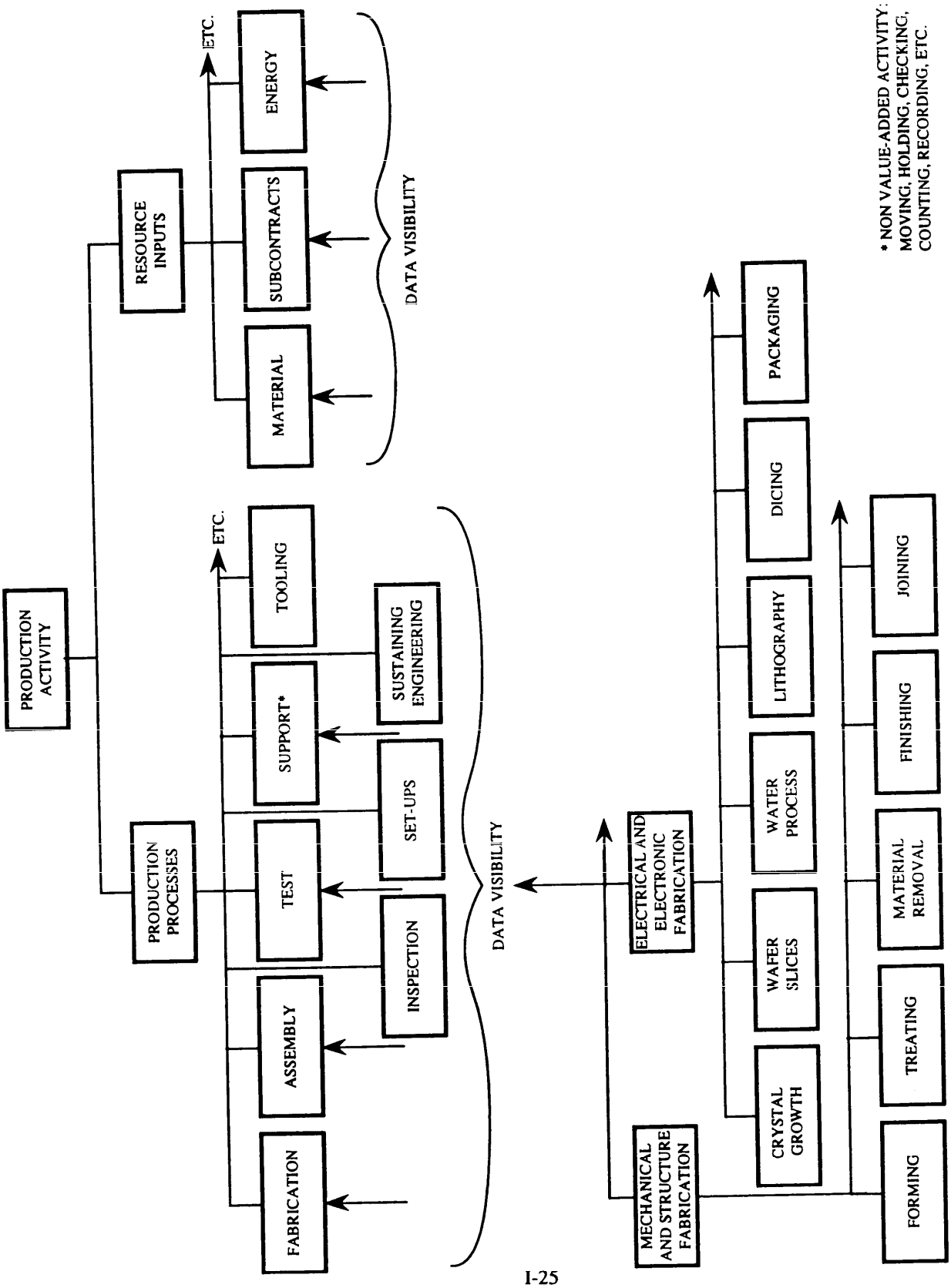

Figure I-14. PRODUCTION ACTIVITIES AND PROCESSES

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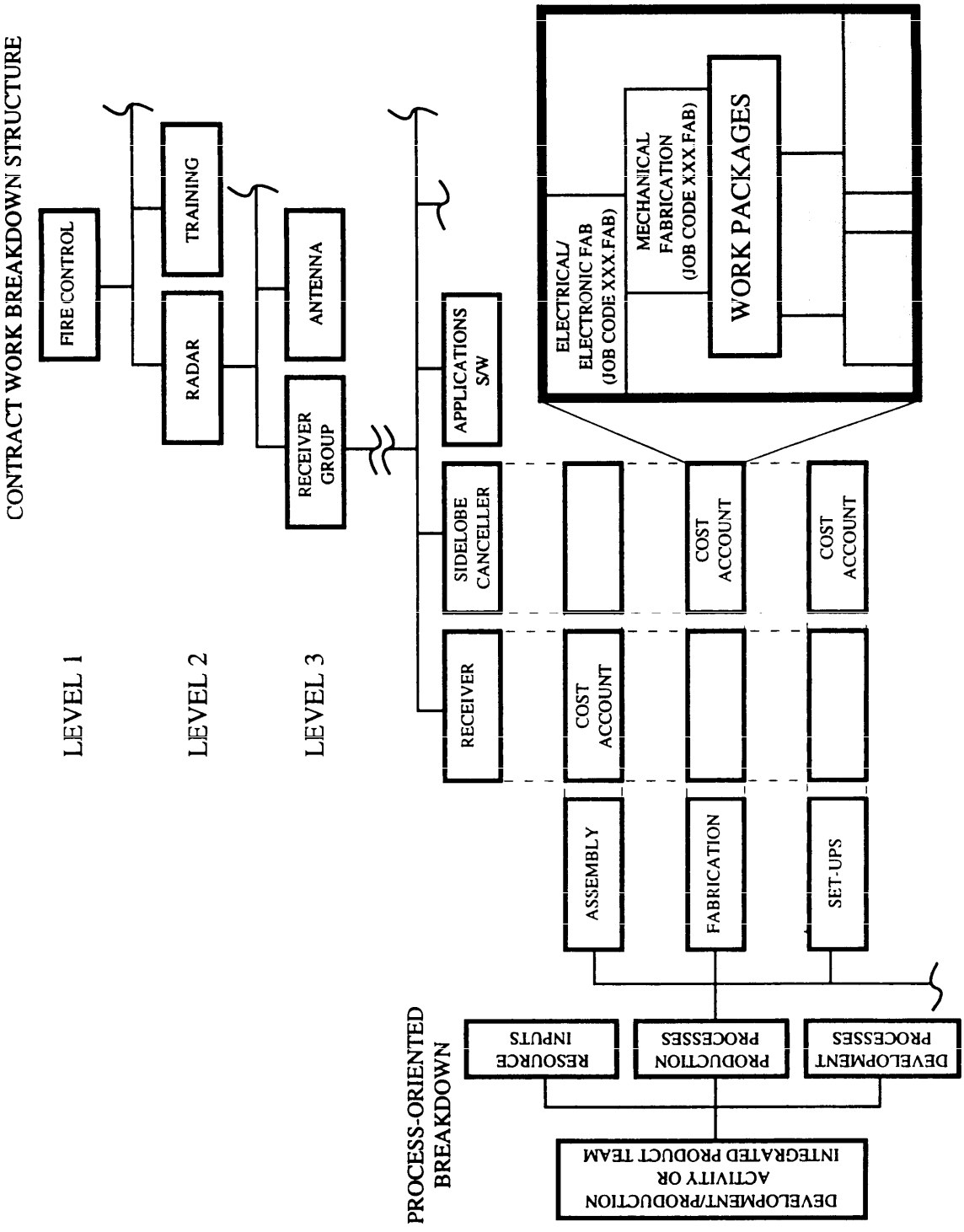

Figure I-15. LINKAGE BETWEEN WORK BREAKDOWN STRUCTURE AND PROCESS-ORIENTED BREAKDOWN

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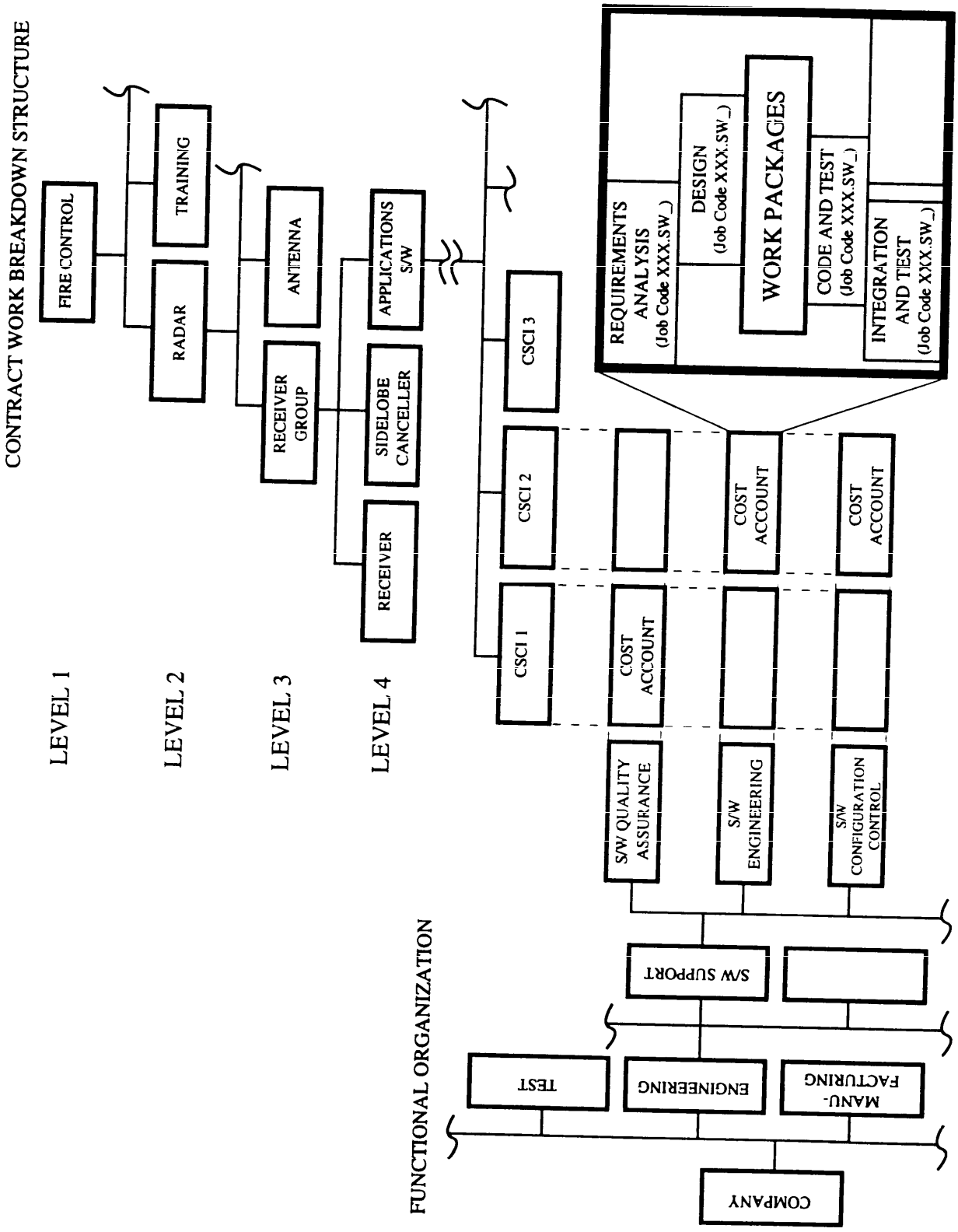

Figure I-16. LINKAGE BETWEEN CONTRACTOR WBS AND CONTRACTOR MANAGEMENT SYSTEMS

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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER	2. DOCUMENT DATE (YYMMDD)
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3. DOCUMENT TITLE

Work Breakdown Structures For Defense Materiel Items

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)	b. ORGANIZATION	
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8. PREPARING ACTIVITY

a. NAME	b. TELEPHONE (Include Area Code)	
Air Force Materiel Command	(1) Commercial 513-257-4153	(2) AUTOVON 787-4153
c. ADDRESS (Include Zip Code) Air Force Materiel Command Product Management Division (FMA) Wright-Patterson AFB, Ohio 45433	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340	

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