DEFENSE SYSTEM SOFTWARE MANAGEMENT PLAN

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The sharply rising costs of software programs in the Defense System acquisition process, with respect to acquisition procedures, development and maintenance of such software, and the increasing importance of the software roles in the overall mission effectiveness of major Defense Systems constitute serious technical and management problems that must be solved if we are to have the Defense Systems that are needed for our national security.

In an effort to provide solution to some of the key problems underlying Defense
System software acquisition, management, coordination, and control, the DoD Software Management Steering Committee has formulated a comprehensive plan comprising policy, practice, procedure, and technology initiatives. The plan is described in detail in this document.
DEFENSE SYSTEM SOFTWARE
MANAGEMENT PLAN
DoD Defense System Software Management Program

Introduction

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In an effort to provide solutions to some of the key problems underlying Defense System software acquisition, management, coordination, and control, the DoD Software Management Steering Committee has formulated a comprehensive plan comprising policy, practice, procedure, and technology initiatives. The plan, described in detail in the attached paper, is divided into the following Sections:

Part One Policy, Practice, Procedure, Technology Elements
Part Two Implementation Brief

I. Action Vehicles and Resources Estimates
II. Organizational Roles, Responsibilities and Interactions

The DoD Software Management Steering Committee intends to carry out the actions described in this plan, and to seek the support of the Service Components, Federal Contract Research Center, and Industry in so doing.

Comments or questions regarding material contained in this paper should be addressed to Mr. B. C. De Roze, OASD(I&L), Room 2A318, Pentagon. The appropriate telephone number is 695-0121.

BARRY C. De ROZE
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DoD Defense System Software Management Program

PART ONE

Policy, Practice, Procedure, and Technology Elements

- Problems Addressed
- Action to be Taken
DoD Software Program Elements

I. Management Policy

A. Software Visibility in Embedded Computer Systems Acquisition

1. Problem/Issue Summary
   - Inadequate Requirement Analyses
   - Inadequate Interface Management
   - Inadequate Documentation
   - Lack of Transferability
   - Inaccurate Cost/Schedule Projections
   - Low Quality
   - Inconsistent Application of Tools and Procedures
   - Management Privileges Pre-empted

2. Actions to be Taken
   a. Management policies will be developed and emphasized to ensure that the same attention is given to software requirements analysis, planning, and design as hardware during the Concept Formulation and Program Validation phases of system development, prior to the DSARC II (or equivalent). Such policies will ensure that software is addressed in ROC's, SOR's, DCP's, and all other appropriate planning documents and enforced through system design reviews.

      Estimated time to complete (years): 0.8
      Estimated total cost (thousands of dollars): 0
      Action Vehicle: DODD XX, DODD 500.2
      Office of Primary Responsibility: OSD

   b. Planning and management directives for embedded computer systems will treat software components as configuration items. All relevant DoD directives, such as DODI 4104.65, ASPR Case 70-83, and MIL-STD-881 on work breakdown structures, will be revised to reflect this change.

1 Time to complete from date of this paper. No connotation of manpower level of effort, nor of specific task duration.

2 External fiscal resources only. Figures do not include costs associated with DoD Civilian or military personnel.
Estimated time to complete (years): 1.0
Estimated total cost (thousands of dollars): 0
Action Vehicle: DODD XX, DOD, MIL-STD, ASPR
Office of Primary Responsibility: OSD

c. A computer resource plan will be developed prior to DSARC II (or its equivalent) and maintained through the life cycle. The purpose of this plan is to identify the important embedded computer system resource acquisition and life cycle planning factors, and establish specific software guidelines to ensure that these factors are adequately considered in the acquisition planning process.

Estimated time to complete (years): 0
Estimated total cost (thousands of dollars): 0
Action Vehicle: DODD XX, Service Directives
Office of Primary Responsibility: OSD, Services Respectively

d. Support items required to cost, effectively develop and maintain the delivered software over the system life cycle will be specified as deliverables with DoD acquiring rights to their design. Examples of such support items are compilers, environmental simulators, documentation, test case analyzers, test data management systems, system exercisers, standards generators and enforcers, and training aids. As with all deliverables, procedures will be developed for establishing and performing effective acceptance tests for deliverable support software, standards, training, and documentation. Also, appropriate procedures will be established for handling proprietary support software.

Estimated time to complete (years): 0.5
Estimated total cost (thousands of dollars): 0
Action Vehicle: DODD XX, Service Directives
Office of Primary Responsibility: OSD, Services Respectively

e. Specific milestones to manage the life cycle development of software will be used to ensure the proper sequence of analysis, design, implementation, integration, test and review. These milestones will include specific criteria that measure their attainment. MIL-STD-483, MIL-STD-490, and AFR 800-14 will be used as a baseline, but they will be expanded to define work to be accomplished, products to be delivered, and quantitative demonstration criteria.

Estimated time to complete (years): 1.0
Estimated total cost (thousands of dollars): 0
Action Vehicle: DODD XX, Service Standards and Regulations
Office of Primary Responsibility: OSD, Services Respectively

I-3
B. Software Language Standardization and Control

1. Problem/Issue Summary

Language Selection
- Lack of correlation between MOL language and engineering problem
- Lack of visibility into design
- Excessive machine dependent characteristics of MOL

Language Proliferation
- Language Learning Process Difficult
- Discourages Development of Test and Support Tools
- Reduction of management visibility and control over software design and development
- Complication of institutional control over language features
- Magnification of documentation, training, and other costs in proportion to number of languages in use

2. Actions to be Taken

a. Management policy encouraging the use of applied Higher Order Language (HOL) by restricting the use of machine coding unless it is conclusively demonstrated that a HOL cannot be used. Rigorous documentation during program development for all macro level coded programs to the algorithm level will be required.

Estimated time to complete (years): 0.5
Estimated total cost (thousands of dollars): 0
Action Vehicle: DODD XX, DODI XX
Office of Primary Responsibility: OSD/DDR&E

b. Discourage the proliferation of HOL's currently being used in the Services, but encourage computer language R&D to enhance software visibility, quality and reliability.

Estimated time to complete (Years): 0.5
Estimated total cost (thousand of dollars): 0
Action Vehicle: DODD XX, DODI XX
Office of Primary Responsibility: OSD/DDR&E
c. Management policy directive will assign each DoD authorized HOL to a control agent that will be responsible for assuring the stability of the language, certifying all implementation, gathering data as to the use of the language, and for disseminating information, compilers, and tools.

Estimated time to complete (years): 3 (then recurring)
Estimated total cost (thousands of dollars): 2,000/year
Action Vehicle: DODD XX, DODI XX
Office of Primary Responsibility: OSD/DDR&E

C. Software Quality Assurance and Control

1. Problem/Issue Summary
   - Lack of management monitoring of software reliability
   - Lack of formal software reliability/quality assurance discipline
   - Lack of quantitative data base for feedback of "lessons learned"

2. Actions to be Taken

   a. Service policies will be encouraged to require experienced personnel with software project background, and recent computer science experience to be assigned to augment existing reliability/maintainability/quality assurance organizations at the Service and program management levels. The software role will include the acquisition and use of existing tools or the development of new tools for accomplishing reliability and quality assurance functions (e.g., code auditors, test case generators/analyzers, guidelines and handbooks, etc.).

   Estimated time to complete (years): 0.5
   Estimated total cost (thousands of dollars): 0
   Action Vehicle: DODD XX, Service Policies
   Office of Primary Responsibility: OSD, JLC/JTCG (ESR) Respectively

   b. Establish a uniform software error data collection and analysis system without delay. These data will be gathered from many programs in order to develop generic methods/analysis, and to predict the amount of development effort needed to correct errors on specific programs, as well as the operational reliability/availability of the software.

Specific Tasks - the steps required under this task are:

(1) Convene a JLC panel under the JTCG-ESR of software reliability technologists
(2) Charter the panel to set forth requirements for error data collection based on appropriate error classifications.

(3) Derive formal definitions of terms within the data requirements list with emphasis on application boundaries, applicable life cycle phases, and usage oriented metrics.

(4) Produce an exhibit of agreed upon data to be collected with associated definitions, metrics, and boundaries ready for attachment to RFP's.

(5) Reflect these data requirements in a computerized software data repository for dissemination across DoD.

Estimated time to complete (years): 1
Estimated total cost (thousands of dollars): 0
Action Vehicle: Contract Exhibit
Office of Primary Responsibility: JLC/JTCG (ESR)
II. Management Practices and Procedures

A. Software Acquisition Management Standards

1. Problem/Issue Summary

   a. Lack of standard terminology governing software acquisition and management
   b. Lack of established common standards
   c. Lack of consistent policy and planning guidance (via standards, regulations, instructions)

2. Actions to be Taken

   a. Formalize a complete set of definitions for embedded computer system resources for adoption as a working standard in the DoD.

      Estimated time to complete: 0.5 years
      Estimated total cost (in $K): 0
      Action Vehicle: DODD XX, DODD 5100.40
      Office of Primary Responsibility: OSD, OSD(C) Respectively

   b. Formalize a consistent set of definitions to reconcile computer and software system needs in weapon system, telecommunications, intelligence, and ADP areas of the DoD.

      Estimated time to complete: 1.0 years
      Estimated total cost (in $K): 0
      Action Vehicle: MIL-STD-XX, JCS PUB. 1
      Office of Primary Responsibility: OSD

   c. Review all DoD and component Service regulations, directives, and standards to:

      (1) Identify and correlate the various sources of information describing hardware and software acquisition and life cycle management.

      (2) Identify those existing hardware and software regulations, directives, and standards which must be modified to provide consistency and coverage.

      (3) Identify additional regulations, directives, and standards which are needed to adequately address software areas not covered.
Estimated time to complete: 0.5 years
Estimated total cost (in $K): 50
Action Vehicle: Study Report
Office of Primary Responsibility: OSD

d. Generate and promulgate the necessary modifications to and/or the new regulations, directives, and standards identified in c.(2) and c.(3) above.

Estimated time to complete: 2.5 years
Estimated total cost (in $K): 250
Action Vehicle: DODD, DODI, MIL-STD Service Directives, Regulations, Instructions
Office of Primary Responsibility: OSD and Services Respectively

e. Cancel any existing regulations, directives and standards no longer required as a result of d. above.

Estimated time to complete: 3.0 years
Estimated total cost (in $K): 0
Action Vehicle: DODD, DODI, MIL-STD Service Directives, Regulations, Instructions
Office of Primary Responsibility: OSD, Service Respectively

f. Establish a qualified Office of Primary Responsibility within each Service to process additions and changes for consideration and inclusion in the standard definition list, regulations, directives, and standards.

Estimated time to complete: Recurring
Estimated total cost (in $K): 100 annually
Action Vehicle: Service Instructions
Office of Primary Responsibility: Services

B. Software Acquisition, Management, Development, Operation, and support guides

1. Problem/Issue Summary

   . Insufficient understanding by managers
   . Lack of planning and operation guidance in day-to-day operations
   . Lack of systems engineering methodology and discipline
   . Lack of technology transfer into application domain
   . Lack of personnel skill continuity over life cycle
2. Actions to be Taken

a. Prepare a series of guidelines, checklists, handbooks, examples, and other "how to do it" data within the areas of software development, acquisition, operation, and support for use by program managers and their staffs. A typical (although not complete) list of topics to be addressed are:

(1) Formulating a life cycle plan
   (a) The planning activity
   (b) Cost and resource estimation

(2) Specification and contracting
   (a) Requirements specification
   (b) Concept validation
   (c) Contracting

SOWs and RFPs

(3) Computer resource development plan review

(4) Development visibility and control

(5) Support facility plan evaluation

(6) Product control
   (a) Documentation requirements
   (b) Configuration management

(7) Quality assurance plan evaluation
   (a) Design validation
   (b) S/W verification
   (c) S/W validation and certification

(8) Maintenance
(9) Synopsis of regulations, specifications, and standards

Estimated time to complete: 3 years
Estimated total cost (in $K): 500
Action Vehicle: Service Handbooks
Office of Primary Responsibility: Service Components

b. The products of this program will be disseminated to DoD and component Services in order to evaluate their value and identify where they could be improved. Feedback from the field will be incorporated in updated versions of the guidelines and a continued maintenance effort will be established.

- Estimated time to complete: Recurring
- Estimated total cost (in $K): 50 (Annual)
- Action Vehicle: Service Handbooks
- Office of Primary Responsibility: Service Components

C. Personnel Development and Training

1. Problem/Issue Summary

- Software engineering as a scientific discipline has not been clearly and formally established
- Shortage of practitioners
- Lack of career incentives
- Lack of relevant academic curricula

2. Actions to be Taken

a. Recommend that the Service Logistics Commanders establish offices of primary responsibility (OPRs) for the promotion, coordination and direction of the efforts to develop high level software professionals. These OPRs should reside in AFSC (Air Force), NMC (Navy), AMC (Army) with coordination between these groups by a JTC Joint Technical Coordinating Group. The individuals selected for this OPR function should be of high caliber who are (a) intimately familiar with current state of the art in this area; (b) aware of the needs and problems of software in military systems; and (c) represent the formal engineering, programming, mathematical, and educational sciences.
b. Recommend that the Service Logistics Commanders, through the OPRs, establish an exchange or rotational program to give university level instructors an exposure to the DoD needs. This program should include summer (or equivalent period) assignments to organizations involved in state of the art architecture studies, design, maintenance, etc., e.g., Data Systems Design Center, AF Systems Command, Army and Naval Materiel Commands, operational commands, Federal Contract Research Centers, etc. Educational institutions should include Air Force Institute of Technology, Naval Postgraduate School, Military Academies, and selected civilian universities.

Estimated time to complete: 1.0
Estimated total cost (in $K): 0
Action Vehicle: Service Instructions
Office of Primary Responsibility: JLC/JTCG (XX)

C. Recommend that the Service Logistics Commanders, through the OPRs, establish an apprenticeship program for qualified and promising military and civil service software engineering candidates.

Estimated time to complete: 0.8
Estimated total cost (in $K): 0
Action Vehicle: Service Instructions
Office of Primary Responsibility: JLC/JTCG (XX)

d. Recommend that the Service Logistics Commanders, through the OPRs, establish a general definition of what constitutes a good software engineer (professional profile) thereby establishing specialty codes and career fields. This definition of the profession should carefully delineate educational and experience requirements for various levels of proficiency.

Estimated time to complete: 0.8 years
Estimated total cost (in $K): 0
Action Vehicle: Professional & Career Profiles
Office of Primary Responsibility: JLC/JTG (XX)
e. Recommend that the Service Logistic Commanders, through the OPRs establish an effort to incorporate software engineering into the background of computer scientists and engineers. A practical goal would be to establish regular graduate courses at the Air Force Institute of Technology, Naval Post Graduate School and civilian universities. Discretionary funding to civilian universities should be used to establish the graduate level courses and additionally to establish elective junior and senior level undergraduate courses.

Estimated time to complete: 1.3 years  
Estimated total cost (in $K): 500  
Action Vehicle: Curriculum Plans and Course Outlines  
Office of Primary Responsibility: JLC/JTCG (XX)

f. Recommend that the Service Logistics Commanders, at one or more universities, special training programs tailored for the joint Service software personnel. These programs can vary in length (3 months to a year). They should be aimed at those software personnel who have a fair amount of experience and some management responsibility. These programs would be intended to provide an in-depth exposure to new developments in software engineering.

Estimated time to complete: 1.6 years  
Estimated total cost (in $K): 500  
Action Vehicle: Curriculum Plans and Course Outlines  
Office of Primary Responsibility: JLC/JTCG (XX)

g. Establish the addition of software acquisition/life cycle management practices to the Defense Systems Management School (DSMS) curriculum at the next DSMS Policy Guidance Council meeting. The initial course material could be in the form of readings and/or guest lecturers and be expanded as handbooks and technical guidance becomes available. The course content will be developed by the DSMS faculty with support from OSD and the Services.

Estimated time to complete: 0.2 years  
Estimated total cost (in $K): 0  
Action Vehicle: DSMS Policy Guidance  
Office of Primary Responsibility: OSD

D. Software Quality Specification and Trade-Offs

1. Problem/Issue Summary

   . Lack of system optimization with respect to both hardware and software

   . Lack of quantitative quality, reliability goals and objectives

   . Lack of quantitative test standards
2. Actions to be Taken

a. Specifications for embedded computer systems should contain specific reliability requirements along with the functional and performance requirements. These should be quantified with respect to operational objectives (e.g., system or subsystem downtime), and used to drive the design, development, and testing of embedded software systems.

Estimated time to complete (years): 1.0
Estimated total cost (thousand of dollars): 0
Action Vehicle: System Requirements Specifications Entry
Office of Primary Responsibility: JLC/JTCG (ESR)

b. Hardware design guidelines (within category of embedded computer systems) should be established to allow inclusion of:

- reliability-enhancing procedures and tools such as higher
  yr languages and structured code, test drivers, and
  monitors.

- use of microprogramming and microprocessing
  capabilities to aid in self monitoring and
diagnosis.

(3) Monitor registers and accessible hardware monitoring
probe points to facilitate external monitoring and
diagnosis.

Estimated time to complete: 1 year
Estimated total cost: $750K
Action Vehicle: System Design Specifications
Office of Primary Responsibility: JLC/JTCG (ESR)
III. Technology

A. Coordinated Software Research and Development

1. Problem/Issue Summary

   • Lack of focus in software R&D, study and pilot programs
   • Lack of technological base to implement desired policy, practices, and procedure initiatives
   • Obscure relevancy of many R&D efforts to real improvements in software management policies, practices, and procedure techniques
   • Redundancy and duplication of R&D programs

2. Actions to be Taken

   a. A coordinated R&D program will be initiated to supply the technological base needed to support the management policy, practice and procedure initiatives cited in Sections I and II of the DoD Software. Table III-1 indicates the R&D thrusts required. Specific task areas underlying these initiatives are currently being developed.

      Estimated time to complete: 8 years
      Estimated total cost (thousands of dollars): 38,000

   b. A mechanism will be established for reviewing all technology elements of the DoD Software Program with respect to "prototype or experimental proofing" prior to full scale technology transfer to on-going system applications.

B. Transferability of Software Support Aids

1. Problem/Issue Summary

   • No reuse or transferability of software support aids
   • Procurement and Development Redundancy (Excessive Costs/ Low Quality Products)
   • Low Development Incentive for Support Aids
2. **Actions to be Taken**

   a. A repository will be established within DoD responsible for maintenance and institutional control of support aids for development, test, analysis, and maintenance of computer programs. In support of this action, the following typical activities will be undertaken:

   (1) All aids placed into the physical inventory should be screened, validated and documented according to a certain set of standards. The standards would be developed as part of this project.

   (2) The user must be assisted in determining what aids are applicable to development and in using the aids (in-house or contractually). Guidelines for the use of the aids must be written and a staff of personnel knowledgeable in all facets of computer program development, test, analysis and maintenance must be available to manage the inventory and serve as consultants.

   (3) Policy will be instituted which requires all DoD organizations procuring original software for which support aids will be required to query the repository in advance to ascertain whether existing, Government owned tools could be applied to the particular project, or to justify why this cannot be done.

   Estimated time to complete: 4 years
   Estimated total cost (thousands of dollars): $1000
   Action Vehicle: DODD XX
   Office of Primary Responsibility: OSD

   b. Procurement vehicles (such as directed licensing, royalty payments) will be developed and injected into the contract structure to allow and encourage industry interest in development of transferable tools.

   Estimated time to complete: 2 years
   Estimated total cost (thousands of dollars): 0
   Action Vehicle: Procurement Research
   Office of Primary Responsibility: OSD, Services
DoD Software Management Program

PART TWO

Implementation Brief

Section I

Action Vehicle and Resource Estimate
The action vehicles envisioned for carrying out the management policy initiatives of the DoD Software Management Program are identified in Table I-1, along with a designated Office of Primary Responsibility (OPR). The designated OPR shall take the lead in preparing and coordinating the cited vehicle. The OPR will be supported in this activity by the Software Management Steering Committee, its technical and procurement panels, the Service Logistics Commanders, Service components, and FCRC contract efforts.

Required resources to effect the action are also cited in Table I-1 in terms of both time and money. The time entries represent calendar time for completion starting from the date of this brief. It does not represent the duration of any specific task. Fiscal resources depict only those services which must be procured under contract funding. The cited entries do not include the salary and overhead associated with DoD Civilian or Military personnel.
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* DOD XX = CAPSTONE DIRECTIVE TO SUPPLEMENT AND AID IN THE APPLICATION OF MANAGEMENT PRINCIPLES ESPoused IN DODD 5000.1 AND 5000.2, AS THEY RELATE TO COMPUTER RESOURCES IN SYSTEMS.
Table I - 1b
Software Language Standardization & Control

IMPLEMENTATION OF POLICY ACTIONS

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<th>VEHICLE</th>
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<th>TIME (YEARS)</th>
<th>$ K REQUIRED RESOURCES</th>
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<td>MOL SUPPRESSION</td>
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<td>ESTABLISHMENT OF APPROVED HOL</td>
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<td>INTERIM STANDARDS</td>
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<td>LONG TERM STANDARDS</td>
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<td>DODI XX</td>
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## Table I - 1c

Software Quality Assurance and Control

**IMPLEMENTATION OF POLICY ACTIONS**

**REQUIRED SOURCES**

<table>
<thead>
<tr>
<th>ACTION</th>
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<th>OPR</th>
<th>TIME</th>
<th>$ K</th>
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<td>SOFTWARE QA ORGANIZATION AND PROGRAM PLAN</td>
<td>SERVICE INSTRUCTION</td>
<td>JLC/JTCG (ESR)</td>
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<td>II-5</td>
<td>MIL-STD</td>
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</tr>
<tr>
<td>SOFTWARE ERROR DATA COLLECTION &amp; ANALYSIS</td>
<td>CONTRACT EXHIBIT</td>
<td>JLC/JTCG (ESR)</td>
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<td>-</td>
</tr>
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</table>
The action vehicle envisioned for carrying out the management practice and procedure initiatives of the DoD Software Management Program are identified in Table I-2, along with a designated Office of Primary Responsibility (OPR). The designated OPR shall take the lead in preparing and coordinating the cited vehicle. The OPR will be supported in this activity by the Software Management Steering Committee, its technical and procurement panels, the Service Logistics Commanders, Service components, and FCRC contract efforts.

Required resources to effect the action are also cited in Table I-2 in terms of both time and money. The time entries represent calendar time for completion starting from the date of this brief. It does not represent the duration of any specific task. Fiscal resources depict only those services which must be procured under contract funding. The cited entries do not include the salary and overhead associated with DoD Civilian or Military personnel.
<table>
<thead>
<tr>
<th>ACTION</th>
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<th>REQUIRED RESOURCES</th>
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<td>FORMALIZE DEFINITIONS ACROSS W &amp; TELECOMM., INTELL., AND ADP</td>
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<td>REVIEW OF EXISTING REGULATIONS, DIRECTIVES AND STANDARDS</td>
<td>STUDY REPORT</td>
<td>OSD/ SERVICE</td>
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<td>MODIFY OR ADD REGULATIONS DIRECTIVES AND STANDARDS</td>
<td>DODD, DODI, MIL-STD, SERVICE INSTRUCTIONS, STANDARDS, REGULATIONS (NEW AND REVISED)</td>
<td>OSD, SERVICE LC</td>
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<td>SERVICE COMPONENT INSTRUCTIONS</td>
<td>SERVICE LC</td>
<td>RECURRING</td>
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<td>TIME (YEARS)</td>
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<td>SOFTWARE GUIDELINES, CHECKLISTS, HANDBOOKS</td>
<td>SERVICE MANUALS</td>
<td>SERVICES</td>
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<td>SEMI-ANNUAL USER REVIEWS</td>
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<td>DESIGNATED PROFESSIONAL DEVELOPMENT OPRs</td>
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<td>SERVICES</td>
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<tr>
<td>APPRENTICESHIP PROGRAM</td>
<td>SERVICE DIRECTIVE</td>
<td>SERVICES</td>
<td>0.8</td>
</tr>
<tr>
<td>SPECIALTY CODES/CAREER PATHS</td>
<td>SERVICE DIRECTIVE</td>
<td>SERVICES</td>
<td>0.8</td>
</tr>
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<td>CURRICULA MODIFICATION</td>
<td>SERVICE DIRECTIVE/</td>
<td>SERVICES</td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td>ACADEMIC GRANTS</td>
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<tr>
<td>IN-SERVICE TRAINING PROGRAMS</td>
<td>SERVICE DIRECTIVE</td>
<td>SERVICES</td>
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### Table I - 2c

Software Quality Specification and Trade-Offs

**IMPLEMENTATION OF PROCEDURE ACTIONS**

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<thead>
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<th>ACTION</th>
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<th>REQUIRED RESOURCES</th>
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<td>QUALITY REQUIREMENTS SPECIFICATION AND TEST</td>
<td>REQUIREMENTS</td>
<td>JLC/</td>
<td>TIME</td>
</tr>
<tr>
<td></td>
<td>SPECIFICATION</td>
<td>JTCG (ESR)</td>
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<tr>
<td>DESIGN GUIDELINES FOR SOFTWARE QUALITY ENHANCED</td>
<td>REQUIREMENTS</td>
<td>JLC/</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>SPECIFICATION</td>
<td>JTCG (ESR)</td>
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</table>
TECHNOLOGY

The action vehicles envisioned for carrying out the technology initiatives of the DoD Software Management Program are identified in Table I-3, along with a designated Office of Primary Responsibility (OPR). The designated OPR shall take the lead in preparing and coordinating the cited vehicle. The OPR will be supported in this activity by the Software Management Steering Committee, its technical and procurement panels, the Service Logistics Commanders, Service components, and FCRC contract efforts. Required resources to effect the action are also cited in Table I-3 in terms of both time and money. The time entries represent calendar time for completion starting from the date of this brief. It does not represent the duration of any specific task. Fiscal resources depict only those services which must be procured under contract funding. The cited entries do not include the salary and overhead associated with DoD Civilian or Military Personnel.
Table I - 3a

Coordinate Software Research & Development

IMPLEMENTATION OF TECHNOLOGY ACTIONS

<table>
<thead>
<tr>
<th>ACTION CODE</th>
<th>ACTION VEHICLE</th>
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<th>REQUIRED RESOURCES</th>
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<tr>
<td>COORDINATED</td>
<td>SERVICE COMPONENT</td>
<td>DDR&amp;E/</td>
<td>TIME TO COMPLETE</td>
</tr>
<tr>
<td>R&amp;E</td>
<td>R&amp;D PROGRAMS</td>
<td>SERVICES</td>
<td>DOLLARS</td>
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<tr>
<td>II-1</td>
<td>PROTOTYPE</td>
<td>JLC</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>PROOFING</td>
<td></td>
<td>$38.1 M</td>
</tr>
<tr>
<td></td>
<td>PROTOTYPE SELECTION/</td>
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<td>MONITORING</td>
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Table - 3b

IMPLEMENTATION OF TECHNOLOGY ACTIONS

<table>
<thead>
<tr>
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</tr>
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<tr>
<td>SUPPORT SOFTWARE REPORTING</td>
<td>DODD AND ACOMPANYING SERVICE DIRECTIVES</td>
<td>OSD</td>
<td>JLC</td>
</tr>
<tr>
<td>II-12 PROCUREMENT VEHICLE DEVELOPMENT &amp; USE</td>
<td>PROCUREMENT POLICY</td>
<td>OSD 1/</td>
<td>2</td>
</tr>
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</table>

NOTE: 1/ VIA PROCUREMENT PANEL OF SMSC
DoD Software Management Program

PART TWO

Implementation Brief

Section II

Organizational Roles, Responsibilities, Interaction
MANAGEMENT POLICY

The organizational interactions necessary for implementation of the management policy portion of the DoD Software Management Program are illustrated in Figure II-1.

For both new policy initiatives and changes to existing policy, the following roles shall generally apply:

a. **Steering Committee - OPR**
   1. Review existing policies for coverage, adequacy, realism and auditability.
   2. Determine need for new policy, modified policy, or "no change" action.
   3. Draft policy and coordinate within OSD/Services - include audit standards.
   4. Assess impact of new or modified policy.
   5. Brief DSARC on position, ensuing impact, areas of applicability, exclusions, and expected benefits.
   6. Finalize policy and establish necessary audit mechanisms and reporting structure.
   7. Continuously monitor corresponding service policies, procedures, regulations as well as OSD actions in definitional areas and ADP.
   8. Prepare DSARC checklist to assure program consistency with in force policies, new or modified.
   9. Monitor impact of policy to determine if it produces desired results.

b. **Role of Panels and Panel Members**
   1. Technical and management advisory role.
   2. Policy impact assessment and analysis.
      a. Technological
      b. Economic impact
      c. Procurement impact - industrial motivation
3. Surface additional inadequate existing directives, instructions, and standards.

c. Role of Services

1. Comment on OSD policies during formulation.

2. Prepare accompanying regulations, instructions, and standards for Service components.

3. Carry out policy and accompanying audit mechanism; review with OSD periodically to assess resulting gains and losses.

Specific responsibility and action items with respect to each of the DoD Software Management Program elements are delineated in Table II-1.
Figure II-1
ORGANIZATIONAL INTERACTIONS
POLICY INITIATIVES

DOD SOFTWARE PROGRAM ELEMENTS

COORDINATE POLICY
- FORM
- CONTENT
- AUDIT MECHANISM

OSD POLICY INSTRUMENTS
- DODD
- DODI

SERVICE POLICY INSTRUMENTS
- INSTRUCTION
- REGULATIONS
- STANDARDS

POLICY CONSULTATION AND ADVICE

TECH. COORD. PANEL

SOFTWARE MANAGEMENT STEERING COMMITTEE

PROCUREMENT PANEL

R&D PANEL

SERVICE LOGISTICS COMMANDERS

ARMY SYSCOMS

NAVY AND MARINE SYSCOMS

USAF SYSCOMS

POLICY COMPLIANCE AND DEMONSTRATION
<table>
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<tr>
<th>A. Software Visibility in WS Acquisition</th>
<th>OSD</th>
<th>SERVICE LOGISTICS COMMANDERS</th>
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</thead>
<tbody>
<tr>
<td>a. Requirements Validation &amp; Analysis</td>
<td>P</td>
<td>S</td>
</tr>
<tr>
<td>b. Software as Configuration Item</td>
<td>P</td>
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</tr>
<tr>
<td>c. Comp. System Resource Plan</td>
<td>S</td>
<td>I</td>
</tr>
<tr>
<td>d. Support Software as Deliverable</td>
<td>P</td>
<td>A</td>
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<tr>
<td>e. Milestone Guide &amp; Evaluation</td>
<td>S</td>
<td>I</td>
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<tr>
<td>Criteria</td>
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<td>S</td>
</tr>
<tr>
<td>B. Software Language Standardization &amp; Control</td>
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<tr>
<td>a. MOL Suppression</td>
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</tr>
<tr>
<td>b. Establishment of Approved HOL</td>
<td>P</td>
<td>S</td>
</tr>
<tr>
<td>c. HOL Control Facility</td>
<td>P</td>
<td>A</td>
</tr>
<tr>
<td>C. Software Quality Assurance &amp; Control</td>
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<td></td>
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<tr>
<td>a. Software QA Organization</td>
<td>S</td>
<td>I</td>
</tr>
<tr>
<td>b. Software Data Collection &amp; Reporting System</td>
<td>S</td>
<td>A</td>
</tr>
</tbody>
</table>

**Code:**
P = Primary or Lead Responsibility  
S = Support Responsibility  
A = Advisory Responsibility  
I = Implementation Responsibility
MANAGEMENT PRACTICE AND PROCEDURE

The implementation of management practice and procedures portions of the DoD Software Management Program involves a merger between policy and technology initiatives. In those areas where directives, standards, instructions are involved, the organizational interactions are identical to those prescribed in the policy domain. In those areas where technology provides the primary impetus for practice and procedural steps, the organizational interactions will follow that prescribed in the technology domain.

Specific responsibility and action items with respect to each of the DoD Software Management Program elements are delineated in Table II-2.
Table II-2
Responsibility and Action Summary - MANAGEMENT PRACTICE & PROCEDURE

<table>
<thead>
<tr>
<th>PRACTICE AND PROCEDURE</th>
<th>OSD</th>
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<tr>
<td></td>
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<td>FCRC</td>
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A. Software Acquisition Management Standards

<table>
<thead>
<tr>
<th>Practice</th>
<th>SMSC</th>
<th>FCRC</th>
<th>PANELS</th>
<th>SERVICE COMPONENTS</th>
<th>JTCG</th>
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<tr>
<td>a. Formalize WS Definitions</td>
<td>P</td>
<td>A</td>
<td>S</td>
<td>S</td>
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<tr>
<td>b. Formalize Definitions Across WS Telecommunications Intelligence and ADP</td>
<td>P</td>
<td>A</td>
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<td>S</td>
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<tr>
<td>c. Review of Existing Regulations, Directives, and Standards</td>
<td>S</td>
<td>P</td>
<td>S</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>d. Modify or Add Regulations, Directives, Standards</td>
<td>P</td>
<td>A</td>
<td>P</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>e. Cancel Inappropriate Regulations, Directives, Standards</td>
<td>P</td>
<td>A</td>
<td>P</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>f. Establish OPR for Maintenance of Regulations, Directives, Standards</td>
<td>S</td>
<td></td>
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</table>

B. Software Acquisition, Management, Development, Operation and Support Guides

<table>
<thead>
<tr>
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<th>SMSC</th>
<th>FCRC</th>
<th>PANELS</th>
<th>SERVICE COMPONENTS</th>
<th>JTCG</th>
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<tbody>
<tr>
<td>a. Preparation of Guidelines, etc.</td>
<td>S</td>
<td>S</td>
<td>P</td>
<td>P</td>
<td>S</td>
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<tr>
<td>b. Guide Dissemination and Feedback</td>
<td>S</td>
<td>S</td>
<td>P</td>
<td>P</td>
<td>S</td>
</tr>
<tr>
<td>c. Personnel Development and Training</td>
<td>P</td>
<td>A</td>
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</table>

C. Software Qualify Spec. and Trade-Offs

<table>
<thead>
<tr>
<th>Practice</th>
<th>SMSC</th>
<th>FCRC</th>
<th>PANELS</th>
<th>SERVICE COMPONENTS</th>
<th>JTCG</th>
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<tbody>
<tr>
<td>a. Specification of Quantitative Rel Objectives</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>I</td>
<td>P</td>
</tr>
<tr>
<td>b. Hardware Design Guidelines for System Level Balance</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>I</td>
<td>P</td>
</tr>
</tbody>
</table>
TECHNOLOGY

The organizational interactions necessary for implementation of the technology portion of the DoD Software Management Program are illustrated in Figure II-2.

For new technology programs and initiatives, the following roles shall generally apply:

a. Service Components
1. Originate ideas in technological areas of interest
2. Review program proposals; technical approval or rejection
3. Budget request or reprogramming of funds
4. Provide technical and fiscal management of programs
5. Appraise Software Management Steering Committee of meaningful findings, results, and product developments

b. Role of Panels and Panel Members
1. Originate ideas in technological areas of interest
2. Coordinate technology efforts among Services; evaluate programs for transferability
3. Technical advocacy in respective Services
4. Brief Software Management Steering Committee of meaningful findings, results, and product developments; provide policy impact assessment
5. Publicize technological developments throughout DoD and industry; interface with other DoD Software Groups, e.g., (ESR, NLCC, etc).

c. Role of Software Management Steering Committee
1. Review technology programs for policy consistency, relevancy, and impact
2. Update policy and audit mechanisms to exploit "enabling technology"
3. Brief DSARC on promising developments, and on imminent improvements resulting from technology

4. Publicize technological developments and their ensuing impact on policy through DoD and industry

5. Advise DDR&E on software technology programs

Specific responsibility and action items with respect to each of the DoD Software Management Program elements are delineated in Table II-3.

For on-going technology programs, the roles of the Service Components and the Software Management Steering Committee are the same as cited above. The role of the Panels and Panel Members is slightly modified to include:

1. Review and coordination of objectives, goals, and implementations

2. Identify strengths and weaknesses in a tri-service context

3. Identify areas of transferability across service lines

4. Identify areas of R&D transfer to contemporary programs

5. Advise and consult with cognizant sponsor organization

6. Brief Software Management Steering Committee and DDR&E on meaningful findings, results, and product developments; provide policy impact assessment
<table>
<thead>
<tr>
<th>ACTION</th>
<th>SMSC</th>
<th>OSD</th>
<th>PANELS</th>
<th>SERVICE COMPONENTS</th>
<th>ESR</th>
</tr>
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<td>A. Coordinated Software R&amp;D</td>
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<td>S</td>
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<td>S</td>
<td>S</td>
</tr>
<tr>
<td>B. Transferability of Software Support Aids</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>a. Support Software</td>
<td>P</td>
<td>A</td>
<td>S</td>
<td>I</td>
<td></td>
</tr>
<tr>
<td>b. Procurement Vehicles</td>
<td>P</td>
<td>S</td>
<td></td>
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</tbody>
</table>
Software Management Steering Committee

Statement of Principles

CAPSTONE DIRECTIVE

I. Management Policy

Software Visibility in Weapon System Acquisition - Computer resources in systems are managed as elements or subsystems of major importance during conceptual, validation, full-scale development, production, deployment, operation and support phases. The purpose of the Directive is to supplement and aid in the application of the management principles espoused in DODD 5000.1 and DODD 5000.2 as they relate to these resources.

1. Software requirements and risk analyses, planning, preliminary design, and interface control and integration will be conducted during the Concept Formulation and Program Validation phases of system development, prior to the DSARC II. Ease of maintenance and modification will be major considerations in the initial design.

2. Planning and management directives for embedded computer systems will treat software components as configuration items.

3. A computer resource plan shall be developed prior to DSARC II and maintained through the life cycle. The purpose of the plan is to identify the important embedded computer system resource acquisition and life cycle planning factors, and establish specific software guidelines to ensure that these factors are adequately considered in the acquisition planning process.

4. Support items required to cost effectively develop and maintain the delivered software over the system's life cycle will be specified as deliverable with DoD acquiring rights to their design. Examples of such support items are compilers, environmental simulators, documentation aids, test case generators and analyzers, test data management systems, system exercisers, standards enforcers, and training aids.

5. Specific milestones to manage the life cycle development of software will be used to ensure the proper sequence of analysis, design, implementation, integration, test, operation and maintenance. These milestones will include specific criteria that measure their attainment.

6. Technical and managerial personnel with embedded computer system experience will be assigned responsive to program management organizations.
7. DoD approved Higher Order Languages (HOL) will be used to develop embedded computer systems unless it is conclusively demonstrated that the approved HOL is not cost effective over the system life cycle. Any DoD approved HOL will be assigned to a designated control agent who will be responsible for assuring the stability of the language, certifying all implementations, gathering data as to the use of the language, and for disseminating information, compilers, and tools.

II. Management Practices and Procedures

A. Software Acquisition Management Standards

1. Standard terminology is essential for the management of embedded computer system resources throughout the DoD. Definitions listed in Attachment A will be used as standards throughout the DoD and by DoD contractors in the implementation of DoDD 5000.1 and 5000.2.

2. Review all DoD and component Service regulations, directives, and standards to:

   (a) Identify and correlate the various sources of information describing hardware and software acquisition and life cycle management.

   (b) Identify those existing hardware and software regulations, directives, and standards which must be modified to provide consistency and coverage.

   (c) Identify additional regulations, directives, and standards which are needed to adequately address software areas not covered.

3. Generate and promulgate the necessary modifications to and/or the new regulations, directives, and standards identified in II.A.2. above.

4. Cancel any existing regulations, directives, and standards no longer required as a result of II.A.2. above.

5. Establish a qualified Office of Primary Responsibility within each Service to process additions and changes for consideration and inclusion in the standard definition list, regulations, directives, and standards.

B. Embedded Computer System Resource Acquisition, Management, Development, Operation, and Support Guides

1. The DoD will develop a coordinated embedded computer systems software engineering methodology and discipline to improve the quality of software and provide for the effective management control of its development. To achieve these objectives, the Services shall:

III-2
(a) Prepare and maintain guidelines, checklists, handbooks and examples covering development, acquisition, operation and support. These are intended for day-to-day use by program managers and their staffs.

(b) Establish appropriate education, training or experience career paths with accompanying career incentives to foster the development and retention of professional embedded computer system software engineers.

(c) Initiate a coordinated Research and Development Program to identify and supply the technological base needed to support the policy, practice, and procedure initiatives cited in this Directive.

2. Further, DoD will establish an inventory of embedded computer system hardware, software, and support facility resources.
DEFINITIONS

Computer Data: Basic elements of information used by computer equipment in responding to a computer program.

Computer Equipment: Devices capable of accepting and storing computer data, executing a systematic sequence of operations on computer data or producing control outputs. Such devices can perform substantial interpretation, computation, commensuration, control, and other logical functions.

Computer Firmware: The logical code of computer equipment which interprets the control functions of that equipment.

Computer Program: A series of instructions or statements in a form acceptable to computer equipment, designed to cause the execution of an operation or series of operations. Computer programs include operating systems, assemblers, compilers, interpreters, data management systems, utility programs, and maintenance/diagnostic programs. They also include application programs such as payroll, inventory control, operational flight, strategic, tactical, automatic test, crew simulator, and engineering analysis programs. Computer programs may be either machine dependent or machine independent, and may be general purpose in nature or be designed to satisfy the requirements of a specialized process or a particular user.

Computer Resources: The totality of computer equipment, computer programs, computer data associated documentation, personnel, and supplies.

Computer Software: A combination of associated computer programs and computer data required to command the computer equipment to perform computational or control functions.

Embedded: Objective modifier; integral to, from a design, procurement, and operations point of view.
SOFTWARE MANAGEMENT PROGRAM

PRESENTATION TO DEFENSE SCIENCE BOARD

SOFTWARE TASK GROUP

25 JULY 1975
PRESENTATION OUTLINE

I BACKGROUND AND INTRODUCTION

II NATURE OF PROBLEM

III OBJECTIVE OF DOD SOFTWARE MANAGEMENT PROGRAM

IV POLICY INITIATIVES

V PRACTICE AND PROCEDURE INITIATIVES

VI TECHNOLOGY INITIATIVES

VII ORGANIZATIONAL INTERACTIONS

VIII SUMMARY
BACKGROUND & INTRODUCTION

ANNUAL WEAPON SYSTEM SOFTWARE COST ESTIMATE — —
> $1.4 BILLION

• DIRECT COSTS ONLY

• EXCLUDES INTELLIGENCE, NON-TACTICAL C³, LOGISTIC APPLICATIONS

• CONSERVATIVE ESTIMATE

WEAPON SYSTEM INVOLVING SOFTWARE — — 115

• APPROX. 50% IN DEVELOPMENT

• APPROX. 50% IN O&M
BACKGROUND & INTRODUCTION (CONT’D)

ROLE OF SOFTWARE IS INCREASING — — IT IS NOW HIGH LEVERAGE ITEM

MANAGEMENT PROBLEM INVOLVES — —

- ORGANIZATIONAL FOCUS WITHIN DOD
- COORDINATED POLICY
- COORDINATED PRACTICE/PROCEDURE
- COORDINATED TECHNOLOGY
  - DISCIPLINE & RIGOR
  - QUALITY IMPROVEMENT
  - MANAGEMENT INTERACTION IN DECISION PROCESS
# DOD Software Program Milestones

<table>
<thead>
<tr>
<th>Supporting Milestones</th>
<th>Planning - Staffing Milestones</th>
<th>Actions Completed Milestones</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>May</strong></td>
<td><strong>June</strong></td>
<td><strong>July</strong></td>
</tr>
<tr>
<td>GA Briefing to Steering Group</td>
<td>JLC Software Report</td>
<td>Preliminary Requirements Analysis</td>
</tr>
<tr>
<td>Rand Mid Point Briefing</td>
<td></td>
<td>DOD Automation Objectives Review</td>
</tr>
<tr>
<td><strong>August</strong></td>
<td><strong>September</strong></td>
<td></td>
</tr>
<tr>
<td>Recommendations on High Order Language Requirements (ODA/DFS)</td>
<td>Rand Conclusion Report</td>
<td><strong>Briefing to OASA Principals</strong></td>
</tr>
</tbody>
</table>

**AIA Review of Contractor's Reports**

**Steering Groups Preparation of DOD Software Program**

**Briefings to Key OSD/Service Organizations**

**Review of DOD Software Program by Defense Science Board**

**Letters to AIA and DOD for Formal Review**

**Preliminary Draft to DOD Software Program**

**Revised Draft of Software Program**

**Recommendations of Defense Science Board**
DoD WEAPON SYSTEM
SOFTWARE MANAGEMENT PROGRAM

OBJECTIVE: TO DERIVE AND CARRY OUT A COMPREHENSIVE
AND INTEGRATED SOLUTION TO THE PROBLEMS
OF EMBEDDED COMPUTER SYSTEM RESOURCE
ACQUISITION, MANAGEMENT, AND USE. UNDERLYING
THEMES ARE:
– DISCIPLINE AND RIGOR
– MANAGEMENT VISIBILITY
– COST CONTROL
– SCHEDULE CONTROL
– IMPROVED QUALITY
DoD WEAPONS SYSTEM 
SOFTWARE MANAGEMENT PROGRAM 

(Cont'd)

Scope:

- Policy Initiatives
- Practice and Procedure Initiatives
- Technology Initiatives
EMBEDDED COMPUTER SYSTEM CONCEPT

EMBEDDED COMPUTER SYSTEM

IS INTEGRAL TO AN ELECTRONIC OR ELECTRO-MECHANICAL SYSTEM (e.g. COMBAT WEAPON SYSTEM, TACTICAL SYSTEM, AIRCRAFT, SHIP, MISSILE, SPACECRAFT, COMMAND, CONTROL, AND COMMUNICATIONS SYSTEMS) FROM DESIGN, PROCUREMENT AND OPERATIONS VIEWPOINT

KEY ATTRIBUTES

DEVELOPED, ACQUIRED, OPERATED UNDER DECENTRALIZED MANAGEMENT (DODD 5000.1 & 5000.2)

PHYSICALLY INCORPORATED INTO LARGER SYSTEM WHOSE FUNCTION IS NOT DATA PROCESSING

INTEGRAL TO, OR SUPPORTS A LARGER SYSTEM FROM DESIGN, PROCUREMENT, OPERATIONS VIEWPOINT

OUTPUTS INCLUDE INFORMATION, CONTROL SIGNALS, AND COMPUTER DATA
EMBEDDED COMPUTER SYSTEMS
DETAILED CHARACTERISTICS

- SIMULTANEOUS HARDWARE AND SOFTWARE DEVELOPMENT
- TRANSPORTABLE/DEPLOYABLE (GENERALLY MILITARIZED)
- SPECIAL PURPOSE OR ONE-OF-A-KIND
- PROGRAMS MACHINE DEPENDENT
- DESIGNED TO FIT INTO LARGER, NON-ADP SYSTEM
- TAILORED PROGRAMMING LANGUAGES
- SPECIALIZED COMPUTER EQUIPMENT
- DEVELOPMENT/ACQUISITION/SUPPORT AS A CONFIGURATION ITEM
- NEED HIGH RELIABILITY SOFTWARE
- EXTENSIVE/EXPENSIVE TEST PROGRAMS
### EMBEDDED COMPUTER SYSTEM RESOURCES

<table>
<thead>
<tr>
<th>COMPUTER EQUIPMENT</th>
<th>PERSONNEL</th>
<th>COMPUTER SOFTWARE</th>
<th>COMPUTER SYSTEM DOCUMENTATION</th>
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<tbody>
<tr>
<td>CENTRAL PROCESSORS</td>
<td>SYSTEM ARCHITECTS</td>
<td>APPLICATIONS</td>
<td>SPECIFICATIONS</td>
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<td>TERMINALS</td>
<td>SYSTEM ANALYSTS</td>
<td>COMPILELS</td>
<td>PROGRAM LISTINGS</td>
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<tr>
<td>PRINTERS</td>
<td>PROGRAMMERS</td>
<td>OPERATING SYSTEMS</td>
<td>SCHEMATICS/DRAWINGS</td>
</tr>
<tr>
<td>POWER SUPPLIES</td>
<td>COMPUTER OPERATORS</td>
<td>DIAGNOSTICS</td>
<td>REGULATIONS</td>
</tr>
<tr>
<td>TAPE DRIVES</td>
<td>SYSTEM DESIGNERS</td>
<td>SIMULATORS</td>
<td>STANDARDS</td>
</tr>
<tr>
<td>DISKS/DRUMS</td>
<td>MANAGERS</td>
<td>INPUT/OUTPUT</td>
<td>PROPOSALS</td>
</tr>
<tr>
<td>COMM PROCESSORS</td>
<td>KEYPUNCHERS</td>
<td>ALGORITHMS</td>
<td>ROCS/DARS/CEIPS</td>
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<tr>
<td>A/D CONVERTERS</td>
<td>ELECTRICIANS</td>
<td>AUTOMATIC TEST</td>
<td>CONTRACTS</td>
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<td>SUPPLIES:</td>
<td>SYSTEM USERS</td>
<td>ANALYZERS</td>
<td>HANDBOOKS/MANUALS</td>
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<tr>
<td>CARDS</td>
<td>MAINTAINERS</td>
<td>REPORT GENERATORS</td>
<td>TECH ORDERS</td>
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<tr>
<td>TAPES</td>
<td>SCIENTISTS</td>
<td>UTILITY</td>
<td>MANAGEMENT DATA</td>
</tr>
<tr>
<td>PAPER</td>
<td>ENGINEERS</td>
<td>MAINTENANCE</td>
<td>PERFORMANCE DATA</td>
</tr>
</tbody>
</table>

*CONFIGURATION ITEMS—SATISFY AN END USE FUNCTION AND THEREFORE DESIGNATED BY THE GOVERNMENT FOR CONFIGURATION MANAGEMENT.
PROGRAM ELEMENTS
POLICY INITIATIVES

- SOFTWARE VISIBILITY IN EMBEDDED COMPUTER SYSTEMS ACQUISITION
- SOFTWARE LANGUAGE STANDARDIZATION & CONTROL
- SOFTWARE QUALITY ASSURANCE AND CONTROL
SOFTWARE VISIBILITY IN EMBEDDED COMPUTER SYSTEM ACQUISITION

PROBLEM SUMMARY

- INADEQUATE REQUIREMENT ANALYSIS
- INADEQUATE INTERFACE MANAGEMENT
- INADEQUATE DOCUMENTATION
- LACK OF TRANSFERABILITY
- INACCURATE COST/SCHEDULE PROJECTION
- LOW QUALITY
- INCONSISTENT APPLICATION OF TOOLS AND PROCEDURES
- MANAGEMENT PEROGATIVES PRE-EMPTED
SOFTWARE VISIBILITY IN EMBEDDED
COMPUTER SYSTEM ACQUISITION

POLICY ACTIONS TO BE TAKEN

- ANALYSIS AND VALIDATION OF SYSTEM REQUIREMENTS - PRIOR TO DSARC II
- SOFTWARE TO BE TREATED AS CONFIGURATION ITEM - ACCOMPANYING CONTROLS
- COMPUTER SYSTEM RESOURCE PLAN REQUIRED
- SUPPORT ITEMS AS CONTRACT DELIVERABLES - RIGHTS TO DESIGN
- MILESTONED DEVELOPMENT PLAN AND DEMONSTRATION CRITERIA
**IMPLEMENTATION OF POLICY ACTIONS**

<table>
<thead>
<tr>
<th>ACTION</th>
<th>VEHICLE</th>
<th>OPR</th>
<th>TIME (YEARS)</th>
<th>$K REQUIRED RESOURCES</th>
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<tbody>
<tr>
<td>ANALYSIS AND VALIDATION OF SYSTEM REQUIREMENTS</td>
<td>DODD XX</td>
<td>OSD</td>
<td>0.8</td>
<td>- - -</td>
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<tr>
<td></td>
<td>DODD 5000.2</td>
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<tr>
<td>SOFTWARE AS CONFIGURATION ITEM</td>
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<td>OSD</td>
<td>1.0</td>
<td>- - -</td>
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<tr>
<td></td>
<td>ASPR</td>
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<tr>
<td></td>
<td>MIL-STD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMPUTER SYSTEM RESOURCE PLAN</td>
<td>DODD XX</td>
<td>OSD</td>
<td>0.5</td>
<td>- - -</td>
</tr>
<tr>
<td></td>
<td>SERVICE DIRECTIVES, INSTRUCTIONS, STANDARDS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUPPORT SOFTWARE AS DELIVERABLE</td>
<td>DODD XX</td>
<td>OSD</td>
<td>0.5</td>
<td>- - -</td>
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<tr>
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<td>SERVICE DIRECTIVES, INSTRUCTIONS</td>
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<td>MILESTONED DEVELOPMENT PLAN</td>
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<td>OSD</td>
<td>1.0</td>
<td>- - -</td>
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<tr>
<td></td>
<td>MIL-STD-XX</td>
<td>JLC</td>
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</table>

* DODD XX = CAPSTONE DIRECTIVE TO SUPPLEMENT AND AID IN THE APPLICATION OF MANAGEMENT PRINCIPLES ESPoused IN DODD 5000.1 AND 5000.2, AS THEY RELATE TO COMPUTER RESOURCES IN SYSTEMS.
# ACTION VS. PROBLEM MATRIX

<table>
<thead>
<tr>
<th>ACTION</th>
<th>INADEQUATE REQUIREMENTS ANALYSIS</th>
<th>INADEQUATE INTERFACE MANAGEMENT</th>
<th>INADEQUATE DOCUMENTATION</th>
<th>LACK OF TRANSFERABILITY</th>
<th>INACCURATE SIZING, COST &amp; SCHEDULE PROJECTION</th>
<th>LOW QUALITY</th>
<th>INCONSISTENT APPLICATION OF TOOLS &amp; PROCEDURES</th>
<th>MANAGEMENT PREROGATIVE PREEMPTED</th>
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<td>COMPUTER SYSTEM RESOURCE PLAN</td>
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<tr>
<td>MILESTONE GUIDE AND EVALUATION CRITERIA</td>
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</tbody>
</table>
SOFTWARE LANGUAGE STANDARDIZATION
AND CONTROL

PROBLEM SUMMARY

LANGUAGE SELECTION

- LOW CORRELATION OF MOL TO ENGINEERING PROBLEM
- LACK OF DESIGN VISIBILITY
- MACHINE DEPENDENCE

LANGUAGE PROLIFERATION

- DIFFICULT LEARNING PROCESS
- DISCOURAGES DEVELOPMENT OF TEST AND SUPPORT TOOLS
- REDUCED MANAGEMENT VISIBILITY
- COMPLICATES INSTITUTIONAL CONTROL
- COST MAGNIFICATION
POLICY ACTIONS TO BE TAKEN

- RESTRICT USE OF MACHINE ORIENTED LANGUAGES
- ESTABLISH FAMILY OF APPROVED HIGHER ORDER LANGUAGES FOR USE IN DOD WEAPON SYSTEM APPLICATIONS

   LONG TERM STANDARDS
   INTERIM STANDARDS WITHIN SERVICES

- ENCOURAGE LANGUAGE R&D BUT STRICT LIMITATIONS AND CRITERIA FOR TRANSITION
- ESTABLISH HIGHER ORDER LANGUAGE CONTROL FACILITY FOR AUTHORIZED LANGUAGE
  - LANGUAGE STABILITY
  - CERTIFICATION OF IMPLEMENTATIONS
  - USAGE DATA
  - DISSEMINATION OF INFORMATION, COMPILERS, SUPPORT TOOLS
# IMPLEMENTATION OF POLICY ACTIONS

<table>
<thead>
<tr>
<th>ACTION</th>
<th>VEHICLE</th>
<th>OPR</th>
<th>TIME (YEARS)</th>
<th>$K REQUIRED RESOURCES</th>
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<tbody>
<tr>
<td>MOL SUPPRESSION</td>
<td>DODD XX</td>
<td>OSD</td>
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<tr>
<td>ESTABLISHMENT OF APPROVED HOL</td>
<td></td>
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<tr>
<td>INTERIM STANDARDS</td>
<td>DODI XX</td>
<td>OSD</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>LONG TERM STANDARDS</td>
<td>DODI XX</td>
<td>OSD</td>
<td>3.0</td>
<td>$14,000</td>
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<tr>
<td>HOL CONTROL FACILITY</td>
<td>DODD XX</td>
<td>OSD</td>
<td>3.0</td>
<td>&lt;$2M/YR</td>
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<tr>
<td></td>
<td>DODI XX</td>
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### Action vs Problem Matrix

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<tr>
<td>Reduce Proliferation</td>
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<td>X</td>
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<td>X</td>
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<tr>
<td>Language Control Facility</td>
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<td></td>
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</table>

**Use of HOL's** 

<table>
<thead>
<tr>
<th>Use of HOL's</th>
<th>Reduce Proliferation</th>
<th>Language Control Facility</th>
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<tbody>
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<td>X</td>
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**Action Selection**

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<thead>
<tr>
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<th>Language Control Facility</th>
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**Language Proliferation**

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<tbody>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
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</table>
SOFTWARE QUALITY ASSURANCE AND CONTROL - SERVICE ACTION

PROBLEM SUMMARY

- LACK OF MANAGEMENT MONITORING OF SOFTWARE RELIABILITY
- LACK OF SOFTWARE RELIABILITY/QUALITY ASSURANCE DISCIPLINE
- LACK OF QUANTITATIVE DATA BASE

POLICY ACTIONS TO BE TAKEN

- AUGMENT QA ORGANIZATIONS WITH SOFTWARE PERSONNEL - SERVICES, PM LEVELS
- FORMAL SOFTWARE QA PROGRAM - ACQUISITION OF TOOLS
- SOFTWARE ERROR DATA COLLECTION AND ANALYSIS
# Implementation of Policy Actions

## Required Resources

<table>
<thead>
<tr>
<th>ACTION</th>
<th>VEHICLE</th>
<th>OPR</th>
<th>TIME</th>
<th>$K</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOFTWARE QA ORGANIZATION AND PROGRAM PLAN</td>
<td>SERVICE INST.</td>
<td>JLC/JTCG</td>
<td>0.5</td>
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<tr>
<td></td>
<td>MIL-STD</td>
<td>(ESR)</td>
<td></td>
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</tr>
<tr>
<td>SOFTWARE ERROR DATA COLLECTION &amp; ANALYSIS</td>
<td>CONTRACT</td>
<td>JLC/JTCG(ESR)</td>
<td>1.0</td>
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<td></td>
<td>EXHIBIT</td>
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## ACTION VS PROBLEM MATRIX

<table>
<thead>
<tr>
<th>Problem</th>
<th>Action</th>
<th>Lack of Management Monitoring of Reliability</th>
<th>Lack of Formal Software Reliability/QA Discipline</th>
<th>Lack of Quantitative Data Base</th>
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</thead>
<tbody>
<tr>
<td>SOFTWARE QA ORGANIZATION AND PROGRAM PLAN</td>
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<td>X</td>
<td>X</td>
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</tr>
<tr>
<td>SOFTWARE DATA COLLECTION AND REPORTING SYSTEM</td>
<td>X</td>
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</table>
PROGRAM ELEMENTS
PRACTICE & PROCEDURE

INITIATIVES

- SOFTWARE ACQUISITION MANAGEMENT STANDARDS
- SOFTWARE ACQUISITION, MANAGEMENT, OPERATIONS,
  SUPPORT GUIDELINES INCLUDING PERSONNEL
  DEVELOPMENT AND TRAINING
- SOFTWARE QUALITY SPECIFICATIONS AND TRADE-OFFS
SOFTWARE ACQUISITION
MANAGEMENT STANDARDS

PROBLEM SUMMARY

- LACK OF STANDARD TERMINOLOGY GOVERNING
  SOFTWARE ACQUISITION AND MANAGEMENT

- LACK OF ESTABLISHED STANDARD

- LACK OF CONSISTENT POLICY AND PLANNING
  GUIDANCE (VIA STANDARDS, REGULATIONS,
  INSTRUCTIONS)
ACTIONS TO BE TAKEN

- FORMALIZED DEFINITIONS FOR WEAPON SYSTEM SOFTWARE
- FORMALIZE DEFINITIONS TO RECONCILE WEAPON SYSTEM, TELECOMMUNICATIONS, INTELLIGENCE, AND ADP SOFTWARE NEEDS
- REVIEW ALL DOD AND SERVICE COMPONENT REGULATIONS, DIRECTIVES, STANDARDS
  - CORRELATE DESCRIPTION OF HARDWARE, SOFTWARE, SYSTEM ACQUISITION AND LIFECYCLE MANAGEMENT
  - ENHANCEMENT, CLARIFICATIONS
  - ADDITIONS
  - MODIFICATIONS
  - CANCELLATIONS
- ESTABLISH OR ASSIGN OPR FOR MAINTENANCE
## IMPLEMENTATION OF PROCEDURE ACTIONS

<table>
<thead>
<tr>
<th>ACTION</th>
<th>ACTION VEHICLE</th>
<th>OPR</th>
<th>TIME TO COMPLETE</th>
<th>REQUIRED RESOURCES</th>
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<tbody>
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<td>FORMALIZE WS DEFINITIONS</td>
<td>DODD XX</td>
<td>OSD</td>
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<tr>
<td>FORMALIZE DEFINITIONS ACROSS WS TELECOMM., INTELL., AND ADP</td>
<td>MIL-STD-XXX</td>
<td>OSD</td>
<td>1.0</td>
<td></td>
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<tr>
<td>REVIEW OF EXISTING REGULATIONS, DIRECTIVES AND STANDARDS</td>
<td>STUDY REPORT</td>
<td>OSD/SERVICE</td>
<td>0.5</td>
<td>$50K</td>
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<td>MODIFY OR ADD REGULATIONS, DIRECTIVES AND STANDARDS</td>
<td>DODD, DODI, MIL-STD, SERVICE INSTRUCTIONS, STANDARDS, REGULATIONS (NEW AND REVISED)</td>
<td>OSD, SERVICE LC</td>
<td>2.5</td>
<td>$250K</td>
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<tr>
<td>CANCELLATION</td>
<td>DIRECTIVE, REGULATION, AND STANDARD CANCELLATION</td>
<td>CSD, SERVICE LC</td>
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<td>MAINTENANCE OPR</td>
<td>SERVICE COMPONENT INSTRUCTIONS</td>
<td>SERVICE LC</td>
<td>RECURRING</td>
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**ACTION VS PROBLEM MATRIX**

<table>
<thead>
<tr>
<th>ACTION/PROBLEM</th>
<th>LACK OF STANDARD TECHNOLOGY</th>
<th>LACK OF ESTABLISHED STANDARDS</th>
<th>LACK OF CONSISTENT POLICY &amp; PLANNING GUIDANCE</th>
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<tbody>
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<td>FORMALIZE WS DEFINITIONS</td>
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<td>FORMALIZE DEFINITIONS ACROSS WS, TELECOMMUNICATIONS, INTELLIGENCE, AND ADP LINES</td>
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<td>REVIEW OF EXISTING REGULATIONS, DIRECTIVES, AND STANDARDS</td>
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<tr>
<td>MODIFY OR ADD REGULATIONS, DIRECTIVES, STANDARDS</td>
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<td>X</td>
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<tr>
<td>CANCEL INAPPROPRIATE REGULATIONS, DIRECTIVES, STANDARDS</td>
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<tr>
<td>ESTABLISH OPR FOR MAINTENANCE OF EACH REGULATION, DIRECTIVE, AND STANDARD</td>
<td>X</td>
<td>X</td>
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</tbody>
</table>
SOFTWARE ACQUISITION, MANAGEMENT, OPERATIONS, AND SUPPORT GUIDELINES

PROBLEM SUMMARY

- INSUFFICIENT UNDERSTANDING BY MANAGERS
- LACK OF PLANNING AND OPERATIONAL GUIDANCE IN DAY-TO-DAY OPERATIONS
- LACK OF SYSTEMS ENGINEERING METHODOLOGY AND DISCIPLINE
- LACK OF TECHNOLOGY TRANSFER
- LACK OF PERSONNEL SKILL CONTINUITY OVER LIFE CYCLE
- LACK OF PERSONNEL DEVELOPMENT AND TRAINING
  - SHORTAGE OF PRACTITIONERS
  - LACK OF CAREER INCENTIVES
  - LACK OF RELEVANT ACADEMIC CURRICULA
ACTIONS TO BE TAKEN

- PREPARE A SERIES OF GUIDELINES, CHECKLISTS, AND HANDBOOKS FOR
  - SOFTWARE DEVELOPMENT
  - SOFTWARE ACQUISITION
  - OPERATIONS
  - SUPPORT
- TO BE USED BY PROGRAM MANAGERS AND THEIR STAFFS AND TO BE
  REFLECTED IN DSARC REVIEW PROCESS
- ESTABLISH EDUCATION, TRAINING, OR EXPERIENCE CAREER
  PATHS - PERSONNEL DEVELOPMENT
  - DSMS
  - AFIT
  - NPG SCHOOL
  - CIVILIAN INSTRUCTIONS
  - SERVICE ACADEMIES
## IMPLEMENTATION OF PRACTICE & PROCEDURE ACTIONS

<table>
<thead>
<tr>
<th>ACTION</th>
<th>ACTION VEHICLE</th>
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<th>TIME (YEARS)</th>
<th>$K REQUIRED RESOURCES</th>
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### ACTION VS PROBLEM MATRIX

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<th>TRANSFER TO APPLICATION</th>
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<th>LACK OF PERSONNEL DEVELOPMENT AND TRAINING</th>
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SOFTWARE QUALITY SPECIFICATION AND TRADE OFFS

PROBLEM SUMMARY

- LACK OF SYSTEM OPTIMIZATION
- LACK OF QUANTITATIVE QUALITY GOALS AND OBJECTIVES
- LACK OF QUANTITATIVE TEST STANDARDS
- LACK OF TEST AND SUPPORT SOFTWARE INCENTIVES

ACTIONS TO BE TAKEN

- QUANTITATIVE MEASURE OF SOFTWARE QUALITY DERIVED - - SPECIFICATIONS TO CITE QUANTITATIVE GOALS AND OBJECTIVES - - TESTING TO DEMONSTRATE LEVEL ACHIEVED
- HARDWARE DESIGN GUIDELINES FOR INCLUSION OF SOFTWARE QUALITY ENHANCEMENT
## IMPLEMENTATION OF PROCEDURE ACTIONS

<table>
<thead>
<tr>
<th>ACTION</th>
<th>VEHICLE</th>
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<td>REQUIREMENTS SPECIFICATION</td>
<td>JLC/</td>
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## ACTION VS PROBLEM MATRIX

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PROGRAM ELEMENTS

TECHNOLOGY INITIATIVES

- COORDINATED SOFTWARE RESEARCH AND DEVELOPMENT
- TRANSFERABILITY OF SOFTWARE SUPPORT AIDS
COORDINATED SOFTWARE RESEARCH AND DEVELOPMENT

PROBLEM SUMMARY

- LACK OF FOCUS IN SOFTWARE R & D, STUDY, PILOT PROGRAMS
- LACK OF TECHNOLOGY BASE
- RELEVANCY OF R & D TO IMPROVEMENTS IN POLICY, PRACTICES, AND PROCEDURES
- REDUNDANCY AND DUPLICATION IN R & D

ACTIONS TO BE TAKEN

- COORDINATED R & D
  - SUPPORT POLICY INITIATIVES
  - STATE OF ART ADVANCEMENT
    - SOFTWARE DEVELOPMENT METHODOLOGY/COST ESTIMATION AND SIZING
    - SYSTEM ARCHITECTURE
    - FUNDAMENTALS AND CONCEPTS OF SOFTWARE ACQUISITION, MANAGEMENT, QUALITY AND CONTROL
- PROTOTYPE PROOFING
<table>
<thead>
<tr>
<th>PROGRAM ELEMENT</th>
<th>R &amp; D THRUST</th>
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<tr>
<td>REQUIREMENTS ANALYSIS &amp; VALIDATION</td>
<td>COMMUNICATION AND VALIDATION OF REQUIREMENTS AND HIGH-LEVEL DESIGN</td>
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<td>COST ESTIMATION AND SIZING</td>
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<td>DESIGN FOR MAINTAINABILITY AND MODIFICATION</td>
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<td>RISK ANALYSIS</td>
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<td>DESIGN AND CONFIGURATION ITEM DESCRIPTION</td>
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<td>LEGALITY, DEVELOPMENT INCENTIVES, PROCUREMENT VEHICLES</td>
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<td>IMPROVEMENTS IN SOFTWARE SUPPORT VS TOOLS</td>
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<td>CRITERIA FOR COST/EFFECTIVENESS JUDGMENT</td>
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<td>QUANTITATIVE CRITERIA TO ACHIEVEMENT</td>
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<td>MILESTONE DEFINITION AND SEQUENCING</td>
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<td>LANGUAGE STANDARDIZATION AND CONTROL</td>
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IMPLEMENTATION OF TECHNOLOGY ACTIONS

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<td>ACTION/PROBLEM</td>
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<td>OBSUCRE R &amp; D RELEVANCY, POLICY PRACTICES AND PROCEDURES</td>
<td>REDUNDANCY AND DUPLICATION OF R &amp; D PROGRAMS</td>
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TRANSFERABILITY OF SOFTWARE SUPPORT AIDS

PROBLEM SUMMARY

- LITTLE REUSE OF SUPPORT AIDS
- PROCUREMENT & DEVELOPMENT REDUNDANCY
  - EXCESSIVE COSTS
  - LOW QUALITY
- LITTLE DEVELOPMENT INCENTIVE
  - GOVERNMENT
  - INDUSTRY
ACTIONS TO BE TAKEN

- ESTABLISH DOD REPOSITORY FOR MAINTENANCE AND INSTITUTIONAL CONTROL OF AIDS

  - SCREENING, VALIDATING, DOCUMENTATION
  - USER ASSISTANCE
  - PUBLICITY

- PROCUREMENT VEHICLE TO ENCOURAGE TRANSFERABILITY

  - DIRECTED LICENSING
  - ROYALTIES
  - WARRANTIES
# IMPLEMENTATION OF TECHNOLOGY ACTIONS

<table>
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<tr>
<th>ACTION</th>
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<td>DODD AND ACCOMPANYING</td>
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**NOTE:** ^1 - VIA PROCUREMENT PANEL OF SMSC
### ACTION VS PROBLEM MATRIX

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ORGANIZATIONAL INTERACTIONS
Figure II-2

ORGANIZATIONAL INTERACTIONS TECHNOLOGY INITIATIVES

- ADVISE
- PROGRAM APPROVALS
- SOFTWARE MANAGEMENT STEERING COMMITTEE
- POLICY, PRACTICE, PROCEDURE, TECHNOLOGY AND COORDINATION
- TECH ADVISORY PANEL
- USE SYSTEMS
- NAVY AND MARINE SYSTEMS
- ARMY SYSTEMS
- SERVICE TECHNICAL COMPONENTS
- DOD SOFTWARE PROGRAM ELEMENTS AND PUBLICITY
- TECHNOLOGY PROGRAMS