AEROSPACE SYSTEMS SURVIVABILITY HANDBOOK SERIES

Volume 3. The Survivability Program Plan

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FOREWORD

This Aerospace Systems Survivability Handbook Series is designed to provide its users with insight into the key activities performed by survivability personnel in support of aerospace systems acquisition. The series is not a specification or standard but rather a "how-to" guide for all survivability managers, engineers, and analysts associated with survivability activities likely to be needed on any program, government or commercial.

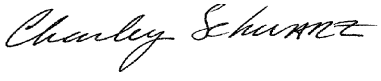
Some of the material used in the handbook series has been adapted from various sections of the Department of Defense (DoD) Deskbook, Internet links, and survivability documents produced by the Joint Technical Coordinating Group on Aircraft Survivability (JTCG/AS), under the sponsorship of the Joint Aeronautical Commanders' Group (JACG). The Service laboratories and centers also produced source documents. This handbook series emphasizes the requirement for integrated teamwork of survivability management, engineering, test and evaluation, and systems analysis in order to accomplish a successful systems acquisition.

The handbook series (JTCG/AS Project A-8-01, Acquisition Deskbook Survivability Section Rewrite) was prepared for the JTCG/AS under the sponsorship of the Principal Members Steering Group (PMSG) and directed by LTC Charles R. Schwarz, Director, JTCG/AS. The handbooks were drafted by Hubert (Hugh) Drake, SRS Technologies, under contract to the Naval Air Warfare Center Weapons Division, China Lake, CA. As the Contract Technical Monitor, Dave Hall provided guidance and initial review. The following working group members provided oversight:

Dale Atkinson, Institute for Defense Analysis
Dr. Bob Ball, Naval Postgraduate School
Kevin Crosthwaite, Director, SURVIAC
Tom Julian, DOT&E/LFT
David Legg, Naval Air Systems Command
Tracy Sheppard, University of Texas
Lowell Tonnessen, Institute for Defense Analysis
Jerry Wallick, Institute for Defense Analysis
Phil Weinberg, JTCG/AS Central Office
Michael Weisenbach, JTCG/AS Central Office

Special recognition goes to Donna Egner and Linda Ryan for providing copies of reference documents from SURVIAC.

Reviewed and released by:



Lieutenant Colonel Charles R. Schwarz
Director, JTCG/AS

CONTENTS

ACRONYMS AND ABBREVIATIONS

ACAT	Acquisition Category
AoA	Analysis of Alternatives
APB	Acquisition Program Baseline
BRP	Basic Research Plan
CAIG	Cost Analysis Improvement Group
CAIV	Cost as an Independent Variable
CARD	Cost Analysis Requirements Description
CCDR	Contractor Cost Data Reporting
CM	Configuration Management
CRD	Capstone Requirements Documents
DoD	Department of Defense
DSMC	Defense Systems Management College
DTAP	Defense Technology Area Plan
DT&E	Developmental Test and Evaluation
INCOSE	International Council on Systems Engineering
IPPD	Integrated Product and Process Development
IPT	Integrated Product Teams
JACG	Joint Aeronautical Commanders' Group
JTCG/AS	Joint Technical Coordinating Group on Aircraft Survivability
JWSTP	Joint Warfighting Science and Technology Plan
LCCE	Life Cycle Cost Estimate
LFT&E	Live Fire Test and Evaluation
LRIP	Low-Rate Initial Production
M&S	Modeling and Simulation
MAIS	Major Automated Information System
MASTER	Modeling and Simulation Test and Evaluation Reform
MNS	Mission Need Statement
MOE	Measure of Effectiveness
MOP	Measure of Performance
MOS	Measure of Operational Suitability
OA	Operational Assessment
ORD	Operational Requirements Document
OSD	Office of the Secretary of Defense
OT&E	Operational Test and Evaluation
P3I	Pre-Planned Product Improvement
PM	Program Manager
PMSG	Principal Members Steering Group
RAM	Reliability, Availability, and Maintainability

S&T	Science and Technology
SAMP	System Acquisition Master Plan
SBA	Simulation-Based Acquisition
SE	Systems Engineer, Systems Engineering
SEMP	Systems Engineering Management Plan
SEP	Systems Engineering Process
STAR	System Threat Assessment Report
STEP	Simulation Test and Evaluation Process
SURVIAC	Survivability/Vulnerability Information Analysis Center
TEMP	Test and Evaluation Master Plan
T&E	Test and Evaluation
VV&A	Verification, Validation, and Accreditation
WBS	Work Breakdown Structure
WIPT	Working-Level Integrated Product Team

EXECUTIVE SUMMARY

The principal purpose of this volume is to address survivability planning as an inherent part of the defense acquisition system's defense technology projects and acquisition programs. Survivability planning is accomplished in direct support of planning required in defense systems acquisition. For activities related to science and technology (S&T) during the pre-systems acquisition period, an existing S&T planning process is used. For systems acquisition, survivability planning is accomplished in concert with a program's Systems Engineering (SE) and Integrated Product Teams (IPT) activities. For sustainment and disposal, survivability supports the Program Manager (PM) and other DoD activities, such as the Joint Technical Coordinating Group on Aircraft Survivability (JTCG/AS).

In defense systems acquisition, planning for survivability objectives supports the requirements community in setting performance objectives. Survivability planning helps develop the acquisition strategy for acquiring and operating survivable DoD systems, both by setting aggressive, achievable survivability objectives and by defining the steps to accomplish those objectives. Survivability objectives are set to balance mission needs with technology resources, taking into account anticipated technology improvements in both DoD and defense industries. To ensure that survivability planning is properly accomplished, experienced survivability personnel must become participants in S&T activities, as well as members of the acquisition program's SE and IPT activities. The IPT is composed of representatives from all appropriate *functional disciplines* (including survivability). These representatives work with a team leader to build successful and balanced programs, identify and resolve issues, and make sound and timely recommendations to facilitate decision-making. Program IPTs focus on program execution and may include representatives from both government and — after contract award — industry.

If survivability is to be applicable at any stage of acquisition, full disclosure of survivability planning and identification of its relationship to other acquisition-support plans and processes are necessary. Survivability, like any other functional discipline, has unique methods, procedures, and assets that can be applied to support program-associated management, engineering, analysis, modeling and simulation (M&S), and test and evaluation (T&E). Electronic warfare, which requires unique test facilities and M&S, plays such a large role in survivability that it should also be considered an inherent part of the survivability planning (see Volume 11 for further discussion of this topic).

This volume will help an organization starting to plan, manage, or conduct a survivability effort accomplish that effort in a disciplined, scientific, and cost-effective manner. The activities described herein have been developed to help participants think through the steps required to plan and execute a survivability effort that meets the needs of the PM for acquisition of mature, usable, operationally effective and survivable warfighting hardware and software. To ensure currency, including during the pre-acquisition phase (prior to Milestone B), survivability

planning must include close and continuous teamwork among DoD planners, technology developers, and warfighters across all Military Departments and Defense Agencies.

The Aerospace Systems Survivability Handbook Series is designed to guide survivability-related personnel in the planning and performance of business, financial and technical functions (management as well as engineering, T&E, and systems analysis). This volume provides insight into the interrelationships of plans and processes as they relate to survivability and acquisition.

1.0 INTRODUCTION

The Defense Acquisition System

A basic understanding of defense acquisition begins with the following definition (as given in SECNAVINST 5400.15A):

> *Defense Acquisition System: A single uniform system whereby all equipment, facilities, and services are planned, developed, acquired, maintained, and disposed of by the Department of Defense (DoD). The system includes policies and practices that govern acquisition, identifying and prioritizing resource requirements, directing and controlling the process, contracting, and reporting to Congress.*

The DoD acquisition system is designed to develop concepts into producible and deployable products that provide capability to the warfighter. The system has its foundation in federal policy and public law, with the development, acquisition, and operation of military systems governed by a multitude of laws, formal DoD directives, instructions and manuals, numerous Service and Component regulations, and interservice and international agreements.

DoD 5000.2 spells out a simplified and flexible management framework for the defense acquisition. This framework, which is applicable to both weapon systems and automated information systems, builds on a base of validated mission needs and requirements to translate mission needs and technological opportunities into stable, affordable, and well-managed acquisition programs.

In accordance with DoD 5000.2, "The Defense Acquisition System establishes a management process to translate user needs (broadly stated mission needs responding to a postulated threat and developed in the Requirements Generation System or business needs responding to new ways of doing business and developed by the appropriate staff office) and technological opportunities (developed or identified in the Science and Technology program based on user needs) into reliable and sustainable systems that provide capability to the user."

The concepts to exploit in systems acquisition are based on an analysis of alternative ways to meet the military need, including commercial and nondevelopmental technologies and products and services determined through market analysis. The analysis may be performed during either concept exploration or technological opportunity development. The DoD Component (or appropriate principal staff office for Major Automated Information System (MAIS) programs) responsible for the mission area in which a deficiency or opportunity has been identified is responsible for preparing the analysis of alternatives. The PM does not normally prepare this analysis, although the PM or PM's representative may participate in the analysis.

Managing the development and fielding of military systems requires three basic activities: technical management, business management, and contract management. The acquisition process runs parallel to the requirements-generation process and the budgeting process (Planning, Programming, and Budgeting System). User requirements tend to be event-driven by threat. The budget process is date-driven by constraints of the Congressional calendar**.** Systems engineering management, the technical management component of DoD acquisition management, bridges these processes and must resolve the dichotomy of event-driven needs, event-driven technology development, and the budget calendar.

Survivability Planning as Part of the Systems Acquisition Process

Survivability planning is accomplished in accordance with instructions in the DoD 5000.2 series and is an inherent part of the Systems Engineering Process (SEP), where technical planning is accomplished. Survivability planning occurs throughout the defense acquisition system starting with the S&T program in pre-systems acquisition.

This volume helps link survivability planning activities to planning and other processes related to acquisition, such as S&T activities, Integrated Product and Process Development (IPPD)/IPT, SE, T&E, and M&S. Survivability functions and steps help guide designers and managers toward progressive acquisition of survivable mission-required systems.

Survivability activities are designed to ensure that survivability is completely and effectively addressed in systems acquisition. Survivability assets should include qualified, skilled survivability personnel in management, engineering, analysis, and T&E specialties, as well as facilities, data, survivability-related processes, and survivability-associated M&S. Planning is accomplished in coordination with the SE and the SEP and in concert with the associated IPTs. Although different survivability personnel are involved in the various phases of defense acquisition, planning should be integrated to ensure a continuum.

The aerospace systems survivability functional discipline covers activities performed in pre-systems acquisition as well as in the full acquisition spectrum from requirements definition and concept development through systems acquisition. Included are the following:

- Science and technology technological developments to fulfill identified mission needs, deficiencies, or opportunities
- Pre-Milestone A requirements generation to define survivability needs
- Acquisition support in
    - Concept design
    - Preliminary and detailed design and development
    - Production
    - Utilization and support

Survivability planning requires thorough understanding of defense systems acquisition and direct participation in S&T and systems-acquisition-associated SE and IPT activities. DoD Regulation

5000.2-R gives the following overview of survivability activities necessary during a system's lifetime:

> The PM shall establish and maintain a survivability program throughout the system life cycle to attain overall program objectives. The program shall stress early investment in survivability enhancement efforts that improve system operational readiness and mission effectiveness by:
>
> - Providing threat avoidance capabilities (low susceptibility);
> - Incorporating hardening and threat tolerance features in system design (low vulnerability);
> - Providing design features to reduce personnel casualties resulting from damage to or loss of the aircraft (casualty reduction);
> - Maximizing wartime availability and sortie rates via operationally compatible threat damage tolerance and rapid reconstitution (repairability) features;
> - Minimizing survivability program impact on overall program cost and schedule; and,
> - Ensuring protection countermeasures and systems security applications are defined for critical component's vulnerability to validated threats for systems survivability, including natural or nuclear advanced technology weapons, conventional weapons, biological, chemical contamination, and electronic warfare threats.

2.0 LIFE-CYCLE INTEGRATION

Life-cycle integration is achieved through integrated development — that is, concurrent consideration of all lifecycle needs during the development process. DoD policy requires that integrated development, IPPD, be practiced at all levels in the acquisition chain of command. Concurrent consideration of all lifecycle needs can be greatly enhanced through the use of interdisciplinary teams.

Integrated Product Teams

Integrated Product Teams are advisory bodies to the PM. They assist the PM in developing strategies and in program planning, as requested by the PM.

The objectives of an IPT are to:

- Produce a design solution that satisfies initially defined requirements.
- Communicate that design solution clearly, effectively, and in a timely manner.

Multifunctional IPTs have additional objectives to:

- Place balanced emphasis on product and process development.
- Require early involvement of all disciplines appropriate to the team task.

Design-level IPT members are chosen to meet the team objectives and generally have distinctive competence in the following specialties:

- Technical management (systems engineering)
- Life-cycle functional areas (eight primary functions)
- Technical specialty areas, such as safety, risk management, quality, etc.
- When appropriate, business areas such as finance, cost/budget analysis, and contracting

Survivability involvement is a function of the PM's needs. The options include a dedicated survivability IPT or survivability representation on the various associated IPTs and systems engineering groups.

Systems Engineering and the Work Breakdown Structure

Systems engineering is responsible for the technical and management efforts of directing and controlling an integrated engineering effort in a system or program. Design and management of a total system, including hardware and software, are involved, as are other system life-cycle elements. The SE process is a structured, disciplined, and documented technical effort through

which systems products and processes are simultaneously defined and developed. Systems engineering is most effectively implemented as part of an overall integrated product and process development effort using multidisciplinary teamwork. As a functional discipline, survivability plays a major role in SE in support of engineering (design and development), analysis (systems as well as independent), T&E (DT&E, OT&E and LFT&E), M&S (development and verification, validation, and accreditation (VV&A)), and associated program-level documents (mission need statements (MNS), operational requirements documents (ORD), SE management plans (SEMP), T&E master plans (TEMP), etc.).

According to DoD 5000.2-R, "Systems engineering shall yield a program WBS [work breakdown structure]. The PM shall prepare the WBS in accordance with the WBS guidance in MIL-HDBK-881.The WBS provides the framework for program and technical planning, cost estimating, resource allocation, performance measurement, technical assessment, and status reporting. The WBS shall include the WBS dictionary. The WBS shall define the system to be developed or produced. It shall display the system as a product-oriented family tree composed of hardware, software, services, data, and facilities. It shall relate the elements of work to each other and to the end product. The PM shall normally specify contract WBS elements only to level three for prime contractors and key subcontractors. Only low-level elements that address high risk, high value, or high technical interest areas of a program shall require detailed reporting below level three. The PM shall have only one WBS for each program."

Consequently, the WBS is the central semantic mechanism for discussion of a program's content in all of the various organizations and disciplines, such as survivability, that must interface with the weapon system. Because the WBS definitional categories developed by the systems engineers will be in wide use, they must be crafted with some care. From a strictly process point of view, however, the Contractor Cost Data Reporting (CCDR) plan is the de facto vehicle by which the WBS is approved. This status comes about because the CCDR plan is the first document in the program acquisition process that sets forth an approved WBS.

The reason for the cost community's role in the review of these systems engineering related categories may not seem clear. However, the WBS structure is of critical importance to the cost analyst because it is the CCDR plan's "target" cost structure that will be used to accrue and compare costs on a definitionally consistent basis across programs. In other words, the ultimate utility of the CCDR cost reports is tied to the cross-program consistency of the WBS elements. The OSD Cost Analysis Improvement Group has review and approval responsibility for the CCDR plan.

Because the WBS is a product of the systems engineering process, survivability elements resulting from the progressive steps of systems engineering should relate to the WBS. The WBS is not intended to be constraining. As the program advances through its design phases, WBS changes may be required. Any proposed changes, which often originate from a contractor, should be evaluated by the PM, supported by the systems engineer and the IPTs, in terms of the benefits offered in context with overall program objectives. Changes may be made, for example, by combining WBS elements from the other defense system categories defined in MIL-HDBK-881,

by deleting portions of WBS elements, or by adding new elements (with input from systems engineers, cost estimators, and any other interested parties) if those provided in MIL-HDBK-881 are inadequate to define the new program.

From the initial Program WBS, preliminary Contract WBSs for individual contracts are developed and negotiated with the contractors involved. MIL-HDBK-881 is cited in solicitations "for guidance only" with two objectives: (1) to negotiate any reporting elements that may be inconsistent with the contractor's proposed approach and (2) to provide flexibility for the contractor to extend the WBS below the agreed reporting level to reflect how work will be accomplished, consistent with the guidance in MIL-HDBK-881.

A final Program WBS is prepared by compiling the elements of the Contract WBS with the initial Program WBS. General contractor requirements are discussed in Appendix A.

Planning Guidance

Planning guidance included in Appendix B contains Chapter 16 (Systems Engineering Planning) of the Defense Systems Management College (DSMC) 1999 text on systems engineering fundamentals and its companion text, the International Council on Systems Engineering (INCOSE) SE "How-to" Handbook, which DSMC references in all its courses. *Systems Engineering Fundamentals* (1999) is intended to be the SE foundation, and the excellent *INCOSE Handbook* is the application. As stated in DSMC's text, "Systems engineering planning is an activity that has direct impact on acquisition planning decisions and establishes the feasible methods to achieve the acquisition objectives." The DSMC text and the INCOSE SE handbook provide the necessary planning guidance for achieving survivability planning for systems acquisition.

3.0 SURVIVABILITY PLANNING

Basically, the key to successful planning is the ability to visualize the assets and resources required to produce and support the required product (survivable aircraft) within cost and schedule constraints throughout its life cycle.

Product definition is the common thread linking all acquisition disciplines. In the current environment of near-full dependence on performance and commercial specifications, the PM faces a significant challenge in making sure the product is clearly defined. The following factors contribute to the difficulty:

- Program planners must know what to plan for.
- System engineering and software designers must know what to design.
- The test community must know what to test.
- The producer must know what to manufacture.
- The logistics community must know what to support.
- Contract management must know what to buy.
- Cost management must know what to estimate and control.
- Funds management must know what to budget.

Not only must the primary elements that are essential to survivability planning (management, engineering, T&E, M&S, and systems analysis) be accounted for, but all survivability elements that make up the product must also be identified. Also essential to the planning process are how those elements relate to managers, developers, and warfighters, as well as how the elements are included in requirements-associated plans and meet acquisition guidance and policy. Threat projections, system performance, unit production cost estimates, life-cycle costs, interoperability, cost-performance/schedule trade studies, acquisition strategy, affordability constraints, and risk management are major considerations at each milestone decision point, including the decision to start a new program. All of these considerations affect survivability planning in support of the defense acquisition system.

The three types of major decision points — milestones, decision reviews, and interim progress reviews — are discussed in Volume 2.

Survivability Top-Level Planning

Because advanced technology is increasingly available in international markets, DoD is required to accelerate the development process as never before. Rapid technology transition from earliest S&T concepts to operational forces is crucial. To fulfill survivability acquisition requirements, an understanding of the relationship survivability plays in the entire acquisition process and its associated elements is necessary.

Survivability top-level planning comprises both technical and management activities as depicted in Figure 1. Technical activities include S&T, engineering design and development, and systems analysis, whereas management activities include planning, implementation, and control; systems documentation support; and specialty integration. All survivability activities associated with acquisition are performed in concert with the PM, the SE and the IPTs. Survivability top-level planning is closely correlated with the SEP and applied in association with the systems engineering and survivability IPTs. Survivability-associated planning and its management, engineering, T&E, and systems analyses functions must be correlated with all elements of acquisition, including the following processes and procedures:

- Service S&T planning processes
- Systems acquisition process
- IPPD/IPT
- T&E
- SEP
- Systems assessment
- Analysis of alternatives (AoA)
- M&S
- Modeling and simulation test and evaluation reform (MASTER)
- Simulation test and evaluation process (STEP)
- Simulation-based acquisition (SBA)

Documentation is required for all essential and any supporting products addressing operational, systems, or technical architecture views such as the System Threat Assessment, AoA, MNS, Capstone Requirements Documents (CRD), ORD, TEMP, System Acquisition Master Plan (SAMP), acquisition strategy, and the Acquisition Program Baseline (APB).

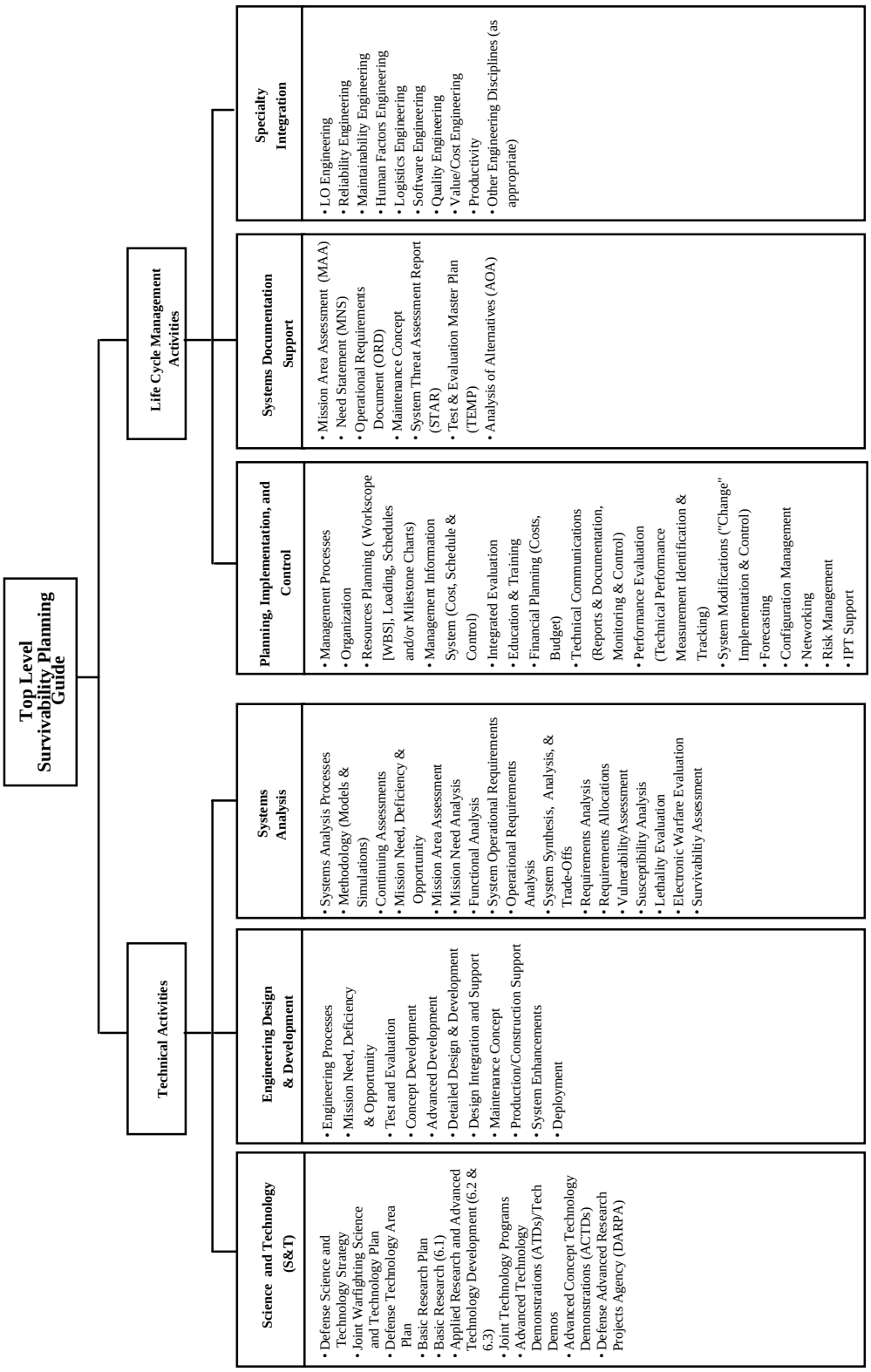


Figure 1. Technical and Management Activities of Survivability Top-Level Planning.

Survivability Planning During Pre-Systems Acquisition

Survivability personnel involved in technology development need to participate in the strategic planning process for defense S&T. The foundation of this process is the *Defense Science and Technology Strategy* with its supporting *Basic Research Plan* (BRP), *Joint Warfighting Science and Technology Plan* (JWSTP), and *Defense Technology Area Plan* (DTAP). These documents present the DoD S&T vision, strategy, plan, and objectives for the planners, programmers, and performers of defense S&T.

Accomplishment and transition of S&T activities and employment of the concept of IPPD/IPT are paramount to the success of the development program. Survivability is an integral part of the PM, SE, and IPT activities of the defense systems acquisition process. It is pertinent to note that survivability engineering, T&E, and assessment (Volumes 4, 6, and 10, respectively) support all phases of the acquisition process and are pertinent to survivability planning. Appendix C provides additional details regarding technological opportunity and transition into systems development and demonstration.

Survivability Planning for Systems Acquisition

Survivability is unique, complex, and technically challenging. It is made up of numerous elements supported by an extensive network of personnel, test facilities, models and simulations, analytical methodologies, techniques, and associated databases.

During the systems acquisition process, the PM considers survivability and mission assuredness of systems vulnerable to physical and electronic attack. Security, survivability, and operational continuity (i.e., protection) are considered to be technical performance requirements because they support achievement of other technical performance aspects such as accuracy, endurance, sustainability, interoperability, range, etc., as well as mission effectiveness in general. The PM includes the considerations in the risk-benefit analysis of system design and cost. Users must be familiar with critical infrastructure protection and space control requirements and must account for necessary hardening, redundancy, backup, and other physical-protection measures in developing system and family-of-system requirements.

Programmatically and operationally, survivability is a major component addressed in all phases of military aerospace defense systems acquisition. Survivability therefore receives direct attention in the SE and IPT planning and associated activities critical to a successful acquisition cycle. The approach to survivability planning begins with the overarching DoD defense acquisition system's S&T phase followed by the systems acquisitions SEP, which contains survivability as a primary element, and the IPTs, which are integral parts of the defense acquisition integration, oversight, and review process.

Defense acquisition works best when all DoD Components work together cooperatively to share data and information of all types, and the workforce is empowered. Each DoD Component is

directed to implement the concepts of IPPD and IPTs as extensively as possible**.** All appropriate functional disciplines and DoD Components are encouraged to support the systems engineering process and to participate in IPTs to the maximum extent practicable and useful.

Survivability Technical Management Functions

Technical management is a broad term that includes management of a totally integrated SE effort, including engineering, analysis, T&E, production, and logistics support over the system life cycle.

The goal of the technical manager is to deploy an effective system in a timely manner, to sustain the system, and to satisfy the need at an affordable cost. Technical management involves balancing a system's cost, schedule, and performance. *Cost* includes all funds required to design, develop, produce, operate, support, and dispose of a system. *Schedule* includes the time it takes to design, develop, produce, and deploy a fully supported system. *Performance* is the degree to which a system can be expected to achieve a set of specific mission requirements; included are criteria for both effectiveness (i.e., whether it does the job required) and suitability (i.e., whether the user can employ the system.

Technical management includes the following activities:

- Define the system/product (establishing the configuration management baseline).
- Develop the APB.
- Conduct design engineering.
- Perform SE (system cost, schedule, and performance trade studies).
- Develop and acquire computer resources, including software.
- Plan for acquisition logistics.
- Conduct DT&E.
- Conduct OT&E (including LFT&E).
- Identify and track reliability, availability, and maintainability (RAM) requirements.
- Transition from development to production.
- Address standardization and specifications (e.g., performance specifications).
- Establish a configuration management (CM) process.
- Ensure producibility of the final design.

- Define manufacturing processes and controls.
- Plan for system or product disposal.
- Investigate the potential for Pre-Planned Product Improvement (P3I).

Technical management can be described as input, process, and output. The *input* is the need or requirement. The *process* is how the technical activities are managed. The *output* is the end item. Linking these three parts is a feedback loop that improves the end item based on customer (user) comments and recommendations.

Primary Elements Influencing Survivability Planning

Survivability planning is influenced by and interfaces with numerous program-associated activities, processes, plans, documentation, etc., as illustrated in Figure 2.

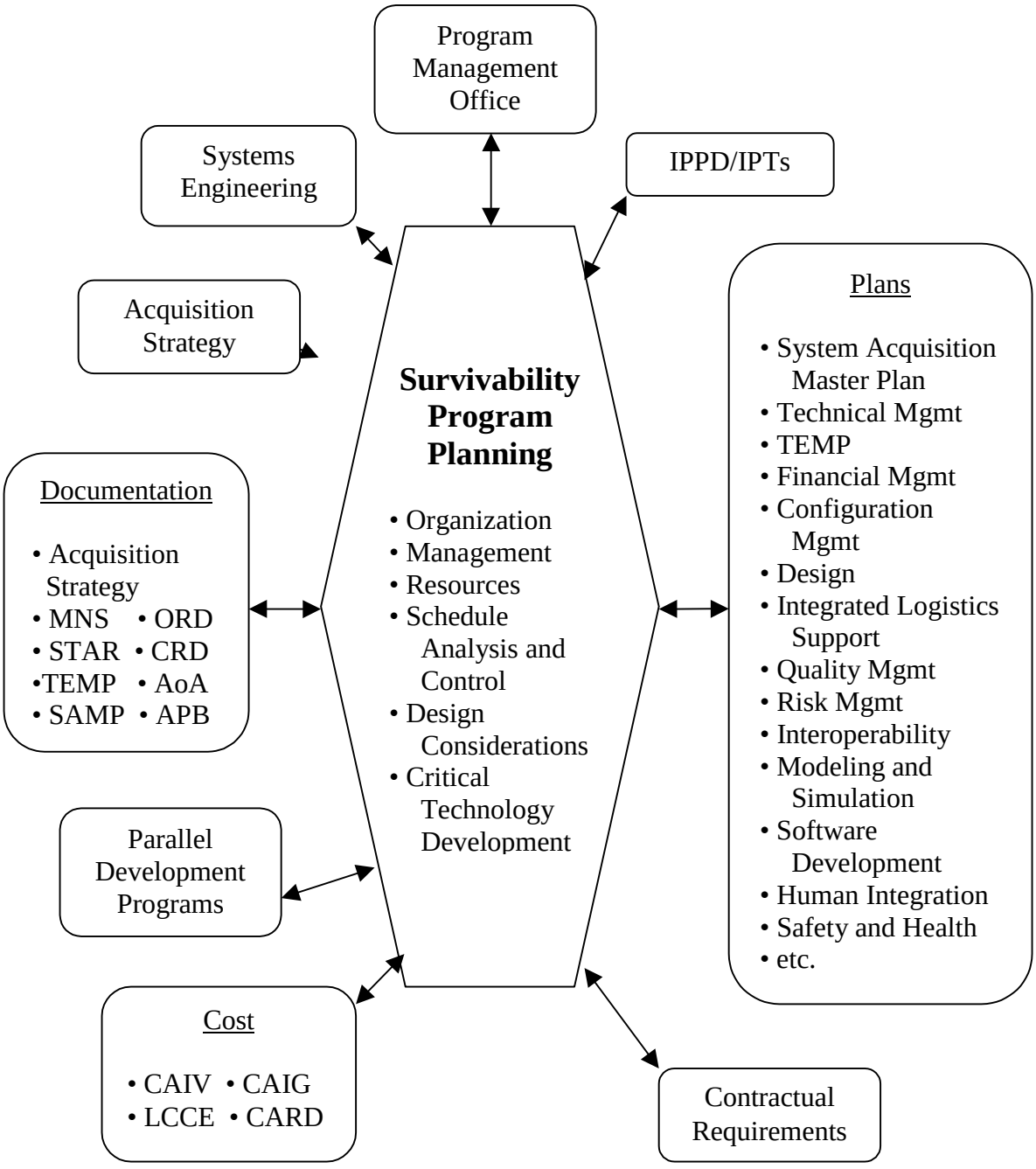


Figure 2. Activities Associated With Survivability Program Planning

Survivability Planning for Tests and Evaluations

Planning for T&E begins during the concept and technology development phase. The PM is responsible for forming the T&E Working-Level Integrated Product Team (WIPT). Representatives from the DT&E (contractor and government), OT&E, LFT&E, and intelligence communities are responsible for supporting the WIPT. A T&E WIPT can be useful for a pre-system acquisition activity (e.g., an advanced concept technology demonstration, an advanced technology demonstration, or a joint warfighting experimentation) for a program that has a likelihood of becoming an acquisition program. A continuous T&E WIPT, including representation from the survivability community, can help ensure a smooth transition and can be used to prepare the initial TEMP. The early integration of T&E with program management ensures a test strategy consistent with and supportive of the acquisition strategy.

The TEMP provide a road map for integrated simulation, T&E plans, schedules, and resource requirements necessary to accomplish the T&E program. The TEMP should include sufficient detail to permit planning for the timely availability of the test resources required to support the T&E program.

The following T&E guidelines apply:

- Test planning shall consider the use of ground test activities, to include hardware-in-the-loop simulation, prior to conducting full-up, system-level testing, such as flight testing, in realistic environments.
- Planning, at minimum, shall address all system components (hardware, software, and human interfaces) critical to achieving and demonstrating contract technical performance specifications and ORD-defined operational effectiveness and suitability requirements.
- Test planning and conduct shall take full advantage of existing investment in DoD ranges, facilities, and other resources, wherever practical, unless otherwise justified in the TEMP. The DoD Major Range and Test Facility Base is maintained and managed to support and provide capabilities for DoD acquisition programs in accordance with *DoD Directive 3200.11*[i].
- Appropriate use of accredited models and simulations to augment DT&E, OT&E, and LFT&E shall be coordinated through the T&E WIPT.

DT&E planning is accomplished using associated test facilities planning procedures, which are generally unique to the facility. The facility personnel and the tester prepare the procedures.

For OT&E, DoD Components brief the DOT&E on concepts for an OT&E or operational assessment (OA) 120 days prior to start. They submit the T&E plan 60 days prior to start and report major revisions as they occur. Test plans should include test objectives, measures of effectiveness (MOEs), measures of performance (MOPs), and measures of operational suitability (MOSs), planned operational scenarios, threat representations, targets, resources, test limitations,

and methods of data gathering and certification, reduction, and analysis. Details of the planned test events permit the DOT&E to assess operational realism.

According to *10 USC 2399*, system contractors may participate during OT&E only in support of a beyond-LRIP (low-rate initial production) decision for ACAT I and II programs to the extent the program has planned for them to be involved in the operation, maintenance, and other support of the system when it is deployed in combat. A support contractor that has participated (or is participating) in the development, production, or testing of a system for a DoD Component (or for another contractor of the DoD) may not be involved in any way in establishing criteria for data collection, performance assessment, or evaluation activities for the OT&E. These limitations do not apply to a contractor that has participated in such development, production, or testing solely in test or test support on behalf of DoD.

The TEMP includes a LFT&E planning matrix that covers all tests within the LFT&E strategy, schedules for these tests, and the issues they will address. Also included is information on which the planning documents the Services propose to submit to DOT&E for approval and which they propose to submit for information and reviews only. Appendix C of 5000.2-R ("Live Fire Test and Evaluation Mandatory Procedures & Reports") describes the detailed LFT&E test procedures, test conditions, data collection, and analysis processes to be used during the conduct of each live-fire test. Appendix B of Volume 2 of this handbook series provides additional detail on the content of the detailed test and evaluation plans required for the full-up, system-level live fire tests. The detailed test and evaluation plan should be submitted to DOT&E for comment at least 30 days before test initiation. DOT&E has 15 days for submission of comments subsequent to its receipt of the detailed test plan or evaluation plan.

Planning the M&S Approach

The PM plans for and documents the M&S approach as part of the acquisition strategy and keeps the approach current throughout the program life cycle. That planning must comply with DoD Component implementing directives.

The PM accomplishes the following:

- Map M&S onto the design process to identify the core M&S development that the contractor or DoD Component S&T element must address.
- Identify which steps of the design process M&S will accomplish or facilitate.
- Make necessary investments to enable execution of the M&S approach, including early identification of and planning for required resources.
- Integrate M&S efforts over the life cycle of the system, from requirements and concept development, through engineering, production, testing, sustainment, and post-production support.

- Relate M&S to other acquisition activities such as simulation, the T&E process, Price or Cost as an Independent Variable, and IPPD.

The appropriate Lead Executive Component Executive or Service Acquisition Executive and T&E authorities approve the M&S approach.

Appendix A.

General Contractor Requirements

Survivability program. Within the framework of the contractor's engineering organization or contractually specified systems engineering discipline, the contractor shall develop, propose, implement and maintain an effective survivability program that is planned for and integrated into all phases of aircraft design, development and production. Survivability program management shall be integrated into the contractor engineering management organization and the engineering management plan required by the implementing documentation.

Organization. The contractor shall provide adequate staff for managing and accomplishing the survivability program. The responsibilities and functions of those personnel directly involved with implementation of the program shall be clearly defined. The responsibility and authority of the survivability organization shall be involved with all relevant design, support, and program management activities so that the survivability design requirements are effectively incorporated into the aircraft. The relationships to each relevant activity shall be defined.

Procedures. The contractor shall establish the procedures that are necessary to conduct the survivability program. They shall require.

a. Inclusion of contractually specified survivability requirements in the system design.

b. Imposition and allocation of survivability requirements on subcontractors.

c. Provision of system design, analysis and management activities with survivability information and guidance.

d. Control and monitoring of survivability program funds and expenditures.

e. Implementation and control of developmental, evaluation, and verification tests and/or analyses.

f. Means by which design and support activities will provide the survivability engineering organization with the information needed for each of the survivability program tasks.

g. Methods of apprising the responsible procuring activity of the program and funding status.

Program plan. The contractor shall develop, propose, obtain government approval of, and implement a survivability program plan. It shall outline the procedures by which the contractor proposes to conduct the survivability program tasks, incorporate the design requirements, and conduct the demonstration and tests for which he is responsible. The functional relationship with other program tasks and events shall be clearly shown and described. Each task in the plan shall be identified with the work breakdown structure so that tractability and monitoring of funding may be accomplished. The required survivability program tasks are the design requirements, the demonstrations and tests. The contractor shall conduct the survivability program in accordance with this standard ant the approved program plan. The plan shall describe:

a. The tasks, schedules, manpower requirements, special facilities, and significant milestones of the program. Planned use of subcontractors, to supplement in-house capabilities, must be indicated and the subcontractors identified when possible.

b. An organizational structure with survivability personnel at a level such that survivability design techniques are effectively implemented.

c. A procedure for conveying to subsystem ant component designers the latest survivability design techniques applicable to their particular design areas. This procedure might be in the form of periodic briefings, internal information bulletins, personal contact between survivability and design engineers on a regular basis, and shall include active participation by survivability personnel in making design decisions.

d. A procedure for designers to provide current design information to survivability analysis personnel so that survivability assessments and trade studies reflect the status of weapon system design as it actually exists.

e. The plan and schedule for survivability program reviews.

f. A description of the anticipated design support tests in all areas of survivability (vulnerability reduction, detectable,
etc.).

g. Proposal of methodologies for specific requirements of this standard where procuring agency approval is required.

h. Technical support for Government or other contractors' effort to be carried out concurrently or in conjunction with or in support of the contractor survivability effort.

i. Submission of data in accordance with the Contract Data Requirements List (CDRL), DD Form 1423.

Program reviews. Program reviews shall be planned and scheduled to permit the contractor and Government representatives to periodically examine the status of the survivability program. These reviews shall be coordinated with the aircraft system design reviews and be identified in the survivability program plan. The contractor shall document all survivability actions which have taken place on the aircraft systems during the period covered by the program review. These reviews shall include:

a. Review of survivability enhancement features proposed for incorporation in the aircraft design and comparison with system specification requirements and current threat estimates. The reviews shall be supported by survivability analysis, or other approved quantitative means of assessing the survivability enhancement trade studies resulting from such proposals.

b. Review of current system survivability estimates and achievements for each specified design requirement.

c. Review of potential engineering, development, or testing problem areas, and possible solutions.

d. Identification of the principal items inhibiting planned achievement and proposed solutions.

e. Status of survivability program funds, expenditures, and allocations for future tasks.

f. Status and results of trade studies conducted for survivability engineering, and the effects of engineering decisions and trades upon survivability achievements and potential.

g. Review of incorporated survivability design features. This shall be conducted during design reviews as specified in the procurement contract.

h. Review of vulnerability and survivability assessments conducted as scheduled in the survivability program plan.

i. Review of all development and verification testing and results.

j. Participation by subsystem designers to the extent necessary.

k. The documentation of the results of design reviews.

l. Review of life cycle survivability program for hardness assurance and maintenance provisions during production and operational phases.

Appendix B.

Systems Engineering Planning Guidance

A new Defense Systems Management College (DSMC) text on the of Systems Engineering Fundamentals (1999) is currently available. Topics include the systems engineering process; system analysis and control; and planning for, organizing, and managing systems. The guide provides a basic, conceptual-level description of Systems Engineering Management (SEM) as it relates to the development and life cycle management of a system--including basic concepts, problem-solving, tools to balance the process, and issues integral to the SEM effort. This text supplements course material at DSMC and is the first guidance issued on the topic of systems engineering since the Systems Engineering Management Guide (1990).

DSMC now uses it in all of their courses where Systems Engineering (SE) is taught, and promote it as a companion to the International Council on Systems Engineering (INCOSE) SE "How-to" Handbook, which they reference in all of their courses. Systems Engineering Fundamentals (1999) is intended to be the SE foundation and the excellent INCOSE Handbook is the application.

Further information (add'l description, downloading a free PDF version, ordering hardcopies, etc.) can be found at http://www.dsmc.dsm.mil/pubs/gdbks/sys_eng_fund.htm

The INCOSE SE "How-to" Handbook on Systems Engineering is an interdisciplinary approach and means to enable the realization of successful systems. It focuses on defining customer needs and required functionality early in the development cycle, documenting requirements, then proceeding with design synthesis and system validation while considering the complete problem:

- Operations
- Performance
- Test
- Manufacturing
- Cost & Schedule
- Training & Support
- Disposal

Chapter 16 of the Defense Systems Management College Press's October 1999 supplementary text titled Systems Engineering Fundamentals is provided below.

CHAPTER 16
SYSTEMS ENGINEERING PLANNING

16.1 WHY ENGINEERING PLANS?

Systems engineering planning is an activity that has direct impact on acquisition planning decisions and establishes the feasible methods to achieve the acquisition objectives. Management uses it to:

- Assure that: all technical activities are identified and managed,
- Communicate the technical approach to the broad development team,
- Document decisions and technical implementation, and
- Establish the criteria to judge how well the system development effort is meeting customer and management needs.

Systems engineering planning addresses the scope of the technical effort required to develop the system. The basic questions of "who will do what" and "when" are addressed. As a minimum, a technical plan describes what must be accomplished, how systems engineering will be done, how the effort will be scheduled, what resources are needed, and how the systems engineering effort will be monitored and controlled. The planning effort results in a management-oriented document covering the implementation of program requirements for system engineering, including technical management approaches for subsequent phases of the life cycle. In DoD it is an exercise done on a systems level by the government, and on a more detailed level by contractors.

Technical/Systems Engineering Planning

Technical planning may be documented in a separate engineering management plan or incorporated into a broad, integrated program management plan. This plan is first drafted at project or program inception during the early requirements analysis effort. Requirements analysis and technical planning are inherently linked, because requirements analysis establishes an understanding of what must be provided. This understanding is fundamental to the development of detailed plans. To be of utility, systems engineering plans must be regularly updated. To support management decision making, major updates will usually occur at least just before major management milestone decisions. However, updates must be performed as necessary between management milestones to keep the plan sufficiently current to achieve its purpose of information, communication, and documentation.

16.2 ELEMENTS OF TECHNICAL PLANS

Technical plans should include sufficient information to document the purpose and method of the systems engineering effort. Plans should include the following:

• An introduction that states the purpose of the engineering effort and a description of the system being developed,
• A technical strategy description that ties the engineering effort to the higher-level management planning,
• A description of how the systems engineering process will be tailored and structured to complete the objectives stated in the strategy,
• An organization plan that describes the organizational structure that will achieve the engineering objectives, and
• A resource plan that identifies the estimated funding and schedule necessary to achieve the strategy.

Introduction

The introduction should include:

Scope: The scope of the plan should provide information concerning what part of the big picture the plan covers. For example, if the plan were a DOD program office plan, it would emphasize control of the higher-level requirements, the system definition (functional baseline), and all activities necessary for system development. On the other hand, a contractor's plan would emphasize control of lower level requirements, preliminary and detail designs (allocated and product baselines), and activities required and limited by the contractual agreement.

Description: The description of the system should:

• Be limited to an executive summary describing those features that make the system unique,
• Include a general discussion of the system's operational functions, and
• Answer the question "What is it and what will it do?"

Focus: A guiding focus for the effort should be provided to clarify the management vision for the
development approach. For example, the focus may be *lowest cost to obtain threshold requirements,*
superior performance within budget, superior standardization for reduced logistics, maximum use of the open systems approach to reduce cost, or the like. A focus statement should:

• Be a single objective to avoid confusion,
• Be stated simply to avoid misinterpretation, and
• Have high-level support.

Purpose: The purpose of the engineering effort should be described in general terms of the outputs, both end products and life cycle enabling products, that are required. The stated purpose should answer the question, what does the engineering effort have to produce?

Technical Strategy

The basic purpose of a technical strategy is to link the development process with the acquisition or contract management process. It should include:

• Development phasing and associated baselining,
• Key engineering milestones to support risk management and business management milestones,
• Associated parallel developments or product improvement considerations, and
• Other management generated constraints or high-visibility activities that could effect the engineering development.

Phasing and Milestones: The development phasing and baseline section should describe the approach to phasing the engineering effort, including tailoring of the basic process described in this book and a rationale for the tailoring. The key milestones should be in general keeping with the technical review process, but tailored as appropriate to support business management milestones and the project/program's development phasing. Strategy considerations should also include discussion of how design and verification will phase into production and fielding. This area should identify how production will be phased-in (including use of limited-rate initial production and long lead-time purchases), and that initial support considerations require significant coordination between the user and acquisition community.

Parallel Developments and Product Improvement:

Parallel development programs necessary for the system to achieve its objectives should be identified and the relationship between the efforts explained. Any product improvement strategies should also be identified. Considerations such as evolutionary development and pre-planned product improvement should be described in sufficient detail to show how they would phase into the over-all effort.

Impacts on Strategy

All conditions or constraints that impact the strategy should be identified and the impact assessed.
Key points to consider are:

• Critical technologies development,
• Cost As an Independent Variable (CAIV), and
• Any business management directed constraint or activity that will have a significant influence on the strategy.

Critical Technologies: Discussion of critical technology should include:
• Risk associated with critical technology development and its impact on the strategy,
• Relationship to baseline development, and
• Potential impact on the overall development effort.

CAIV: Strategy considerations should include discussion of how Cost As an Independent Variable (CAIV) will be implemented, and how it will impact the strategy. It should discuss how unit cost, development cost, life cycle cost, total ownership cost, and their interrelationships apply to the system development. This area should focus on how these costs will be balanced, how they will be controlled, and what impact they have on the strategy and design approach.

Management Issues: Management issues that pose special concerns for the development strategy could cover a wide range of possible issues. In general, management issues identified as engineering strategy issues are those that impact the ability to support the management strategy. Examples would include:

• Need to combine developmental phases to accommodate management driven schedule or resource limitations,
• Risk associated with a tight schedule or limited budget,
• Contractual approach that increases technical risk, and
• Others of a similar nature.

Management-dictated technical activities—such as use of modeling and simulation, open systems, IPPD, and others—should not be included as a strategy issue unless they impact the overall systems engineering strategy to meet management expectations. The strategy discussion should lay out the plan, how it dovetails with the manage-ment strategy, and how management directives impact it.

Systems Engineering Processes

This area of the planning should focus on how the system engineering processes will be designed to support the strategy. It should include:

• Specific methods and techniques used to perform the steps and loops of the systems engineering process,
• Specific system analysis and control tools and how they will be used to support step and loop activities, and
• Special design considerations that must be integrated into the engineering effort.

Steps and Loops: The discussion of how the systems engineering process will be done should show the specific procedures and products that will ensure:

• Requirements are understood prior to the flow-down and allocation of requirements,
• Functional descriptions are established before designs are formulated,

• Designs are formulated that are traceable to requirements,
• Methods exist to reconsider previous steps, and
• Verification processes are in place to ensure that design solutions meet needs and requirements.

This planning area should address each step and loop for each development phase, include identification of the step specific tools (Functional Flow Block Diagrams, Timeline Analysis, etc.) that will be used, and establish the verification approach. The verification discussion should identify all verification activities, the relationship to formal developmental T&E activities, and independent testing activities (such as operational testing).

Norms of the particular technical area and the engineering processes of the command, agency, or company doing the tasks will greatly influence this area of planning. However, whatever procedures, techniques, and analysis products or models used, they should be compatible with the basic principles of systems engineering management as described earlier in this book.

An example of the type of issue this area would address is the requirements analysis during the system definition phase. Requirements analysis is more critical and a more central focus during system definition than in later phases. The establishment of the correct set of customer requirements at the beginning of the development effort is essential to proper development. Accordingly, the system definition phase requirements analysis demands tight control and an early review to verify the requirements are established well enough to begin the design effort. This process of control and verification necessary for the system definition phase should be specifically described as part of the overall requirements analysis process and procedures.

Analysis and Control: Planning should identify those analysis tools that will be used to evaluate alternative approaches, analyze or assess effectiveness, and provide a rigorous quantitative basis for
selecting performance, functional and design requirements. These processes can include trade studies, market surveys, modeling and simulation, effectiveness analyses, design analyses, QFD, design of experiments, and others.

Planning must identify the method by which control and feedback will be established and maintained. The key to control is performance-based measurement guided by an event-based schedule. Entrance and exit criteria for the event driven milestones should be established sufficient
to demonstrate proper development progress has been completed. Event-based schedules and exit criteria are further discussed later in this chapter. Methods to maintain feedback and control are developed to monitor progress toward meeting the exit criteria. Common methods were discussed earlier in this book in the chapters on metrics, risk management, configuration management and technical reviews.

Design Considerations: In every system development there are usually technical activities that require special attention. These may come from management concerns, legal or regulatory directives, social issues, or organizational initiatives. For example, a DoD program office will

have to conform to DoD 5000.2-R, which lists several technical activities that must be incorporated into the development effort. DoD plans should specifically address each issue presented in Part 4 of DoD 5000.2-R. In the case of a contractor there may be issues delineated in the contract, promised in the proposal, or established by management that the tech-nical effort must address. The system engineering planning must describe how each of these issues will be integrated into the development effort.

Organization

Systems engineering management planning should identify the basic structure that will develop the system. Organizational planning should address how the integration of the different technical disciplines,
primary function managers, and other stakeholders will be achieved to develop the system. This planning area should describe how multi-disciplinary teaming would be implemented, that is, how the teams will be organized, tasked, and trained. A systems-level team should be established early to support this effort. Roles, authority, and basic responsibilities of the system-level design team should be specifically described. Establishing the design organization should be one of the initial tasks of the system-level design team. Their basic approach to organizing the effort should be described in the plan. Further information on organizing is contained in a later chapter.

Resources

The plan should identify the budget for the technical development. The funds required should be matrixed against a calendar schedule based on the event-based schedule and the strategy. This should establish the basic development timeline with an associated high-level estimated spending profile. Short falls in funding or schedule should be addressed and resolved by increasing funds, extending schedule, or reducing requirements prior to the plan preparation. Remember that future analysis of development progress by management will tend to be based on this budget "promised" at plan inception.

16.3 INTEGRATION OF PLANS – PROGRAM PLAN INTERFACES

Systems engineering management planning must be coordinated with interfacing activities such as the:

• Acquisition Strategy to ensure that technical plans take into account decisions reflected in the Acquisition Strategy. Conflicts must be identified early and resolved,
• Financial plan to assure resources match the needs in the tech plan. Conflicts should be identified early and resolved,
• Test and Evaluation Master Plan (TEMP) to assure it complements the verification approach. It should provide an integrated approach to verify that the design configuration will meet customer requirements. This approach should be compatible with the verification approach delineated in the systems engineering plan.

• Configuration management plan to assure that the development process will maintain the system baselines and control changes to them,
• Design plans (e.g., electrical, mechanical, structural, etc) to coordinate identification of IPT team composition,
• Integrated logistics support planning and support analysis to coordinate total system support,
• Production/Manufacturing plan to coordinate activities concerning design producibility, and follow-on production,
• Quality management planning to assure quality engineering activities and the quality management functions are included in system engineering planning,
• Risk management planning to establish and coordinate technical risk management to support total program risk management,
• Interoperability planning to assure interoperability suitability issues are coordinated with system engineering planning. (Where interoperability is an especially critical requirement such as, communication or information systems, it should be addressed as a separate issue with separate integrated teams, monitoring, and controls), and
• Others such as modeling and simulation plan, software development plan, human integration plan, environment, safety and health planning, etc.

Things to Watch For

A well developed technical management plan will include:

• The expected benefit to the user,
• How a total systems development will be achieved using a systems engineering approach,
• How the technical plan complements and sup-ports the acquisition or management business plan,
• How incremental reviews will assure that the development stays on track,
• How costs will be reduced and controlled,
• What technical activities are required and who will perform them,
• How the technical activities relate to work accomplishment and calendar dates,
• How system configuration and risk will be controlled,
• How system integration will be achieved,
• How the concerns of the eight primary life cycle functions will be satisfied,
• How regulatory and contractual requirements will be achieved, and
• The feasibility of the plan, i.e., is the plan practical and executable from a technical, schedule, and cost perspective.

16.4 SUMMARY POINTS

• Systems engineering planning should establish the organizational structure that will achieve the engineering objectives.
• Planning must include event-based scheduling and establish feedback and control methods.
• It should result in important planning and control documents for carrying out the engineering effort.

• It should identify the estimated funding and detail schedule necessary to achieve the strategy.
• Systems engineering planning should establish the proper relationship between the acquisition and technical processes.

Appendix C

Technological Opportunity Activities

According to DoD 5000.2 a technology project is a directed, incrementally funded effort designed to provide new capability in response to technological opportunities or a validated operational or business (e.g., accounting, inventory cataloging, etc.) need. Technology projects are "pre-systems acquisition," do not have an acquisition category, and precede program initiation.

The S&T program consists of the following:

Basic Research -- scientific study and experimentation directed toward increasing knowledge and understanding in the science fields and discovering phenomena that can be exploited for military purposes;

Applied Research -- translates promising research into solutions for broadly defined military problems with effort that may vary from applied research to sophisticated breadboard subsystems that establish the initial feasibility and practicality of proposed solutions or technologies; and

Advanced Technology -- demonstrates the performance payoff, increased logistics capabilities, or cost reduction potential of militarily relevant technology.

Technological opportunities within DoD laboratories and research centers, from academia, or from commercial sources are identified within the Defense S&T Program. The DoD S&T Program mission is to provide the warfighters of today and tomorrow with superior and affordable technology to support their missions, and to enable them to have revolutionary war-winning capabilities. The S&T Program is uniquely positioned to reduce the risks of promising technologies before they are assumed in the acquisition process. The Deputy Under Secretary of Defense (Science & Technology) (DUSD(S&T)) is responsible for the overall direction, coordination, quality, and content of the DoD S&T Program (including software capability).

Science and Technology Program

The S&T Program is planned, programmed, and conducted by the military Departments and the Defense Agencies. The Departments use their S&T programs to provide warfighting and system options for their components. The Defense Agencies are responsible for certain multi-Service aspects of S&T, and for designated programs that support national security objectives.

The Departments and Defense Agencies coordinate their programs through Defense S&T Reliance. Reliance provides a forum where S&T programs are planned, balanced and reviewed

jointly, to ensure that unnecessary duplication is eliminated and to ensure compliance with this Strategy and Defense Planning Guidance. Reliance is overseen by an Executive Committee chaired by the Deputy Director, Defense Research and Engineering. Reliance has grown in strength over the past years. It is now responsible for preparing the S&T plans.

S&T Strategic Planning Process.

The technological advantage we enjoy today is a legacy of decades of investment in S&T. Likewise, our future warfighting capabilities will be substantially determined by today's investment in S&T. In view of declining defense budgets and manpower reductions, advancing military technology and ensuring that it undergoes rapid transition to the warfighter are national security obligations of ever greater importance.

To fulfill these obligations, the Director, Defense Research and Engineering (DDR&E), has continually enhanced the strategic planning process for defense S&T. The foundation of this process is the *Defense Science and Technology Strategy* with its supporting *Basic Research Plan* (BRP), *Joint Warfighting Science and Technology Plan* (JWSTP), and *Defense Technology Area Plan* (DTAP). These documents present the DoD S&T vision, strategy, plan, and objectives for the planners, programmers, and performers of defense S&T.

These documents are a collaborative product of the Office of the Secretary of Defense (OSD), Joint Staff, military services, and defense agencies. The strategy and plans are fully responsive to the National Security S&T Council's National Security Science and Technology Strategy and the Chairman of the Joint Chiefs of Staff's Vision and Joint Vision 2010 (JV 2010), as shown in Figure 3. The strategy and plans and supporting individual S&T master plans of the military services and defense agencies guide the annual preparation of the defense program and budget. The strategy and plans are made available to the U.S. Government, defense contractors, and our allies with the goal of better focusing our collective efforts on superior joint warfare capabilities and improving interoperability between the United States and our allies.

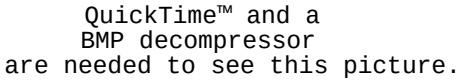


Figure 3. Science and Technology Strategic Planning

S&T Program Transition

To ensure the transition of innovative concepts and superior technology to the warfighter and acquisition customer, the DoD Component S&T Executives use three mechanisms -- Advanced Technology Demonstrations (ATDs), Advanced Concept Technology Demonstrations (ACTDs), and Joint Warfighting Experiments (JWEs). The specific plans and processes for these transition mechanisms are described in the Joint Warfighting S&T Plan. S&T activities are to be conducted in a way that facilitiates or at least does not preclude the availability of competition for future acquisition programs.

- ATDs areused to demonstrate the maturity and potential of advanced technologies for enhanced military operational capability or cost effectiveness.

- ACTDs are used to determine military utility of proven technology and to develop the concept of operations that will optimize effectiveness.

- JWEs are used to develop and assess concept-based hypotheses to identify and recommend the best value-added solutions for changes to doctrine, organizational structure, training and

education, materiel, leadership, and people required to achieve significant advances in future joint operational capabilities.

One path into systems acquisition begins with examining alternative concepts to meet a stated mission need. This path begins with a decision to enter Concept and Technology Development at Milestone A. The phase ends with a selection of a system architecture and the completion of entrance criteria into Milestone B and System Development and Demonstration Phase.

In accordance with DoD 5000.2, each DoD Component should maintain a transition fund in the out-years of the FYDP to allow rapid transition of projects from technology opportunity and user needs activities to System Development and Demonstration or Commitment to Low-Rate Production. Each DoD Component determines the size of its transition fund. The transition fund for the first year of the program must be distributed to individual budget lines prior to submission of the Budget Estimate Submission for that year.

Entrance Criteria

Entrance into System Development and Demonstration is dependent on three things: technology (including software) maturity, validated requirements, and funding. Unless some other factor is overriding in its impact, the maturity of the technology will determine the path to be followed. Prior to entering System Development and Demonstration, there is to be an ORD validated by the requirements authority. The ORD contains operational performance requirements and addressing cost for a proposed concept or system. Time-phased ORDs must be validated by the requirements authority prior to program approval. If a mature technology, non-developmental item, or commercial item is being considered for transition to an acquisition program at Milestone B or C, it must have a validated ORD prior to being approved as an acquisition program.

[i] DoD Directive 3200.11, *Major Range and Test Facility Base*, September 29, 1980 (Changes 1-3)