Achieving Effective Results in Acquisition

Guidelines for Recommended Actions

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January 2009

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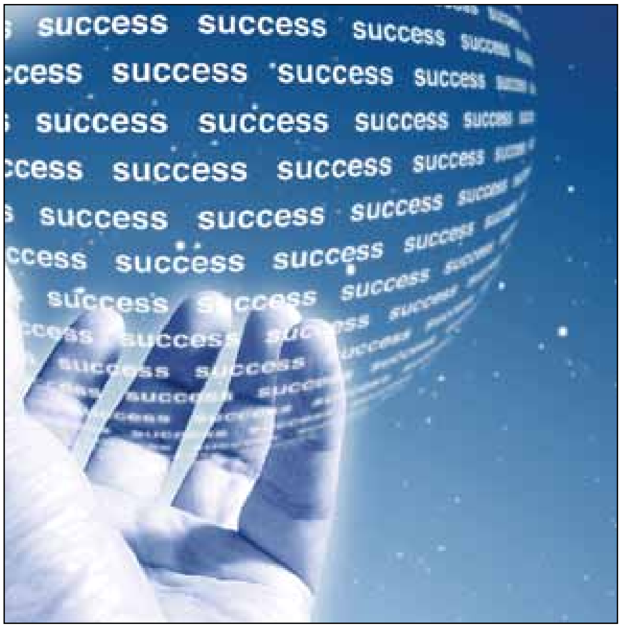

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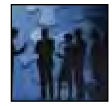

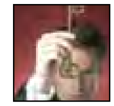

Achieving Effective Results in Acquisition: Guidelines for Recommended Actions

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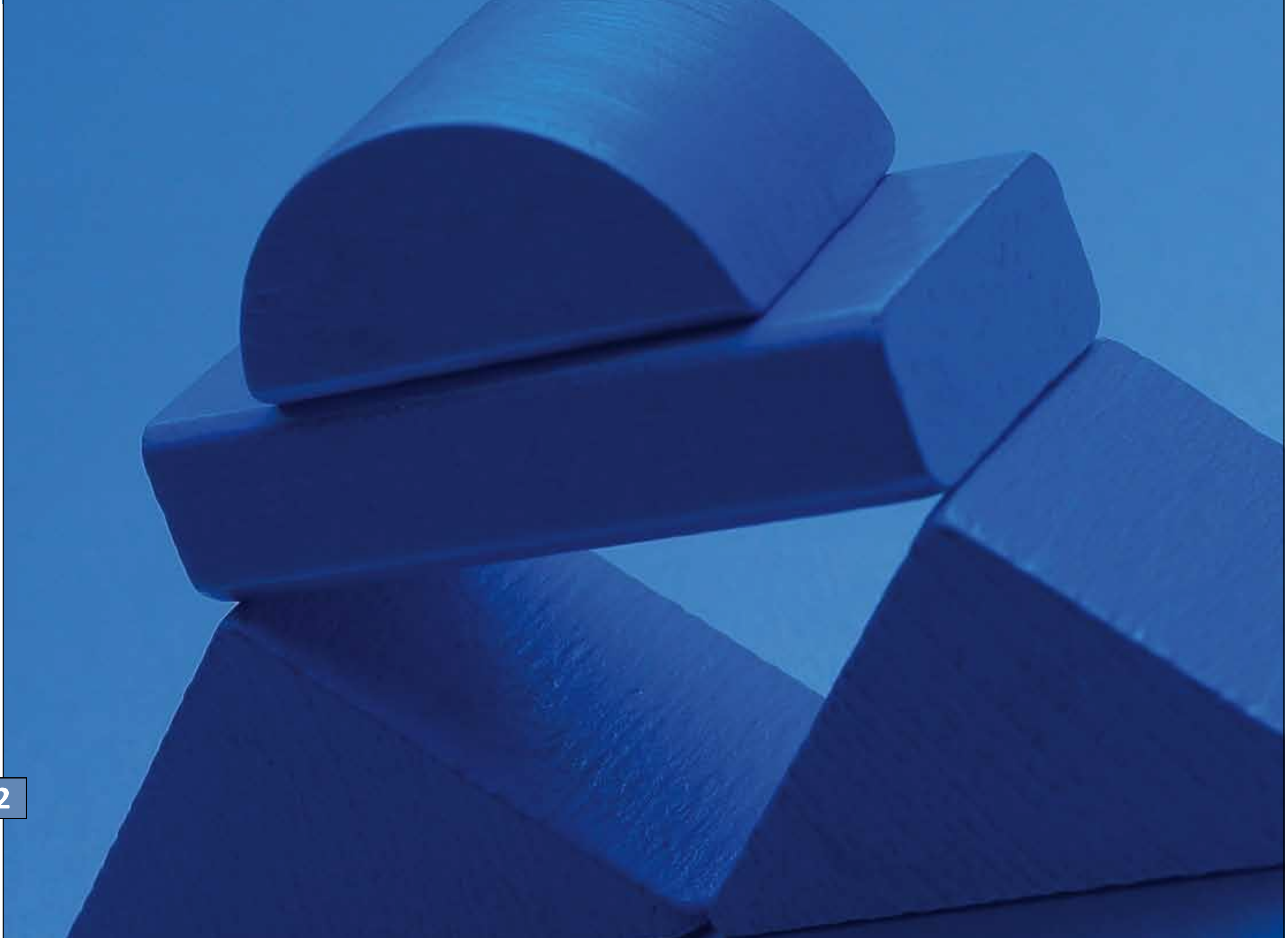

SECTION ONE

Executive Summary

The federal government is experiencing great difficulty in acquiring the products and services necessary to adapt to the ever-changing capabilities of the new technologies used by consumers and adversaries. Despite years of dedicated acquisition reforms, many federal acquisition programs continue to underperform, significantly overrunning their planned costs and schedules. To improve the success of federal acquisition programs, MITRE focused on examining successful programs, discerned the principles and practices that made them successful, and determined which ones could be applied to other programs.

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The result is a practical guide for formulating and executing acquisition programs based on successful practices permitted within the realm of existing federal acquisition policies and regulations. We believe, and our experiences support, that Program Managers (PMs) and Chief Engineers (CEs) have the ability to implement these successful practices when they have adequate resources and support from their direct leadership.

For these successful practices, we provided clear, actionable steps for a PM or CE to implement. We focused on ensuring that the recommended actions were grounded in reality with direct links to successful programs (e.g., Distributed Common Ground System – Army, Theater Battle Management Core System, and Global Hawk). MITRE's findings and recommendations were derived from the hard-earned knowledge and insight of the individuals who led successful acquisition programs. We used this knowledge to develop a framework that PMs or CEs could tailor to meet the unique needs of their acquisition programs.

In April 2008, MITRE assembled a group of former government PMs, CEs, systems engineers, and acquisition specialists who had worked on successful acquisition programs to determine the best practices, and engineering and acquisition-related lessons learned (refer to Appendix A). These practices and lessons learned were used to develop a structured approach to improve the likelihood of success for acquisition programs. Our approach consists of a framework, a sequence of steps, discrete actions for each step, and resources required. The framework and steps are the same for every program; the actions associated with the steps and resource implementations are program dependent. Every program is unique and will require tailoring the approach to ensure its success.

This paper, unlike many of the blue ribbon panel acquisition reports, is unique due to the breadth and detail of the recommended best practices. These common sense actions, which were learned by successful programs, have not been consistently passed down to other programs. To improve the success of current and future acquisition programs, knowledge transfer must happen. This paper is one step in that knowledge transfer process.

Sections Two through Five contain information on the four areas of our approach, associated steps, functional enablers, and foundational activities. It also includes the actions and best practices associated with each step, and successful characteristics of the functional enablers and foundational activities.

Introduction

Today's federal acquisition community is under pressure from Congress, sponsors, and end users to reform its business practices for developing and delivering capabilities. Many acquisition professionals are receiving complaints that their programs take too long, are too expensive, and fail to deliver the required capabilities. Added to that cacophony of charges is the call for rapid acquisitions. This paper provides guidelines to ensure that acquisition programs provide end users with the required capabilities quickly, and within the program's established cost and schedule parameters. These guidelines are based on the knowledge and insight gained from our April 2008 meeting with former government Program Managers (PMs), Chief Engineers (CEs), and acquisition Subject Matter Experts (SMEs) who led successful weapon systems and Information Technology (IT) programs, and findings from our own Systems Engineering (SE) and acquisition research.

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Intent. This paper provides acquisition professionals with guidelines they can implement to ensure their acquisition programs are successful. Each program is unique and has its own set of challenges and issues. However, the principles and practices discussed in this paper apply to most acquisition programs. Acquisition professionals can tailor these principles and practices to their programs, and implement them to achieve program success. Recognizing that the acquisition process is a team endeavor, MITRE encourages acquisition professionals to use a collaborative approach when assessing and selecting the principles and practices that are best suited to the unique needs of their programs.

Content. Section Two provides a summary of the problem we addressed and our approach. Section Three provides the essential steps across a program's lifecycle (i.e., from concept to Operations and Support [O&S]) that are needed to achieve success. Section Four contains the two fundamental activities that are the bedrock of successful programs: advocacy and SE. Section Five addresses the functional enablers required for the steps to succeed. A program self-assessment matrix is provided in Appendix B.

Application. The steps, activities, enablers, principles, and practices discussed in this document can be applied to programs across the federal government. The Department of Defense's (DoD's) acquisition lifecycle, which is described in the DoD Instruction 5000 series, is this paper's representative lifecycle. The DoD's acquisition lifecycle is similar to those of other agencies and departments. The DoD 5000 and other System Development Lifecycles (SDLC) begin with end user requirements and concept initiation, and transition into risk reduction and technology development. They then reach the major decision point for beginning engineering development, Milestone B (MS B) in the DoD lifecycle, and finally capability production, delivery, and O&S. Another similarity is the work performed by PMs and CEs who take an end user's need and execute an acquisition program that results in providing a mission-effective capability.

Overview

Problem Statement

The deteriorating performance trend of formal federal acquisition programs has resulted in Congress, the executive branch, and Industry losing confidence in the federal government's ability to acquire timely and relevant capabilities for the Military Services and federal agencies. The shortfalls of the Military Services' acquisition programs are highlighted in the Government Accountability Office's annual assessment[1] of 72 DoD weapons programs, which stated that "…cost and schedule outcomes for Major weapons programs are not improving…" and "…current programs are experiencing, on average, a 21-month delay in delivering initial capabilities to the warfighter."

IT systems development programs are also performing poorly across the government and Industry. In many cases, IT programs are conceived and executed as a monolithic structure, resulting in an over-constrained development that under delivers capabilities. Figure 1 illustrates IT programs' successes, only 16 percent of which are completed on time and within budget.

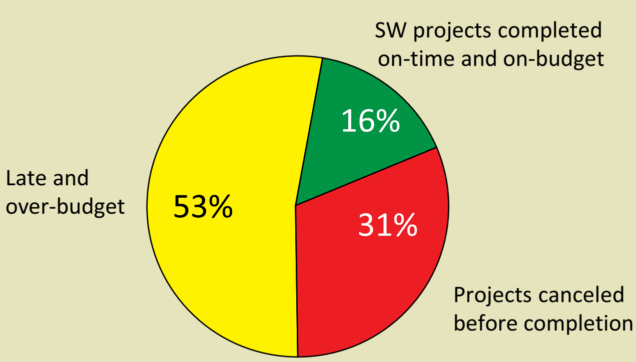
A PM must reconcile a number of external forces in today's acquisition environment. First, there are significant department/agency regulatory and policy demands placed on a program's key leadership along with numerous oversight activities that sometimes result in conflicting changes to program direction. Second, there are numerous interfaces among programs and systems that introduce unpredictable changes in the boundary conditions of systems/programs. They demand sophisticated governance, and very agile program execution and coordination. Finally, traditionally PMs work for a single resource sponsor. This is changing, as a growing number of programs have multiple funding sources. Each source can 'vote with their dollars' on what the program does, implying potential disunity in program control and direction.

The downward trend of an acquisition program's performance is especially costly in today's environment of increasingly complex systems and a need for expanded interoperability. Numerous blue ribbon panels have examined this situation and reported their findings and recommendations, but few were implemented. The reasons behind the lack of follow-through are not the subject of this paper.

To improve the success of federal acquisition programs, MITRE focused on examining successful examples, discerned the principles and practices that made them successful, and determined which ones could be applied to other programs. For these success factors, we provided clear, actionable steps that a PM or CE could implement. We focused on ensuring that the recommended actions were grounded in acquisition reality with direct links to successful programs (e.g., Distributed Common Ground System – Army, Theater Battle Management Core System, and Global Hawk). MITRE's findings and recommendations were derived from the hard-earned knowledge and insight of the individuals who led successful acquisition programs. We used this knowledge to develop a framework that PMs or CEs could tailor to meet the unique needs of their programs, rather than develop general recommendations for improving the acquisition systems in the federal government.

[1] GAO-08-674T Defense Acquisitions: Results of Annual Assessment of DoD Weapon Programs, April 2008.

>>> ***Figure 1. Commercial and Government IT Programs' Results***



IT System Development "Facts of Life"

Commercial & Government IT Project Developments:

- *Average final product contains 61% of the originally specified features*
- *Average cost growth exceeds 89%*

— Defense Science Board SW Study 2000

Objective

This paper is intended to help federal acquisition programs succeed by providing the Program Management Office's (PMO's) acquisition professionals with a list of essential actions and critical functions that help them effectively manage the complexities associated with federal acquisition programs. We define a successful program as one that delivers increments of necessary capabilities in a predictable, rapid timeframe (e.g., for IT systems tens of months versus years) within the agreed-upon cost and performance thresholds.

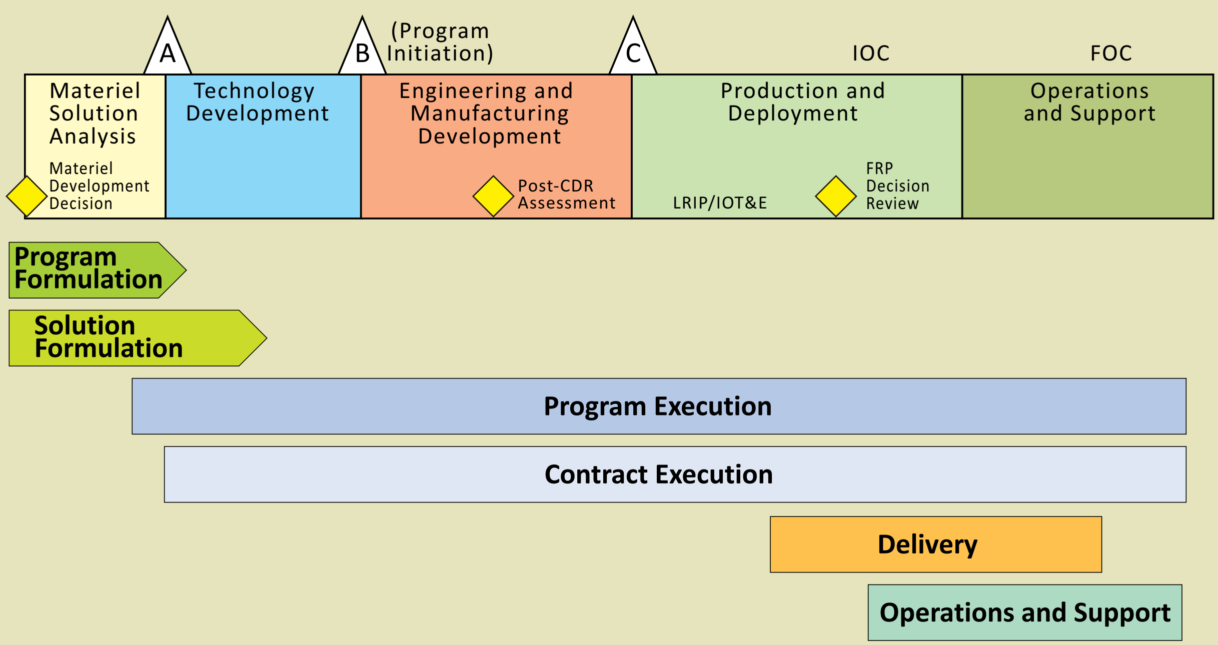
This document provides guidelines for achieving successful acquisition programs based on the experiences of former PMs, CEs, and SMEs, and their experiences with three types of acquisitions: weapons systems; Command, Control, Computers, Communications, Intelligence, Surveillance, and Reconnaissance (C4ISR) systems; and business systems that support the infrastructure. The guidelines in this document apply to all three types of acquisitions and unique details are noted, where applicable.

Approach

MITRE assembled a small group of distinguished and experienced former PMs and CEs from the Services and Intelligence Community (IC), practicing systems engineers, and SMEs for a week-long meeting to determine what makes acquisition programs successful. (Refer to Appendix A for the list of participants.) This effort was part of MITRE's broader SE initiative to capture and share knowledge with MITRE's project leaders, and the government PMs responsible for formulating and executing programs. The group's findings (i.e., key activities and functional enablers) are summarized in this guide. The approach consists of a framework, steps, detailed actions, and the resources needed (i.e., functional enablers). The framework and steps are the same for all programs; the actions associated with the steps and the resources are program dependent. ***Every program is unique and will require tailoring the approach to ensure its success.***

This framework can be applied to contemporary Programs of Records (PORs) under the existing policies and regulations. The approach identifies the leadership, management, and SE practices, and the success characteristics that allow programs to operate within individual or multiple, concurrent dynamic acquisitions. The approach also assumes PMs and their staffs have received fundamental acquisition training and possess a working knowledge of their federal acquisition system.

> > > ***Figure 2. Acquisition Program Lifecycle***



The approach begins by partitioning the DoD 5000's lifecycle activities into four areas: formulation, execution, delivery, and O&S (see Figure 2):

Program Formulation: These start-up activities occur immediately after a favorable concept/materiel development decision identifies the program's mission, purpose, scope, organization, and advocacy on which the program will be established.

Solution Formulation: These activities are required to develop, analyze, and mature the concept. They require a sound understanding of the program to ensure the critical development risks are identified and characterized, and that the government baselines are defined prior to the prime contractor's development efforts.

Program Execution: These activities focus on producing the knowledge and infrastructure necessary to conduct the end-item acquisition, development, and fielding efforts. These activities follow the formulation phase.

Contract Execution: These activities are associated with preparing for, acquiring, and managing the Industry partners responsible for building and delivering the capabilities.

Delivered Capabilities: These activities are required to plan and transition new or legacy systems into new capabilities through Initial Operational Capability (IOC).

O&S: These post-deployment activities follow the completion of the IOC.

To sustain the program's success over the lifecycle, the PM must understand and execute the key steps and the two lifecycle-spanning foundational activities: advocacy and applied SE (see Figure 3):

Advocacy: This refers to the underlying support from senior-level stakeholders for the program's existence from initiation to delivery of the required capability. Advocacy is used to shape, guide, and defend the program within existing competitive federal acquisitions environment.

Applied Systems Engineering: Developing and using sound SE practices by the government and contractor teams are important to the formulation, execution, delivery, and sustainment of required capabilities. Developing and applying these practices help the PMO to gain the critical technical knowledge required for program success.

Ten functional enablers support the successful execution of these steps (see Figure 3):

Contracting: Develop sound contracting strategies, plans, and execution methods that are appropriate for their acquisition circumstances.

Cost Estimation: Consistently and accurately estimating technical and programmatic costs is an essential practice for PMOs.

Domain Engineering: The engineering activities (e.g., software engineering, database engineering, network engineering, and hardware-related engineering such as radar, processors, and communication) that are used to develop specific capabilities or parts of a program, and are typical areas of program's cost and schedule growth.

Industry Considerations: PMs and their staff must understand the unique corporate cultures and motivations of their Industry partners, and leverage these differences rather than viewing them as sources of conflict.

Information Assurance (IA) and Certification and Accreditation (C&A): This highly specialized set of mandatory security processes that must be included in the system development and deployment lifecycle to protect the capability.

Interoperability: Emerging trends in the C4ISR and IT industries necessitate program strategies that embrace interoperability.

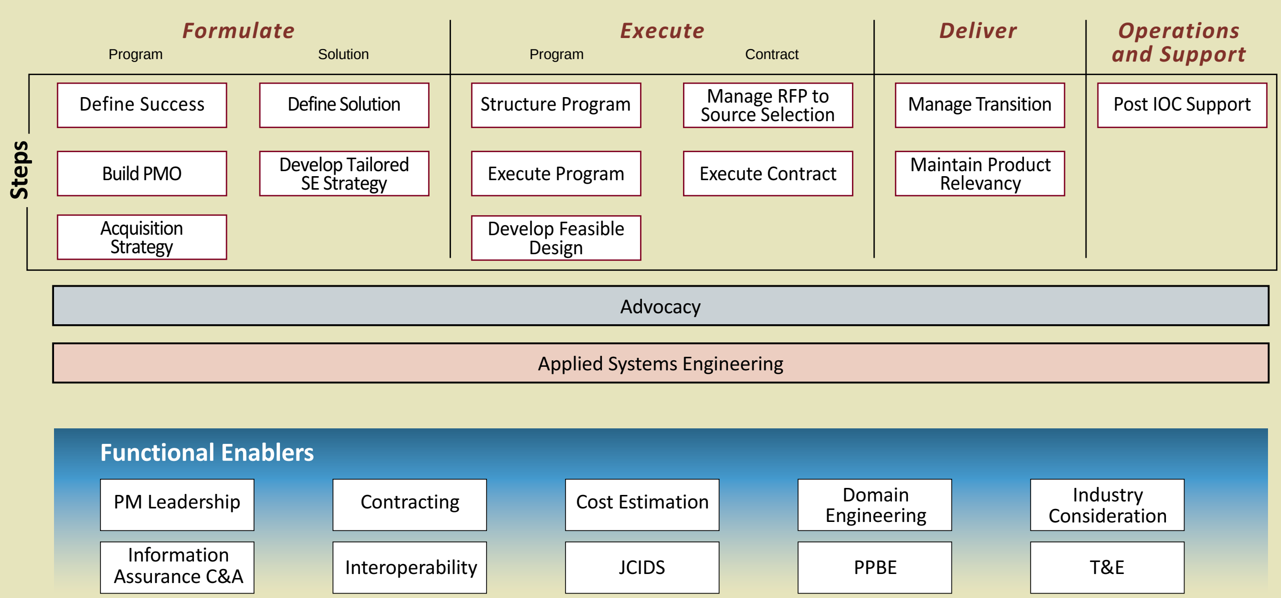
Joint Capabilities Integration and Development System (JCIDS): The DoD's operational capability needs generation process; programs face the challenge of creating acquisition and development strategies that fulfill joint requirements.

Planning, Programming, Budgeting, and Execution (PPBE): A critical DoD decision support system used in financially shaping a program's formulation and execution phases.

PM Leadership: A PM's success is measured by his or her ability to lead the formulation and execution of an acquisition program that results in delivering the required capability within the agreed-upon cost and schedule boundaries.

Test and Evaluation (T&E): T&E is an essential function that, when implemented correctly, enables a PM to deliver proven capabilities that meet the end user's requirements and continually improve the product throughout the lifecycle process.

> > > *Figure 3. Framework for Success: Key Steps in Program Lifecycle*



Summary

The MITRE-developed framework divided an acquisition program's lifecycle into four areas: formulation, execution, delivery, and O&S. For each area, the framework provides a set of critical activities (i.e., steps) and resources (i.e., the 10 functional enablers) required for the steps to be effective. The framework also provides additional activities (i.e., two continuous foundational activities) that span the lifecycle. For evolutionary acquisition programs, the framework is implemented in an incremental manner; the first iteration focuses on the end objective and the first increment, while the remaining increments are less well-defined.

Formulation and execution, which are the primary focus of this paper, are subdivided into two lower-level phases that extend across multiple lifecycle phases. The formulation activities: program and solution, include the early, critical tasks in a program's lifecycle that are the origins of a program's success. The three steps in program formulation: define success, establish PMO, and develop acquisition strategy, transition the warfighter/operator-expressed capabilities into a credible and executable program. The two steps in solution formulation: define solution and develop SE strategy, are the PMO's engineering activities, which develop the range of potential solutions, and their associated costs, schedules, and performance implications.

The execution activities: program and contract, originate with the PMO and stakeholders, bring in Industry (i.e., the contractors responsible for building and delivering the products), and continue throughout the program's lifecycle. Program execution contains three steps: structure the program, execute the program, and develop a feasible solution, that define a realistic stream of capability increments with realistic cost and schedule objectives based on PMO-conducted system architectures and designs, and that are supported by prototyping. The two steps under contract execution: manage Request for Proposal (RFP) to source selection and contract execution, establish firm, specific contract objectives and guide the contract's execution to ensure the on-time, on-cost delivery of a mission-effective capability to the warfighter or operator.

Delivery and O&S are the final lifecycle areas. The two steps under delivery: manage the transition and maintain product relevancy, ensure the program remains focused on delivering mission-effective capabilities to warfighters and operators. The approach recognizes O&S' dominant role in post-IOC support, which begins by applying sound SE practices upfront and continues through each milestone decision, program review, and the operational suitability testing period.

One of several acquisition resources available for PMs and CEs when constructing and running programs is this document, "Achieving Effective Results in Acquisition." Toolkits are another resource that can help a PM successfully formulate and execute a program. One such toolkit is the Defense Acquisition University's April 2008 Program Manager toolkit, Version 2.0, which is available on the Web. Although focused on the DoD acquisition environment, this toolkit can apply to a wide range of programs across the federal government.

SECTION THREE

Steps to Success

The Framework for Success (see Figure 3) depicts a series of activities (i.e., steps) that can help a program deliver the required capability within the agreed-upon cost and schedule parameters. The activities, which span the program's lifecycle, are assigned to one of the phases outlined in Section Two: program and solution formulation, program and contract execution, delivery, and O&S. The three steps under program formulation are: define success, develop acquisition strategy, and establish PMO. For each step, we provide a brief introduction and a set of suggested actions or helpful tips. This content structure is followed for the four areas: formulation, execution, delivery, and O&S.

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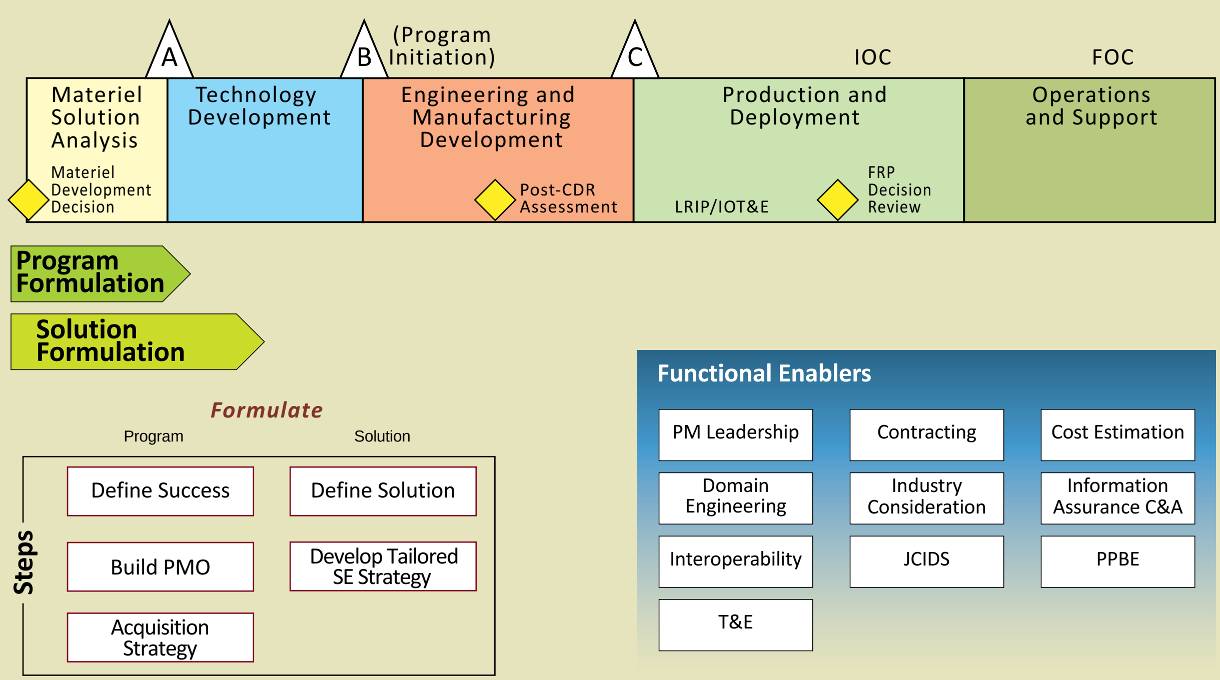
>>> ***Figure 4. Formulation Phase***



Two ownership principles are critical to the framework execution: the PM owning the program's outcome (i.e., assuming responsibility and accountability for the program's success) and the CE owning the program's technical outcome. The Framework for Success steps enable the PM and CE to gain the knowledge needed for a program's progress by making program advancements knowledge based, not acquisition documentation based. Emphasis is on the framework's early steps including the standup of a PMO and the PM/CE commitment to government-executed systems engineering tasks.

FORMULATION

The beginning of a new program is a result of significant effort on the part of three communities (see Figure 4); the operational or user community who needs the capability, the sponsoring community responsible for funding, and the acquisition community with the resources to deliver it. The first and most important step of an acquisition program is blending realistic capabilities into an affordable and achievable acquisition program. Transforming promises and desires into reality within a program's cost and schedule constraints is a difficult step. The path from a desired capability or need to a conceptual solution with a viable business case is the first major hurdle that a new acquisition effort must overcome. We divided formulation into two categories: a program, which establishes capability objectives, builds advocacy, and describes the way ahead; and a technical solution, which provides the first cut at what is achievable within the program's cost and schedule constraints. A program's capability and technical solution will undergo considerable refinement on the way to the go/no-go program decision milestone (i.e., MS B).

For evolutionary acquisition programs, the formulation phase develops the end objective and the associated incremental objectives with an emphasis on the first increment. The formulation phase is revisited for each follow-on increment until the program achieves the required capability.

An example of deviating from this framework is the following. An IT program PM decided to terminate the formulation phase prior to establishing good user requirements and solution definition. An imposed RFP release date became the program's main priority. This rush to the RFP—contract award stage—resulted in poor technical and programmatic knowledge required for a good RFP and contract execution. Subsequently, the contract execution encountered significant technical issues, which seriously eroded its user sponsorship and viability as a program.

Program Formulation

The PM shapes the acquisition initiative into a credible and executable program beginning with the capability needs expressed by the warfighter or operator. Capabilities are a defining element of this stage of a program; their value to users drives the program or causes it to die, due to lack of support or technical or financial infeasibility. The program-level cost estimate, which is based on the solution formulation effort, is generated in this phase. The desired characteristics of this estimate are realism, credibility, thoroughness, and defensibility. This phase is intended to define success, outline the way ahead required to acquire the capability (i.e., acquisition strategy), and build the staff. The iterative technology-push/requirement[2]-pull dynamics in a program's lifecycle will cause periodic refinements of these objectives. However, these initial approximations are critical to a program's success. To effectively establish the effort as a program[3], the following three actions needed are: Define Success, Build the PMO, and Acquisition Strategy.

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2 There are several types of requirements: operational/user requirements, system requirements, and derived requirements. The user develops Operational/User requirements; the PM/CE develops system requirements, which are usually contained in a Systems Requirements Document (SRD); and, the developing contractor develops derived requirements in response to the SRD.

3 For brevity, we use the term "program" to refer to the collection of efforts associated with this phase. For DoD programs, the effort will not be a POR until after MS B.

Define Success

Defining success involves developing a value proposition that focuses the SE and Analysis of Alternatives (AoA) activities on the program's key operational objectives. In the early stages, a program should develop and gain approval with a concise and relevant value proposition that defines what the program brings to the enterprise, how it provides utility in operational terms, when it will deliver the capabilities, and costs throughout the life-cycle. Developing a value proposition forces the PM to define value in operational terms that describe significant improvements over existing capabilities that the program can offer (i.e., differentiate the program from legacy capabilities as well as capabilities offered by other programs). After the value proposition is defined, the program uses it to drive the design, focus the program's efforts on supporting the value chain, terminate efforts that do not contribute to operational effectiveness, and solicit advocacy from enterprise leadership and end users.

Effective governance is an essential part of defining success. The PM and CE should start early to understand the department/agency governance objectives, by whom, for what purpose and through what process. They should also be familiar with the various oversight staff. These staff exists at several levels such as portfolio/capability level, funding sponsorship level, and enterprise or system-of-systems technical management levels.

If a Program Charter for the program does not exist, the PM should draft one that formally establishes the PM's chain of command stating who is authorized to issue program direction. The Program Charter should include the governance body roles, responsibilities, and reporting requirements. When developing essential governance documentation, such as a program charter, a governance structure, or oversight coordination approach, keep the written documentation succinct and specific. Do not include unresolved issues. The PM should have the governing documentation signed by the most-senior acquisition official and funding sponsors.

For programs with more than one resource/funding sponsor, an equitable funding share line is necessary at the onset of a program. The Program Charter should document the program's funding sources and sponsors' obligations. There must be a direct, traceable connection between the capabilities and funding required to support the equitable funding agreement. For a program requiring enterprise IT infrastructure support, the funding agreement should state each party's share of the cost for building or interfacing with the enterprise-wide infrastructure.

For enterprise level and system-of-systems programs, MITRE has two tools that assess a program's challenges from a broad perspective. These tools are: a Profiler that assesses the program from a system context, strategic context, stakeholder context, and implementation context; and Stakeholder Analysis that helps shape risk and increase program benefits to the stakeholders.

Build the PMO

Formulating the program and solution is a team effort. It demands a technically and managerially competent PMO staff that can quickly gain the programmatic and technical knowledge essential for success. With this information, the PMO develops essential technical and acquisition plans; constructs the program's integrated master schedule; determines external dependencies, risks, and critical path; and drafts key acquisition documents, which effectively constitute the program's business plan. The program's enduring foundation is shaped by the PMO staff from initial acquisition and solution formulation through program structure and feasible design to RFP requirements. Outcome of programs are largely determined by how well the PM and staff execute the formulate steps and execute program steps (see in Figure 3). The staff is expected to effectively engage in oversight and insight roles with its Industry counterparts.

Successful PMOs have been established. One example is a weapon system program team that implemented the content contained in this section. The Senior Acquisition Executive selected a technically competent and operationally experienced PM, and a chief engineer who is a recognized technical expert. These people built a culture that emphasized a disciplined management approach founded on honest communications of the technical facts, and teamwork among the PMO staff. The PM/CE chose people who exhibited these characteristics. This program enjoys continued success and has earned recognition from senior DoD leadership as an exemplar in acquisition.

In today's acquisition climate, finding and bringing such people into the PMO requires the following:

- Identify the PM early. An effective PM must have proven leadership skills, operational credibility,

proven program management experience, and knowledge of the required technical domain. The strengths of the supporting team, especially those of the CE and Deputy PM, must compensate for the PM's shortfalls.

- Establish the minimum essential staff, including a Deputy PM, CE, lead systems engineer, lead systems architect, budget and financial manager, and a warfighter/operator representative with proven success working on acquisition and engineering efforts.
- Arrange for dedicated support from a contracting officer, an Information Systems Security Engineer (ISSE), lead software systems engineer, selected domain engineers, logistics engineer, and test engineer.
- Limit the PMO staff to fewer than 50 personnel. Smaller program offices are more efficient in making decisions, and better equipped to react to changes with agility in decision making.
- Use National/DoD Laboratories, Federally Funded Research and Development Centers (FFRDCs), and System Engineering and Technical Assistance (SETA) contractors for tasks that require unique expertise that is not available within the PMO staff.
- Understand the support contractors' business models when using them to augment the PMO staff. Contractors' intentions are to serve the PM while growing their business; they often serve as the "eyes and ears" and agents of influence for their companies.
- Remember that at least half of the PMO's workload is ad hoc tasking. Account for this when developing staffing requirements or balancing the workload.
- Keep the same PM at least through the concept/materiel solution analysis phase and into the technology development phase implementation.
- Create a strong team by hand-picking key team members.
- Establish a mechanism to pull-in and shed staff, as needed. The PM and CE should have the authority to remove non-performing staff and return them to their previous positions.
- Acquire an independent set of experts with no vested interest in the program's outcome to advise the PMs and CEs on technology and programmatic issues, rapid prototyping and integration, and to validate risk and mitigations options.

Program formulation and execution is a continuous, dynamic environment that mandates a high level of vigilance by the PM, CE, and PMO staff for detecting early signs of trouble, considering appropriate response, and addressing the challenge. A healthy state of vigilance is achieved and maintained by answering the following questions.[4]

- Has the program maintained alignment between user requirements and its incremental development/delivery approach?
- What is the program's critical path? Does the program plan and integrated master schedule track to this critical path?
- Has the program established a technology needs/capability roadmap with its Science and Technology (S&T) community?
- Does the current program's cost estimate match its authorized budget/financial plan?

4 The Air Force Acquisition Reform Newsletter, "Agile Acquisition, Ten (Plus) Questions You Need To Ask," October 2004.

- Do the current and future budgets adequately fund the PMO staff including external experts/consultants?
- Has the program included historical program tax in its budget?
- Is the program meeting its obligation and expenditure rates?
- How well is the operational test community integrated into the program activities?
- What percentage of software reuse is the program planning on using? A high percentage increases risk.
- Does an attitude exist in the PMO staff to "I'll worry about that after contract award"?

Acquisition Strategy

The acquisition strategy establishes how capabilities that the program has identified will be acquired, and how they will be supported throughout the lifecycle, from development to operations. Developing the acquisition strategy is an iterative effort that is best led by the PM with participation from the PM's staff leads and the contracting officer. ***An acquisition strategy is more than a contracting strategy; it is a means to deal with uncertainty (e.g., to pursue enterprise opportunities and mitigate the program's risks).***

The PM should use the acquisition strategy development efforts as a top-level framework to shape the program.

Working in collaboration with the program's stakeholders, the PM will determine: capability versus technology implementation/limitations match; enterprise opportunities; risk reduction and competitive prototyping/preliminary design efforts; the development and deployment approach (single or multiple); technology insertion considerations; enterprise interoperability implications; external interdependencies with other programs and capabilities; minimal logistics; training and personnel impacts; affordability/Total Ownership Cost (TOC) objectives; Program Objective Memorandum (POM) Fiscal Year profiles; and the roles and responsibilities of government and Industry (e.g., the contract's strategy).

The acquisition strategies for IT programs may vary from the acquisition strategies for weapon systems programs. For IT programs, one significant difference is the application of many small development efforts rather than the single monolithic development approach that is common in some prototyping or system development efforts. The distributed approach (i.e., many small, concurrent development efforts that require integration into an increment's capability solution) appeals to a broader set of stakeholders and demonstrates smaller but genuine progress. Rapid results can be achieved by a program's ability to identify non-productive or non-value-added efforts earlier, and eliminate them with minimal disruption to the overall effort. The distributed approach provides stakeholders with more options than the "all or nothing" option of a single major development effort.

> > > ***Figure 5. Lifecycle Phases Criticality***

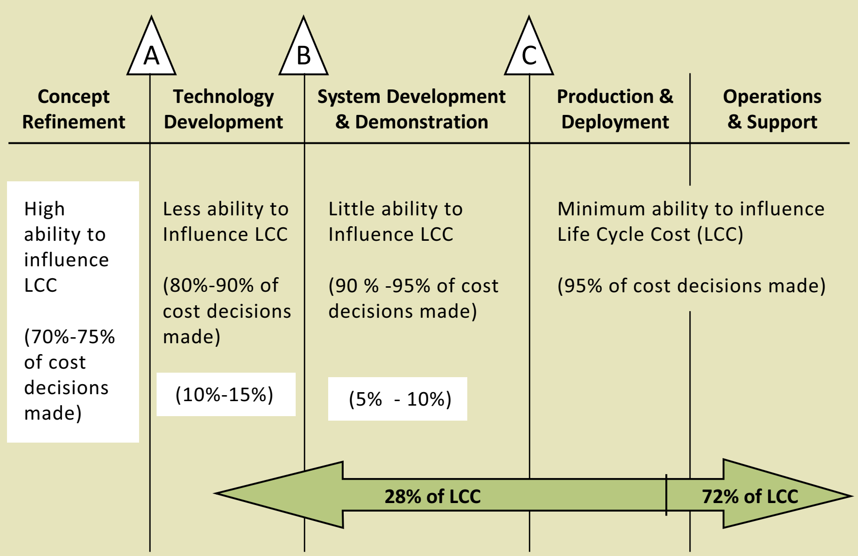


Chart from NAS Pre MS A & early Phase SE Report dated 2008

Successful action steps for an acquisition strategy include:

- Take an enterprise view of where, how, when, and why the program fits the Military Service's or federal agency's portfolio of legacy and future capabilities.
- Refrain from outsourcing efforts to develop the acquisition strategy. Strategy development should be ***led by the PM,*** with support from the CE and FFRDC/ National Laboratories, rather than a third party who lacks an intimate understanding of the program and might have conflicting interests.
- Keep the end objective in mind and focus on the development efforts required to deliver them.
- Align the acquisition strategy with the SE strategy, and delineate the SE roles of government and contractors, which are different.
- Use incremental strategies to keep pace with changing requirements and technologies.
- Recognize that the ***government is always the integrator;*** the government ultimately retains full responsibility for the program's success.
- Understand how Industry and contractor cultures can impact a program; use this knowledge to work effectively with them and avoid repeating mistakes.

Solution Formulation

A successful program is built upon a solid technical foundation that is developed through the PMO's engineering activities, resulting in understanding the range of potential solutions and their associated cost, schedule, and performance implications. This is the first significant step toward gaining the critical technical knowledge required for a program's success; it is the basis for future development efforts (see Figure 3). Solution formulation starts in the concept phase and continues in the technology development phase. For a DoD program, the AoA is a good starting point for solution formulation. To commence technology development, the PM needs a Concept of Operations (CONOPS) and a ***high-level system design*** to support a decision milestone (i.e., MS A). These government responsibilities can be supported by Industry.

Solution formulation is acquisition sensitive; it ***must be done by the PMO*** with assistance from National/DoD Laboratories or FFRDCs. While there must be extensive dialog with Industry and investigations of technologies, business models, and costs, the PM must separate the solution formulation effort from Industry to avoid a competitor or team capturing the capability. The technical architecture[5] for the solution should be developed and maintained by the PMO. This will allow for continuing competitive evolution and rapid iterative development of the system without proprietary lock-in or artificial constraints.

For IT programs, the solution formulation must consider the enterprise IT infrastructure it will 'ride-on.' This enterprise IT infrastructure should offer an agile, interoperable foundation for Command and Control (C2) systems featuring net-addressable connectivity, a shared data architecture and data-access subsystem, and, in some cases, shared processing hardware. This will reduce the impact of unpredictable changes from other systems. Ideally, this enterprise IT infrastructure would be based on government-owned enterprise architecture.

Define the Solution

The solution(s) must represent the SE translation of the operational requirements and CONOPS into a high-level system design with estimates for the required technology (i.e., hardware and software) implementation. Defining the solution(s) for an evolutionary development requires identifying a series of escalating capabilities and the associated Critical Technology Elements (CTEs) that will achieve the desired operational outcomes. The PMO team ***must understand and focus on the minimum required operational capabilities,*** regardless of the breath of possible operational capabilities that excite the end users. The solution(s) informs the follow-on technology development efforts to mature identified CTEs, reduce risks, and conduct prototyping in context with an overall system concept. With a solution and CONOPS in hand, the PMO has the understanding required to generate preliminary system requirements and program-level cost estimates. For evolutionary acquisitions, the PMO addresses the end objective and first increment solutions. Subsequent increments would focus on their increment solution, which

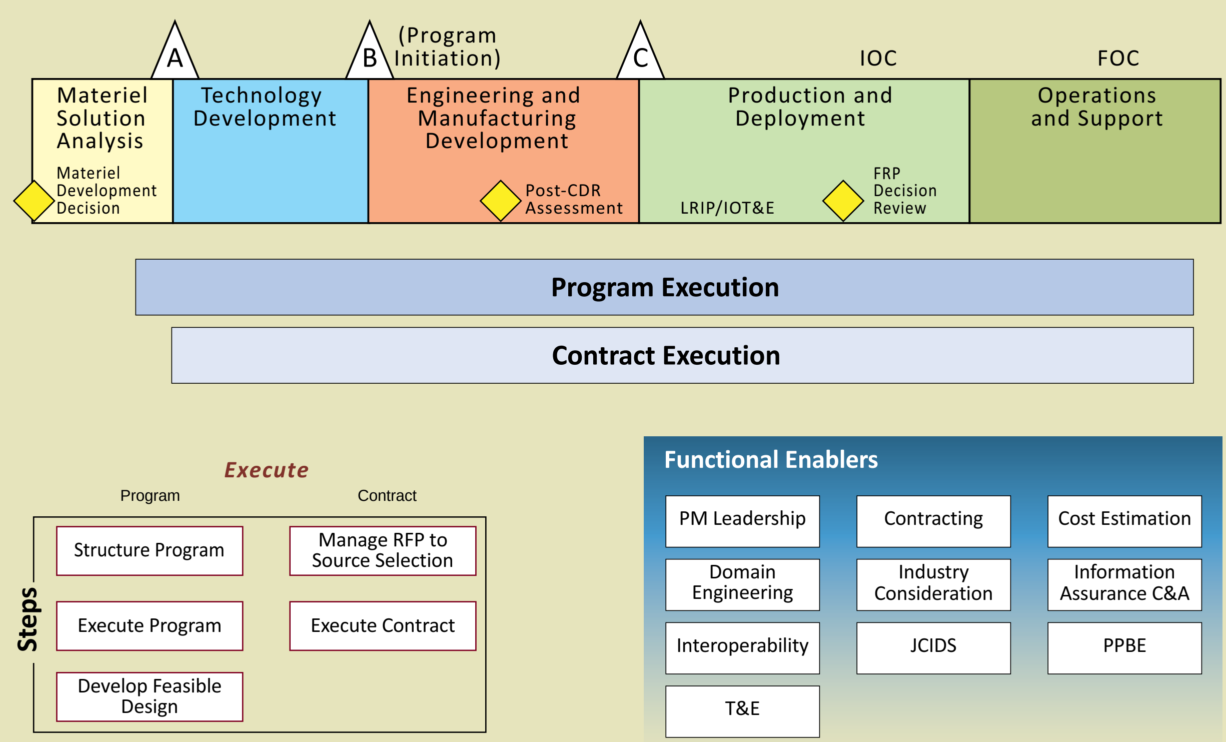
5 A system's technical architecture is the actual structure of a system. It consists of its elements or components including external interfaces, the functional and performance properties of these elements, and the relationships among them. This architecture needs to support the system's requirements including user needs. During system development, the architecture typically evolves in terms of content and detail as the system solution matures.

includes revisiting the end-objective solution implications. An example of a lesson learned is an advanced system PM who selected Industry to define the solution, rather than the government. Industry was awarded several multi-million dollars study contracts for paper solutions. The winning solution was used to structure a large technology risk reduction and prototype effort. Industry, not the PM and staff, controlled the program's future from the study phase forward. After spending tens of millions dollars, the program was cancelled.

Successful actions for defining a solution include:

- ***"Get real at the outset."*** The PMO's team, especially the design engineers, should participate in actual exercises and field operations before designing the solution(s).
- Include the ***warfighters and operators*** in efforts to develop the solution(s).
- Ensure the solution(s) is comprehensive and sufficiently defined to support generating initial program cost estimates, including operations and support elements.
- Conduct a CE-led, system level, design review and ***verify that the system contains the performance and functional attributes*** required by the operational capabilities and the required technology.
- Understand that defining the solution(s) is an iterative SE activity that requires an experienced team of architects and functional experts from the relevant domains.
- Break the solution(s) concept into architectural constructs that are unlikely to change (e.g., Internet Protocol Version 6 in C4ISR and business IT systems) and leave developmental areas loosely specified for future iterative optimization.
- Embrace interoperability and include the required enterprise interfaces as part of the solution.
- Be cognizant of enterprise opportunities that might be pursued with a reasonable expenditure of resources in a continual planning effort; avoid being too enamored with the presently chosen development path.
- Preserve design options to avoid premature technology lock-in.
- Focus on technical risks; they are key objectives for the technology development phase.
- Develop a high-fidelity definition of technical and program risks while developing the solution(s) definition.

> > > ***Figure 6. Execution Phase***



- Employ simple modeling and simulation tools to identify and mitigate risks.

Develop a Tailored SE Strategy

Without sound SE practices that are understood and led by the government, a program is unlikely to succeed. The SE strategy defines the overall technical approach, including elements such as CTE risk reduction, prototyping, and competing preliminary designs; and the timing and content of the delivered capabilities. It should identify the minimum essential SE processes and techniques tailored to the program's unique needs, including its enterprise or system-of-systems implications. Figure 5 emphasizes the need for, and the benefits derived from, applying a tailored SE approach early in a program's lifecycle. For example, a C2 program ignored this step. It lacked understanding of the technology risks and their relationship to key program capabilities. As a result, the program was severely impaired in conducting technology development. This undermined the program's ability to deliver useful products.

The actions required to develop a successful tailored SE strategy include the following:

- Determine the degree of opportunity and technical risk the program is willing to take into system development.
- Shrink the size and scope of development efforts, and define manageable execution increments so that requirements do not change faster than the capabilities are developed.
- Focus on delivering capabilities that use processes, rather than focusing on building new processes.
- Structure the strategy to verify the challenging functional and performance areas as early as possible.
- Create a robust performance engineering plan that ensures performance is considered at the component and system levels in the requirements, design, and testing phases.
- Make T&E a key component of the SE strategy. To prevent future failures, use it in a ***"test to fail"*** approach for determining where, when, and why the system fails, rather than a ***"test to pass"*** approach, which may take the least risky path through testing. Engage the operational test community at the formulation phase.
- Recognize the importance of IA and C&A when planning the upfront SE activities.
- Use Technology Readiness Levels (TRLs) to benchmark the program's critical technologies.
- Employ "fly-offs" (i.e., competing prototyping efforts) to reduce risks and determine achievable performance objectives.
- Balance SE control functions to minimize overhead and allow for efficient decisions. Determine the minimum processes required for requirements management, configuration management, data management, engineering reviews, change control, and opportunity and risk management efforts.
- Use smaller development efforts to isolate high-risk developments so they do not impact the overall program.
- Use the government's S&T base to solve the most difficult problems (i.e., fund S&T efforts as contractors and subsystems). Develop an approach for inserting S&T-developed solutions into the contractor's ongoing work effort.
- Seek honest external validation of the PMO's internal TRL assessments.
- Use the technology development phase to mature CTEs with a TRL of less than six.

EXECUTION

The execution phase involves implementing the program's strategic planning and solution definition efforts that result in delivering capability to the warfighter or operator. Execution originates with the PMO, brings in Industry to build and deliver the products, and continues throughout the program's lifecycle. Implementing the key program success steps (see Figure 3) is the responsibility of the PM and CE. Every step is important and demands the highest levels of leadership and management from the PM and CE, and superior performance from the PMO. The 10 functional enablers and two foundational activities are critical to the program's success.

Execution is divided into two categories: program execution and contract execution (see Figure 6). Program execution focuses on establishing a realistic stream of capability increments with firm cost and schedule objectives based on PMO-developed system architectures and designs. Contract execution focuses on Industry's role in delivering the capability, beginning with the PMO establishing firm, specific, contract objectives (e.g., having a competitive environment throughout the lifecycle) through the RFPs, source selection process, and contract execution for on-time, on-cost delivery of mission-effective capability. For evolutionary acquisition programs, the PMO addresses the end objective and its first increment in the execution phase. For subsequent increments, the execution phase's steps focus on the increment and its implications on the program's end objective and follow-on increments.

Program Execution

Under program execution, the structure and execute sections build upon the knowledge gained from the foundation established in the formulation activities. Structuring a program uses the stakeholder's objectives, the technology's reality, and the SE development approach to produce a program plan that outlines the way forward. The program's end objective, evolutionary acquisition approach and increments are considered and defined along with resource estimates. Implementation of the program's way forward is done in the program execution section with emphasis on the near-term increments. Program execution commences with technology development activities and continues until the capabilities are delivered to the operators. The third section under program execution, feasible design, is its own section, due to its importance in successful programs. In the ***feasible design step***, the PMO gains significant technical understanding and SE insight, which are ***mandatory to successfully execute a program.***

Structure the Program

Defining a program with realistic objectives that are within the PM's span of control is key to enabling rapid outcomes in acquisitions. The program's structure should recognize dependencies with other systems and programs, avoiding excessive external programmatic dependencies. For IT programs, the Solution Formulation (refer to page 15) addresses an enterprise IT infrastructure approach that minimizes dependency impact to the program. Thus, the program reacts to one dominant external dependency, the enterprise IT infrastructure, rather than changes coming from multiple individual programs. Oversight staffs are another source for identifying and mitigating potential conflicts at the program and system level (refer to "Define Success," page 12).

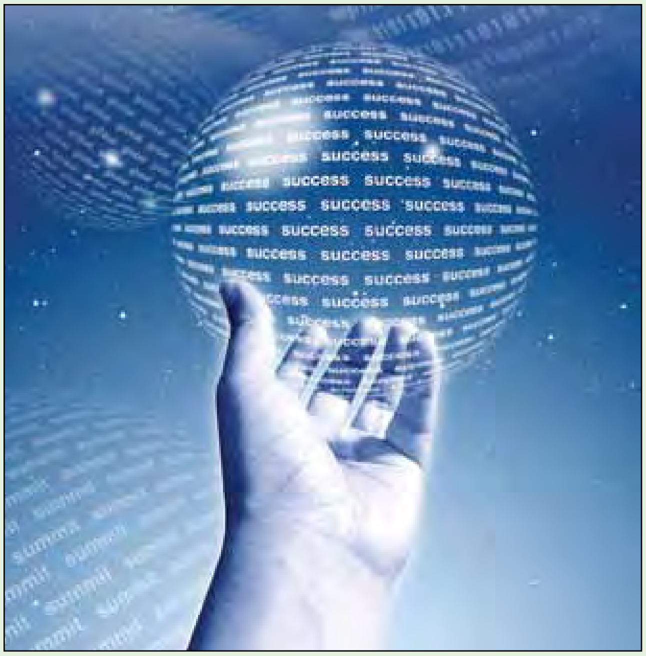
For many IT programs, and possibly parts of weapon systems programs, the concept of ***"think big, start small, scale fast"*** is essential to the program's success. Partition the program into a rapidly executed series of developments and deployments rather than classical waterfall development with an IOC of a massive set of capabilities. This should allow the PM to execute within the Observe-Orient–Decide-Act (OODA) loop of oversight. It also allows the PM to effectively manage cost including terminating efforts that encounter cost, schedule, or performance problems. Thus, the PM builds trust with the oversight authorities as they see effective program execution in each subsequent spiral.

When a program has more than one funding sponsor, the PM must recognize that the sponsors 'vote' with their dollars. The PM must structure each increment/spiral to emphasize capabilities aligned with one or more funding sources. The funding sponsors would then recognize the benefit and contribute to their portion of the program. The overall sequence of capability deliveries could be structured to meet the most critical needs of each sponsor.

External program interactions should be managed to minimize outside distractions to the internal technical team. The PM should use Memorandums of Agreements/ Understandings (MOA/MOU) and Service Level Agreements (SLAs), when necessary, to establish formal dependency requirements and commitments between programs.

Developing a program's structure is a dynamic activity that must keep pace with ongoing technology developments, engineering activities, and the participation of stakeholders. Successful action steps to structure a program include:

- Work with the agency or department's resource and requirements sponsors to establish a ***match*** between the desired ***capabilities***, the likely ***available funding***, and the ***technology's maturity***.
- Continue refining program-level lifecycle cost estimations that are conservative and supported by SE team engineering justification. Avoid using optimistic cost factors in developing budget estimates.
- Understand the sponsors' requirements, resources, and tolerance for risk and structure accordingly.
- Employ MOAs/MOUs and SLAs to define inter-program critical dependencies and obligations between



programs. Expect a funding obligation to be an integral part of the MOA/MOUs and SLAs.

- Avoid budget-driven program churn and stretch-outs. For DoD programs, ***fence POM and Future Years Defense Program funding as a condition for proceeding past MS B.*** The PM must broker this agreement with the Program Executive Officer (PEO) and Service Acquisition Executive.
- Establish the program's objective capability and the increments to achieve the objective.
- Include the operational test and C&A communities early to ensure clarity on schedules and capability expectations.
- Build in "do or die" capability increments that include firm dates and costs.
- Each capability increment should be approximately 20 percent of the objective requirement set. The most important requirements for operational outcome should come first; the less important capabilities should be added later, if possible.
- Highlight success in delivering capability increments to help ensure future funding commitments (i.e., encourage rewarding results that support the program objectives).
- Develop an approach for incorporating breakthrough technologies or emerging technology demonstration capabilities within the program. Include mitigation plans and alternative fall back plans if emerging capabilities fail to meet expectations.
- Understand that changes will occur and be prepared with a Plan B.
- Work with the stakeholders to develop and maintain balanced program expectations and a value proposition for the program (refer to "Define Success," page 12).
- Construct a program plan that gives the PM confidence in achieving the program's objective. Base the plan on solid technical knowledge obtained during the define solution and feasible design steps.
- Establish an S&T network (e.g., National/DoD Laboratories, FFRDCs, universities, and Industry) related to the technologies used by the program.
- Leverage the DoD's Joint Capability Technology Development (JCTD) community for technology infusion and transition.
- Develop a system development plan that realistically ensures meeting or exceeding the Acquisition Program Baseline's (APB) thresholds.

Execute the Program

Moving a program toward delivering a stream of escalating capabilities over reasonable timelines and costs requires specific directed actions. It begins with engineering to better understand the technologies and their applications, and includes the programmatic activities taken by the PMO to develop and deliver the capabilities. Actions taken in this and other steps, such as developing a feasible design (refer to "Develop a Feasible Design," page 20), provide the PM with a solid programmatic and technical baseline for proceeding. When changes occur to program objectives, such as available funding or emerging technologies/user needs, the PM/CE has the knowledge, insight, and trained staff to adapt to these conditions. Courses of actions, implementation plans, cost and schedule implications, and effects on program objectives are assessed and determined based on facts and a baseline. In carrying out a disciplined programmatic and systems engineering approach, the PM has an agile OODA execution capability.

An example of doing this step correctly is an advanced sensor program that had the PM, CE, and staff (described on page 12 "Build the PMO"). They thoroughly understood the required capability and what it took to deliver it. Programmatic and technical baselines were established and used by the PM/CE. When technical, testing, contract or programmatic problems arose, the PMO effectively overcame them. The program achieved a successful operational evaluation that was on time and within budget. This PMO lived by many of the action steps listed below.

Successful action steps for executing a program include:

- Making the near-term goal the successful execution of a program's next phase rather than completing a MS decision review.
- Focusing on gaining technical and programmatic knowledge and understanding before generating the mandatory documentation.
- Having a ***dedicated PMO SE team*** responsible for working the solution space from definition to delivery.
- ***Taking technical risks early*** and using operationally relevant environments. Learn from the failures.
- Conducting cost-benefit trades in collaboration with the stakeholders/end users for program continuation when 80 percent of the required capabilities have been delivered.
- Structuring external interactions by the PM assuming the "outward facing" role to socialize a program through the agency or department, while the Deputy PM manages the program's internal activities.
- Dedicating at least one senior PMO individual to act as a liaison with stakeholders and oversight staff.
- Having the Procurement Contracting Officer (PCO) work directly with the PM who provides input to the PCO's annual performance assessment.
- Committing to achievable goals that are backed by a realistic understanding of cost, schedule, and capability performance. A program that loses credibility is unlikely to regain it.
- Leveraging the PEO, or the agency or department equivalent, to insulate the program from external "what if" drills and potential sources of requirements creep.
- Understanding the business rhythm of the agency or department, and being responsive to it.
- Establishing the program's configuration control board and engineering review board early to manage the inevitable requirements and engineering changes. Get inside the "OODA loop" of such changes by defining rapid spirals, whenever possible.
- Establishing bi-monthly or quarterly PMO-led program reviews for the PM and CE that focus on all program activities (e.g., Developmental Testing/Operational Testing [DT/OT], training, logistics and deployment, deployed capabilities, emerging requirements and technologies, opportunities and risks, future acquisition efforts, etc.) rather than focusing on ongoing contracts.
- Developing and executing an outreach or communications plan to keep the major stakeholders informed of the program's status.

Develop a Feasible Design

Developing a feasible design[6] is critical to executing the program. The PMO must use information from Industry, the results from prototyping efforts and CTE risk reduction efforts, National/DoD Laboratories and FFRDCs, and its own engineering experience to develop a feasible system-level design. The insight gained from wrestling with the technology to meet the functional and performance requirements is invaluable to the program's success. The PM uses this knowledge to state what the technical response to the end user's requirements looks like, what it will cost, and how long it will take to deliver the capability.

With a feasible design in hand, the PMO can generate a realistic and defendable program-level cost estimate for developing, delivering, operating, and maintaining the required capability at a cost estimation fidelity required by oversight organizations. Working together, the PM and user can rationally shape end user capabilities that are technically achievable along with decision-quality cost and schedule information. Additionally, the PM can

6 Feasible design is a government-developed system design that includes subsystem and component levels with defined hardware and software implementations and external interfaces. A feasible design verifies that the user's needs can be satisfied in a technical solution. It is based on the architecture developed in the Define Solution step. Design fidelity supports a system requirements review, and is the technical baseline for developing a Cost Analysis Requirements Document (CARD) quality program cost estimate.

confidently propose the program's APB as well as shape key parts of the RFP. A feasible design represents the requisite engineering knowledge required for a successful system development phase (i.e., the Engineering and Manufacturing Development phase for the DoD).

An example of a PMO-produced feasible design is the advanced sensor program as discussed on page 19. The CE formed a dedicated, experienced PMO SE team. This team had access to existing prototype engineering information, preliminary system requirements, and operationally relevant test results. A disciplined engineering approach and work plan was implemented. In-progress reviews were conducted by the PM/CE. The completed feasible design validated the program's cost estimate, which was a large, unfunded request. The program went forward and achieved its IOC.

Successful action steps to develop a feasible design include:

- Having the CE or lead SE lead the development efforts.
- ***Limiting the top-level system requirements*** to a manageable number (e.g., 50) of verifiable system-level requirements.
- Ensuring the feasible design has its CTEs at a TRL of six or better (e.g., a CTE that has demonstrated required functional or performance outputs in a relevant environment).
- Validating operational and technical feasibility through mission, functional, and data thread analysis.
- Remembering that a feasible design is neither a reference model, nor is it intended that Industry builds to that design.
- Executing tailored SE practices, which include the "ilities" (e.g. availability, reliability, and maintainability).
- Understand that the DoD Architectural Framework is useful for establishing program-to-program information exchanges and for developing the operational perspective (but not as a design tool).

Contract Execution

Industry is frequently employed to turn a program's requirements into capabilities or to obtain services for the program's execution. National/DoD Laboratories and FFRDCs also are used to conduct rapid prototyping. Obtaining qualified contracting support is critical early in a program's lifecycle. Contract actions could start with Industry prototyping critical technologies or carrying out risk-reduction efforts during the technology development phase. They could also begin in the concept/materiel solution phase with Industry performing trade studies on potential system concepts. For IT programs, conducting multiple small development efforts will increase the number of contractual actions planned for and executed during an IT program's life. Using Government-Wide Acquisition Contracts, Multiple Agency Contracts, and General Services Administration schedules can simplify the process and reduce length of the development effort.

The government and Industry play important roles; the PCO and PM state what is needed, and Industry responds by describing how it will meet that need (i.e., how it can build the capability, the anticipated costs, and when the capability can be delivered). After a contract or task order has been awarded, the PMO oversees the contract's execution, which is a complex task. Through the contracting officer, the government enters into a legal contract, governed by law and regulations, with many interested parties monitoring progress. Starting with drafting the RFP and ending with the contract's execution, the success of Industry delivering what the end user needs requires a team effort, which includes the PMO, contractors, stakeholders, and end users. However, the ***key characteristics*** of the desired contract demand a ***series of rapid capability deliveries, and allow the work to be redirected to other vendors at the discretion of the government.*** This acquisition strategy changes the focus of Industry from "win the contract" to "deliver the product." Contract execution is subdivided into two parts: manage RFP to source selection and execution.

Manage RFP to Source Selection

A source selection is an infrequent occurrence for most programs, which makes it difficult to do without external expertise. Finding and acquiring a capable, suitable Industry partner is essential to achieving effective results. Source selection directly benefits from the outcomes of the formulation and program execution phases. The PMO, now armed with well-vetted operational capabilities, technical knowledge from its engineering efforts, and a draft or final version of the acquisition strategy, can craft an effective RFP. The PCO, PM, and CE are key leaders in constructing a draft of the RFP. The PMO SE's team technical knowledge makes them invaluable to the technical portion of the source selection evaluation. Similarly, the cost and schedule knowledge that was gained from developing the feasible design supports the cost proposal evaluation.

Successful action steps for RFP to source selection include:

RFP

- Find a PCO who is ***experienced, creative***, works well with the PM, and who will become part of the solution rather than an obstacle. The ***PM should be authorized to choose the PCO*** and, if required, return the PCO to his or her "owning" organization.
- ***Multiple awards*** that place ***multiple contractors*** in an "active" status are likely to produce contract teams consisting of the key personnel whose management is committed to excellence.
- Involve Industry in drafting the RFP including contract and incentive structures. For a good RFP, if the government does not know, do not make it up (i.e., ask Industry).
- Emphasize the need for good SE practices; require credible and realistic contractor-developed Integrated Master Plan (IMP) and Integrated Master Schedule (IMS).
- Maximize the Award Fee/Incentive Fee (AF/IF) to motivate superior performance, emphasizing the capabilities delivered, not compliance with process.
- Ensure the prime contractor understands that AF determination will be based on total performance. The contractor must be held to the requirements of the award fee plan.
- Ensure the PCO ***protects the government's data rights*** with the proper data rights clauses and intellectual property data rights (e.g., rights to protect the design, software, architecture, patents, and technology).
- Limit the RFP's Contract Data Requirements Lists (CDRLs) by making each CDRL serve a critical need (i.e., delivering high-value and intellectual property to the government).

Source Selection

- Require that source selection teams establish their evaluation plan and procedures, prior to issuance of the RFP.
- Use an Acquisition Center of Excellence facility and select experienced team leads to head the source selection teams. These steps will aid in defending against contract award protests.
- During orals, permit pertinent questions that relate to the presentation. The question and answer session will reveal another side of the team's character and ability.
- Use "gray beards" for visits to contractor facilities to gain insight on existing capabilities and expertise.
- Employ Software (SW) design exercises to gauge if a contractor can perform the required technical work.
- Perform SE process audits on the specific teams bid to do the work as a reality check of proposed versus actual capability.
- Recognize that the cost's Basis of Estimate (BOE) and the IMS are very important; the source selection team must assess BOE validity and IMS credibility.
- Focus the source selection criteria on critical factors, and remind the evaluators not to be misled by unsubstantiated proposal claims.

Contract Execution

Working the relationships between the PM, PCO, and prime contractor is key to effectively executing the contract. Effective and rapid results are possible when the contractor is treated like a partner in a non-adversarial arrangement. The PM must balance the minimum amount of contract controls with the ability to recognize and take proactive corrective actions when efforts begin to fall off plan. There are a number of successful PMO–Contractor partnerships examples. These successes can be traced to the leadership qualities of the government and contractor PMs, PCO support, and technical expertise resident within the PMO staff.

For example, an unmanned air vehicle program made partnership a key program execution objective. The PM actively recruited experienced, proven technical experts for the PMO. This technically competent staff, through frequent on-site engagements with their Industry counterparts, formed individual informal partnerships. When problems arose, the PMO staff became part of the solution. The PM-to-PM communication benefited from these partnerships as both sides had similar views of the situation and options. The program achieved considerable success including formal recognition of excellence by an industry association.

Successful action steps for contract execution include the following:

- Have a PCO who is willing to encourage procurement innovation, and ***take informed and controlled risks***.
- Maintain the contractor's focus on the end-to-end performance and interfaces. It is easy to lose effectiveness and performance by sub-optimizing efforts around subsystem performance.
- Recognize that the ***contractor will measure the PMO team's quality*** (i.e., skills, relevant experience, and work ethics) early into the contract execution phase, and will ***adjust the contractor-provided team accordingly***.
- Establish the PMO's oversight and insight engagement plan.
- Characterize government- and contractor-proposed contract initiatives as "not allowed by the Federal Acquisition Regulations (FAR)," "possible under the FAR," or "no FAR issues." Explore using "possible under the FAR" initiatives for maximum contract execution flexibility.
- Establish and execute an effective AF plan to motivate the contractor in areas that are beneficial to the program's overall outcome. Avoid a plan that focuses on the current problem of the quarter. ***Designate the PM as the fee determining official***.
- Use gates/technical reviews to measure progress and readiness to proceed. Avoid using schedules as the reason for continuing forward.
- Define the roles and responsibilities of the PMO's "plant rep" (if used) to avoid "going native."
- Insist that contractors produce well-engineered documents that are clear, concise, and understandable.
- AFs must be linked to firm measures of the program's success (e.g., actions required for achieving technical performance metrics or contract performance objectives). Institute timely periodic contractor feedback to avoid surprises at AF time.
- ***Contract start is crucial***; the first 15 percent of the contract's effort, as measured by cost and schedule, sets the likely outcome for the contract's performance.
- Know the critical path, risks, and dependencies internal to the program and contract, and external to the program.
- Recognize the importance of using an Integrated Baseline Review as an indicator of the quality of the contractors' SE abilities.
- Use a systems integration laboratory. Plan for integration and testing as it requires dedicated engineering effort.

- Establish a specification tree and technical baseline controls.
- Include Defense Contract Management Agency (DCMA) plant representatives, including the Administrative Contracting Officer (ACO), and a quality assurance cadre as members of the PM's extended program staff.
- Invite end users and operational testers to attend contractor reviews.
- Balance the program's government furnished equipment (GFE) and government furnished information (GFI) requirements against what the contractor is responsible for providing.
- Invest PMO management efforts on GFE/GFI, and avoid making this a source of contractor reason for schedule growth.
- Develop a good estimate of the GFI/contractor test data requirements early in the contract execution process.

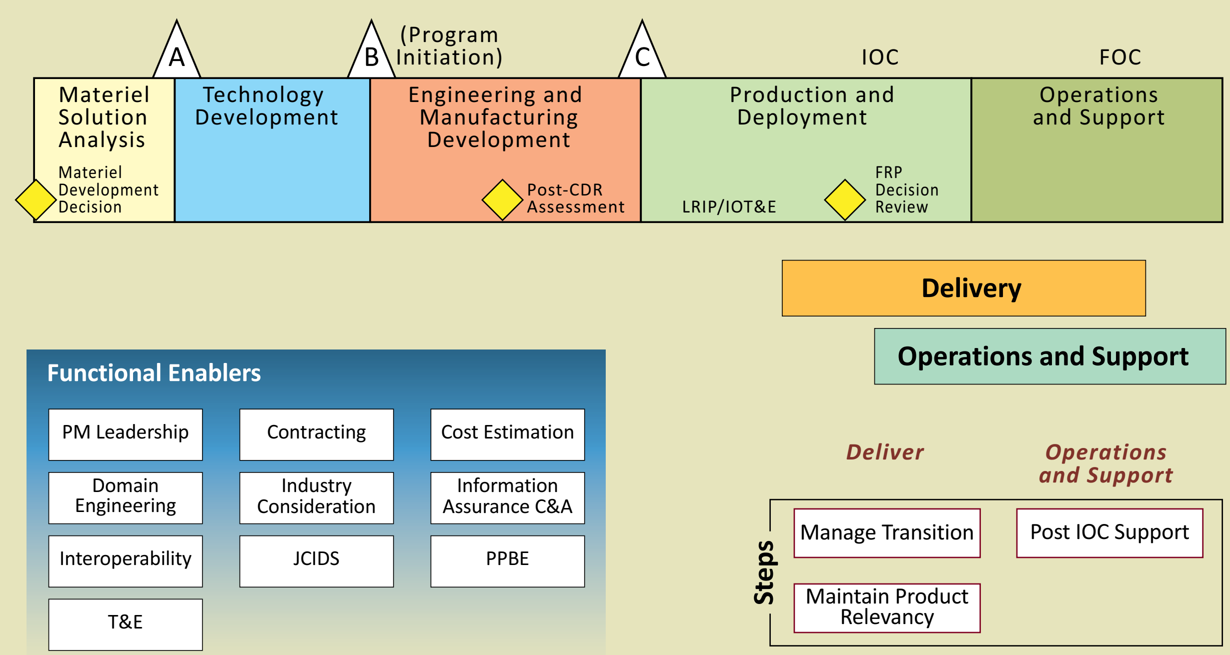
The PMO staff has two distinct contract execution roles. One is oversight that is focused on the quality of products or services that the contractor is obligated to provide. The other is insight, where the government is seeking an in-depth understanding of what is/is not progressing well within the contract or what may be an emerging problem. When the insight role is done well, an informal working-level partnership is created. Knowledge and expertise is shared between both sides for achieving common goals. Oversight and insight roles benefit from using established leading indicators in six critical areas:[7] requirements definition; design maturity; subcontract management; test and evaluation/verification and validation; manufacturing; and sustainment. Included in these six areas are items such as: technical and program baselines' requirements stability; signed versus planned subcontracts; actual versus planned engineering labor hours; actual versus planned technical performance measures with trend assessment; earned value management system trends and assessment; approved versus planned specification and design documentation; actual versus planned closure of design review actions; delivered versus planned hardware and software products, and planned versus actual verification and validation activities.

DELIVERY

A program's objective is to deliver the agreed upon capabilities to the warfighter or operators (see Figure 7). If delivery is delayed, over cost, misguided, or the capability

[7] Extracted from "Guidance for Use of Robust Systems Engineering in Air Force Programs," August 2004.

> > > ***Figure 7. Delivery and O&S Phases***



is unable to interoperate within the end user's enterprise, the program is considered unsuccessful. To avoid interruptions in operations or interoperability shortfalls, programs must ensure the transition from the legacy system to the delivered capability is methodically planned and executed. Success characteristics regarding delivery are described below.

Manage the Transition

To fit a program-delivered capability into the enterprise, legacy systems must be synergistic with the new capability or be displaced by it. In either case, a program will need the support of the key individuals in O&S and sustainment organizations to plan and execute the transition.

Successful action steps for managing the transition include:

- Begin early and make transition planning a deliberate activity in the life of a program. Transition planning should be refined at each major MS decision point and capability increment.
- Reflect the transition in SE, RFP/contract award, and logistics activities.
- For DoD programs, make the transition objectives testable under operational conditions to gauge suitability.
- Identify funding and the organizations responsible for each part of an increment's transition plan.

Maintain Product Relevancy

Several approaches to keep a program relevant and valuable to the end user are based on emerging end user requirements or capabilities of new technologies. A program's incremental or spiral approach is a natural way to handle this situation. Another approach is to preplan a continuing series of product improvements to fielded capabilities. The key is to plan for capability improvements within a program's acquisition strategy/program plan, and to establish a PMO home for handling and executing unplanned options for emerging capabilities.

Successful action steps for maintaining product relevancy include:

- Establish a program's S&T efforts. For DoD programs, establish a liaison to work with the JCTD community for future capability upgrades from this community.
- Ensure that design engineers work directly with operators.
- Organize innovation meetings to elicit and prioritize end user requirements, and provide a means to keep the user community aware of future program plans as each increment is fielded.
- Whenever possible, design engineers should take part in exercises and actual operations on a continuing basis.

OPERATIONS & SUPPORT

The acquisition community recognizes that the majority of a program's TOC is in the O&S lifecycle phase. Good SE practices mandate that O&S requirements are a major input into system requirements and follow-on delivered capability. Although O&S execution is at the latter half of the lifecycle, consideration of and preparation for O&S starts in formulation phase; it remains an essential element throughout the execution and delivery phases. A program's operational assessment of effectiveness and suitability is significantly shaped by its O&S tail.

Successful action steps for O&S include:

- Make O&S a reportable element of all program-level reviews.
- Ensure the O&S CONOPS and related requirements are accurately defined in the formulation phase and budgeted for in the program's budget.
- Ensure the PM and CE establishes a close and ongoing relationship between the PMO's logistics lead, and the operational and support communities.
- Make the oversight logistics staff representative an essential stakeholder; include him or her in all major program and contract reviews.
- Retain data rights that permit the outsourcing of hardware and software maintenance support to a third party. Complete a cost/benefit analysis prior to considering use of a third party maintenance contract. Specific product knowledge gained by the original developer may be costly to duplicate in another company.

Foundational Activities

A program's success is built upon a programmatic partnership among key stakeholders, and a solid understanding of the required technologies and their application in a disciplined engineering approach. The two foundational activities that span a program lifecycle are: advocacy and applied SE, which were identified on page 6 in "Approach," and shown in Figure 8.

>>>

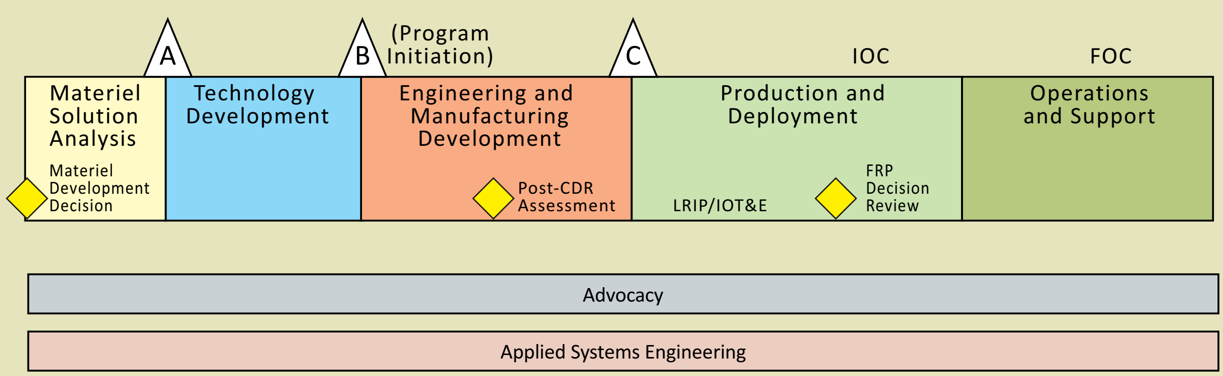
Gain and Sustain Advocacy

As one of the continuing foundations of a program's success, the PM must establish early and effective relationships with agency and department operational and resource sponsors, Service secretariat, and the material development activities (for the DoD, systems commands, and the PEOs) as soon as the initial capabilities are approved. Relationship building will ensure a complete understanding of the position (i.e., advocate, neutral, or adversarial) of each principal's view of the program. The knowledge gained during the early advocacy efforts is useful in shaping future engagement approaches.

Successful action steps for gaining and sustaining advocacy include the following:

- Base the program on a strong operational need.
- Have the ***end user community "pull"*** the program through the acquisition process; "pushing" by the PM is not enough.
- Develop and maintain a senior-level steering group (appropriately sized to the program) to guide and defend the program.
- Work with the operational community (the combat development community for DoD programs) to understand their priorities. Maintain relationships with them to remain abreast of their needs.
- Understand that Congressional staffers (i.e., professional and personal) have legitimate information needs. Work with congressional liaison offices to cultivate the influential individuals and, when possible, meet with them.
- Cultivate and use resource sponsors to represent the program's interests in budget raids.
- Beware of and tap into the existing social networks of retired senior-level officers and officials to gain advocacy and support for the program.

>>> ***Figure 8. Foundational Activities***



- Ensure the ***PM and senior PMO staff "stays on message"*** and have a concise elevator 'speech' about the program to present to senior staff and flag officers. Update the elevator 'speech' to account for ongoing changes and development progress.
- Connect early adopters with the PMO's engineering staff and contractors to establish and sustain support.

Applied Systems Engineering

SE is used to build a strong technical foundation, which is essential to a program success. In the absence of early, continuous SE, the likelihood of program success is zero.[8] ***SE can do more than build a system correctly; it can provide the processes and mechanisms to ensure the right system is built.*** It is important to shape, employ, and revise SE practices to fit the capability's development activities and the environment in which it will reside. PMs and CEs should assess existing traditional and system-of-systems SE practices for their applicability to his or her program's SE effort. Several practices are described in Traditional SE – International Council on Systems Engineering *"Systems Engineering Handbook V3",*[9] Defense Acquisition University "*SE Fundamentals Handbook",*[10] and System-of-Systems SE – *"Systems Engineering for Systems-of-Systems."*[11] PMs and CEs should also ensure that the contractor developing the capability has a well-planned and articulated SE approach. A contractor's Capability Maturity Model Integration (CMMI) level rating is usually at a company or its internal business unit level, and may not be linked to the SE team assembled to perform the contract. The PM/CE should verify the applicable CMMI level for the team assembled to do the work.

Successful action steps for applying SE practices include the following:

- Resource and apply SE from the beginning of a program's life.
- Ensure that the PM understands the importance of good SE practices that are tailored to the lifecycle phase.
- Require contractors to tailor their SE practices to meet the program's unique needs and lifecycle phases. Use tailored SE audits to verify tailoring of their practices.
- Insist on an organic, viable, and active PMO SE staff led by an experienced systems engineer from the concept/materiel solution phase forward.
- Include in the contract a staffing requirement that maintains an effective, organic contractor SE organization that is led by the prime contractor, throughout the life of the contract.
- Foster a collaborative partnership between the PMO and the contractor SE teams that promote opportunity and risk management.
- Establish informal working relationships and communication channels that promote sharing information, identifying problems, and resolving issues.
- Achieve the right balance between engineering discipline and the need to adapt to changing technical and operational environments.
- Maintain the proper perspective between processes and products; processes are important, but ***the delivered capability is what counts.***
- Tailor the PM's SE plan to the capability and environment in which it will be developed and operated.
- Leverage prototyping to verify and demonstrate the technology's readiness (i.e., ability to meet the critical technology elements).

8 Pre-Milestone A and Early-Phase Systems Engineering, A Retrospective Review and Benefits for Future Air Force Acquisition, National Research Council; ISBN: 0-309-11476-4, 2008, National Academies Press, Washington D.C.

9 Traditional SE – International Council on Systems Engineering, Systems Engineering Handbook, Vol. 3, June 2006, INCOSE-TP-2003-002-03.

10 *Defense Acquisition University SE Fundamentals Handbook,* January 2001, Supplementary Text, Defense Acquisition University Press, Ft. Belvoir, VA 22060-5565.

11 *System-of-Systems SE – Systems Engineering for Systems-of-Systems,* DoD, Version 1.0, June 2008, Director, Systems and Software Engineering, Deputy Under Secretary of Defense (A&T).

SECTION FIVE

Functional Enablers

Within the engineering and acquisition functions, a subset of 10 functions can be leveraged to help a program succeed. Section Two identifies these 10 functions (see Figure 9), which are discussed in detail below.

>>>

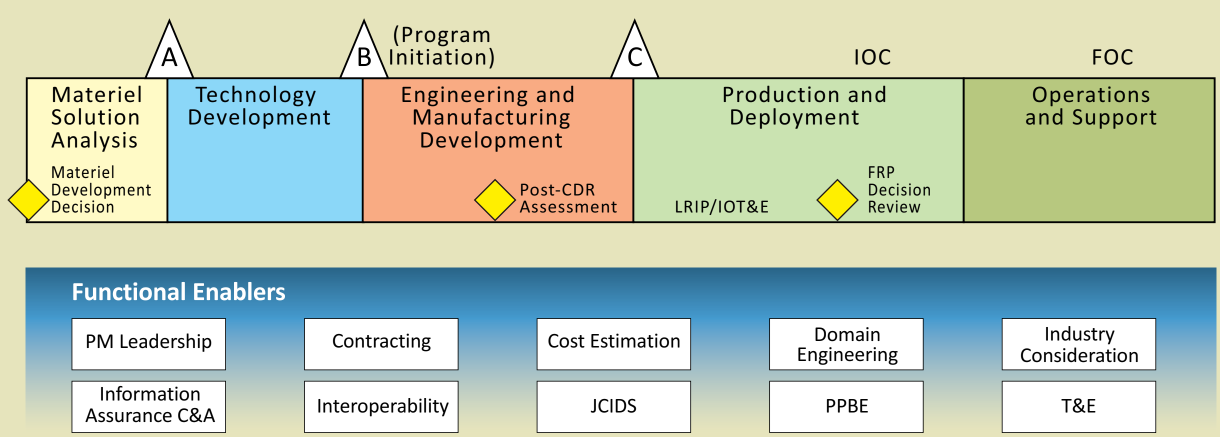
PM Leadership

The PM is accountable for the program's outcome within the authority and resources that are provided by the program's sponsors. The PM formulates and executes the program in cooperation with the program's stakeholders and superiors. As the primary interface to the program, the PM acts as the program's spokesperson, creating a favorable view of the program and inspiring confidence in it. The PM must hold his or her staff accountable to their commitments.

The following personal leadership characteristics were evident in PMs who were recognized for their ability to do the right thing in the face of competing interests:

- Remain cognizant of the responsibilities of a PM and the level of trust associate d with the position.
- ***Act in the best interest of the end user*** (e.g., the warfighter, operator, etc.).
- Remain transparent in all business dealings. The acquisition process relies upon the PM's strength of character and skill in expressing founded disagreements as they arise.
- Maintain an objective view of the program's status and risks; communicate them clearly and do not become emotionally involved.
- Maintain the ***program's credibility and integrity*** by objectively assessing the program status and keeping seniors informed. When situations require, make the difficult but right decision that places the needs of the Service or agency ahead of the program.
- Commit to less than the program can deliver. After making a commitment, the PM must ensure the program delivers the agreed-upon capabilities, as promised. Every surprise should be a good one.

> > > ***Figure 9. Functional Enablers***



Contracting

A viable contract is only possible if the PMO defines specific and concise objectives, costs, and a firm schedule. As partners in developing the RFP, source selection, and contract execution plan, the PM and PCO are responsible for ensuring that Industry partners understand the required capabilities, statement of work, and priorities. The knowledge gained from the contract planning activities will help the PM establish the contract controls necessary to manage the effort while allowing the contractor to focus on development efforts and product delivery.

Characteristics of successful contracting include the following:

- Focus on delivering capabilities incrementally, and adhering to a firm schedule and the agreed-upon costs. Ensure the PMO and contractors understand which Key Performance Parameters (KPPs) will be met, when they will be met, and the agreed-upon costs.
- Expect that contractors will focus on making a profit. Regardless of the contract's form, the contractor's business objectives are served by selling engineering hours. Anticipate and resist the contractor's attempts to grow the contract's scope and costs.
- Craft the RFP's instructions to offerors and evaluation factors (i.e., RFP sections L&M) carefully, and ***be realistic in what is required from the contractor***. Each proposal should be assessed to determine its executability, and past performance must be evaluated.
- ***Maintain open and frequent communications*** with Industry. This will substantially increase the program's chance of success. Enabling Industry to review preliminary requirements and architectures will set the tone for a productive relationship and will aid the government in understanding the available commercial technologies. Additionally, Industry reviewers become more knowledgeable about the program, which results in higher quality proposals.
- Simplify the Contract Line Item Numbers (CLIN) and CDRLs structures to remain consistent with the desired contractual outcomes.

Cost Estimation

The quality of a cost estimate is dependent upon the quality of the engineering and programmatic input that is provided to the cost analyst. Accurate cost estimations enable a program to meet the agreed-upon cost and outcome goals.

The characteristics of successful cost estimation activities include the following:

- Estimate costs early and use the information to organize appropriate work breakdown structure as part of the earliest solution formulation effort.
- Perform the cost estimate iteratively, beginning with a high-level parametric model and then a detailed estimate.
- Maintain cost estimates, updating them as the program matures. A PM must be able to perform cost benefit or sensitivity analysis on any part of the solution throughout the development lifecycle. The more mature the solution, the more accurate the cost estimate.

Domain Engineering

Domain engineering is an integral component to the SE strategy, solution formulation, and program execution processes. It is the PMO source of specific engineering competencies that understand the translation of requirements into hardware and software components, which, when integrated and tested, result in capability. The PMO must have experienced domain engineers to assist with the feasible design task, the contract's development and testing efforts, and verification of the end-to-end capability functionality and performance. Domain engineering represents a broad list of hardware- and software-related engineering disciplines. The CE needs to establish the specific PMO domain engineering staff requirements as derived from the technology being used and the capabilities being developed.

The characteristics of successful domain engineering practices include the following:

- Obtain engineers with relevant product development experience.
- Possess domain engineering expertise comparable to the contractor's engineering team leads.
- Understand what the PMO's role is in hardware and software development, and effectively participate with Industry in oversight and insight engagements (refer to "Contract Execution," page 21).

- Use the National/Services Laboratories, FFRDCs, and SETA companies as sources of domain engineering resources.
- Ensure the contractor establishes the appropriate staff of highly productive domain developers with proven track records.
- Encourage tight development spirals that are organized around the desired interfaces and behaviors.
- Remember: the government gets what is specified in the contract, not what is expected.
- Understand that requirements are never fully understood at the beginning of a program. Good requirements management requires the ability to effectively manage and communicate changes.

Industry Considerations

The PM relies on Industry for a large portion of a program's outcome. Achieving effective, rapid outcomes is a function of how well the PM and staff understand the Industry partner's business base. Similar to the different cultures of the Military Services and PMOs, corporate cultures vary widely. The PM must ***recognize*** this and ***know the unique culture and characteristics*** of a potential Industry partner at the sector/business unit level.

The characteristics of successfully using Industry partners include:

- Understand the contractor's motivation and constraints, which are typically driven by a mix of pressures (e.g., profit, revenue, new business development, milestone delivery, fielding, operational use, and the reputation of their product).
- Know the contractor's business objectives and priorities; it will make the partnership more effective.
- ***Seek opportunities to expand the range of competitors***. The PM should indentify and invite participation by firms that are not in the federal contracting market, if the program is facing an oligopoly in the federal market place. This may involve inviting participation by firms in related industries.
- Consider establishing multiple contract vehicles to allow the government to shift work to contractors that are better suited for the job.

- Evaluate the contractor's ability to perform and make the necessary fixes as soon as problems are discovered.
- Elevate startup problems to the contractor's senior management. Bad news does not get better with age.
- Work aggressively with contractors to reduce requirements creep and growth. Insist that contractors adhere to the agreed-upon costs and fixed milestones.
- Expect contractors to analyze the RFP's language for execution flexibility.
- Understand where contractors' costs come from and how their overhead is calculated to help avoid or mitigate growing contract costs.
- Remain cognizant of the contractor PM's profit and loss responsibility, and that he or she will compete within the corporation for business.
- Understand that subcontractor's arrangements may be structured initially to win rather than perform.
- Establish a close working relationship with the contractor's management team. Hold quarterly meetings with the company's general manager or vice president throughout the performance period.

- Monitor the contractor's turnover as an indicator of the contract's health; elevate problems to the contractor's PM and senior management, as appropriate.

Information Assurance and Certification & Accreditation Process

To avoid costly and unexpected program delays, the PM must recognize that IA and C&A processes are important to the program and solution formulation phases. The security lifecycle will fit into the acquisition lifecycle if it is done from the beginning and managed as a holistic risk management activity. Effective IA is achieved by building it into the requirements and solution development efforts early. ***IA is designed into the system,*** not added after the system design is complete. The PM should have an ISSE to help guide engineering through the IA requirements, development, and test phases, and to provide direct coordination to the certifiers and accreditors.

The following are characteristics of successful IA and C&A processes:

- Obtain an ISSE who understands the system being developed and the C&A process.
- Work the corresponding security requirements up front, based on the impact levels of confidentiality, integrity, and availability. Gain agreement with C&A stakeholders on the requirements.

- Conduct initial risk assessments to identify the impact of loss of confidentiality, integrity, and availability by subsystems. Highlight key dependencies and focus on these areas early.
- Incorporate security patches during development, have a security profile review at integration timeframe, and use as a security baseline for developmental and operational testing.

Interoperability

The PM must understand the importance of interoperability requirements in a program's lifecycle. Interoperability is not an "add on." The emerging model from net-centric[12] developments is shifting to using network services; they are migrating away from the development and ownership of the traditional stovepipe services.

The characteristics of successful interoperability approaches include the following:

- Create a ***technical architecture*** that complies with the overarching federal or department guidance, and features composable elements and middleware that inherently ease the interoperability challenge.
- Use ***incremental deliveries*** as the key to meeting interoperability requirements and rapid outcomes.
- Employ an integration facility that is run by the PMO or use the contractor's systems integration facility with oversight from the PMO.
- Understand that the contractor's motivation to create technical lock-in via proprietary interfaces and system components can only be countered by a government-owned architecture that forbids (or wraps) these elements in non-proprietary interfaces.
- Participate in communities of interest to help implement net-centric information sharing.
- Ensure the PM and PMO understand that ***cultural change is the most difficult part*** of interoperability.

[12] That is in accordance with the DoD Net-Centric Data Strategy (http://www.defenselink.mil/cio-nii/coi/index.shtml) and DoD/Intelligence Community Net-Centric Services Strategy (http://www.defenselink.mil/cio-nii/entservices/index.shtml).

Joint Capabilities Integration and Development System

JCIDS is an operational capability needs process that pertains to DoD acquisition programs, but not necessarily to other agencies and departments. To effectively shape achievable operational requirements, the PM must be active throughout the JCIDS process, working up the chain with the Service's requirements' sponsors and internally with the end users participating in the program's SE process. The PM must understand the JCIDS process and how it is implemented through his or her Service.

The characteristics of successful JCIDS collaboration include the following:

- Establish a relationship with the Joint Staff J-8, which is critical for Joint Requirements Oversight Council (JROC) approval and the Service's Headquarters staff "8" to work up to J-8 or J-2 for IC-related programs.
- Use the PM-Sponsor team as an effective JCIDS process "expediter."
- Work with the Service's requirements staff to ensure the program's success.
- Coordinate with the Service's O-6, who supports the JROC, to ensure he or she understands the program and can advocate it to the JROC.
- Leverage the Joint Urgent Operational Need process for rapidly fielding a capability, where applicable.

Planning, Programming, Budgeting, and Execution

A program must have a solid command of the entire PPBE system, especially the unique nuances of the Services, agencies, or departments. Managing the program's resources internally and externally is a top enabler of rapid results.

The characteristics of successful PPBE involvement include the following:

- Maintain ***consistency in the budget request***. Do not request funding for the same thing more than once.
- Ensure the PM checks previous briefs and can explain changes.
- Manage to a defined spending plan for achieving obligation and expenditure rates.
- Have contract vehicles in place to meet obligation rates.
- Maintain awareness of the agency, department, or Service's strategy documents. If a program is not mentioned, it will be harder to justify.
- Keep the program sponsor (an agency or department equivalent) informed.
- Ensure the PM and stakeholders understand how the program supports the agency, department, or Service's program and planning strategies by 'connecting the dots' for the staff responsible for writing the strategy documents.

Test & Evaluation

A program's T&E objective is to ***improve the capability*** during the development phase, ***not verify the capability's performance*** at the end of the development phase. The PM must explain to the development staff that finding problems during the testing phase is a good (and expected) part of a successful SE effort. The PM must structure the test program as part of the broader SE effort. Programs that are under cost and schedule restraints often reduce the test phase, which is harmful.

The PM must continue to invest in T&E to lower costs and risks. The characteristics of successful T&E efforts include the following:

- Ensure that all requirements can be tested.
- Plan for the program's DT to extend past the contractor's DT to thoroughly test the program's capabilities prior to providing it to the OT organization for evaluation.
- Use the ***DT as a dry run for the OT*** to significantly increase the likelihood of a successful evaluation of operational effectiveness and suitability.
- Look for opportunities to test once; evaluate a technology in many different ways, especially with the "ilities" (e.g., reliability, availability, and survivability).
- Explore using modeling and simulations in place of testing, when practical and effective.
- Leverage T&E to improve the requirements.
- Include testing requirements in the RFP.

SECTION SIX

Conclusion

Successful acquisition programs do not happen by chance; they are the result of many individuals working together to achieve a common objective. An acquisition team includes end users, stakeholders, Industry partners, PM, CE, and PMO staff whose roles are vital to the program's success. This paper captures these roles and provides a framework for success. For the program's lifecycle areas (i.e., formulation, execution, delivery, and O&S), we provide 13 actions or steps to move the program from the beginning to an Industry-provided product that is delivered to the warfighter or operator. We also provide 10 functional enablers to ensure the program's success. Essential to the 13 steps and 10 functional enablers, we provide the two foundational activities required to ensure continued program support and a solid technical base (i.e., advocacy and applied SE). Each component is depicted in the Framework for Success (refer to Figure 3) and discussed in detail in Sections Three, Four, and Five, which also describe the actions and best practices required to achieve a successful acquisition program.

>>>

Appendix A *Achieving Effective Results in Acquisition Study Team*

Former Government PMs/CEs:

Terry E. Dunlavey (DIA PM)

Dolly G. Greenwood (IC PM)

Christopher J. Harvey (Army PM; USA ret)

Michael B. Kelley (Navy PM; USN ret)

Robert W. Kepner (USMC Lead SE)

Dr. Joseph Mitola (DARPA CE)

Douglas O. Norman (AF CE; USAF ret)

Acquisition Specialists:

Dr. William G. Bail (SW Engineering)

Dr. William D. Bell (Testing)

Thomas L. Darner (AF Special Projects; USAF ret)

Daniel R. Klemm (IA, C&A)

Dr. Frederick S. Kuhl (SW Development)

Phil W. Parker (Contracting; USAF ret)

Mary K. Pulvermacher (Interoperability)

Ron Racinez (JCIDS)

William K. Windsor (Budgeting; ANG ret)

Appendix B *Assessment Matrix*

A self-administered Assessment Matrix is provided to aid Program Managers (PMs) and Chief Engineers (CEs) in evaluating their program's health. The Assessment Matrix is built around the actionable framework depicted in Figure 3 and discussed in Sections Three, Four, and Five. This matrix has two parts: one for assessing programs prior to starting system development activities (i.e., Milestone B [MS B] for the Department of Defense [DoD]), and a second that covers the program from Request for Proposal (RFP) to Initial Operational Capability (IOC).

>>>

Assessment Matrix: Concept to Start of Sys Dev

The assigned assessment value (i.e., green, yellow, red) for one of the 13 actionable framework steps is the PM's or CE's personal judgment of that step's contribution to a successful program in the area of performance, cost, and schedule associated with that step. If a value cannot be assigned to that block, leave it blank.

For the "Concept to Start of System Development" assessment matrix, when assigning a green, yellow, or red value, the PM or CE must determine what contribution that action step is providing toward establishing credible, realistic, achievable performance, cost, and schedule objectives, and assess the two lifecycle-spanning foundational activities (i.e., advocacy and applied systems engineering) in a similar fashion. For the Performance, Cost, and Schedule blocks in the "Concept to Start of Sys Dev" assessment matrix, the following criteria are recommended:

Performance Parameters

GREEN = Able to establish key Threshold and Objective values that are acceptable to the User/Stakeholders and achievable by the PMO.

YELLOW = Encountering difficulties in establishing one or more key Threshold and Objective values, but the User/Stakeholders and PMO believe the difficulties are not show-stoppers.

RED = One or more key Threshold and Objective values are unacceptable to the User/Stakeholders or unachievable by the PMO.

Cost

GREEN = Able to establish a Cost Target that is acceptable to the User/Stakeholders and achievable by the PMO.

YELLOW = Encountering difficulties in establishing a Cost Target, but the User/Stakeholders and PMO believe the difficulties are not show stoppers.

RED = Cost Target is unacceptable to the User/Stakeholders or unachievable by the PMO.

Schedule

GREEN = Able to establish a Schedule that is acceptable to the User/Stakeholders and achievable by the PMO.

YELLOW = Encountering difficulties in establishing a Schedule, but the User/Stakeholders and PMO believe the difficulties are not show-stoppers.

RED = Schedule Target is unacceptable to the User/Stakeholders or unachievable by the PMO.

> > > ***Figure 10(a). Assessment Matrix***

Concept to Start of System Development

	Defining Acquisition Program Baseline		
Program Formulation			
Define Success			
Dev Acq Strategy			
Establish PMO			
Solution Formulation			
Define Solution			
Sys Eng Strategy			
Program Execution			
Structure Program			
Execute Program			
Dev Feasible Design			
Tech Dev RFP(s)			
Source Selection(s)			
Execute TD Contract(s)			
Advocacy			
Applied Systems Engineering			

Assessment Matrix: RFP to IOC

For the "RFP to IOC" assessment matrix, when assigning a green, yellow, or red value, the PM or CE must determine the worth of the action step in achieving/maintaining the program's performance, cost, and schedule objectives, and assess the two lifecycle spanning foundational activities (i.e., advocacy and applied systems engineering) in a similar fashion. For the Performance, Cost, and Schedule blocks in the "RFP to IOC" assessment matrix, the following criteria are recommended:

Performance Parameters

GREEN = Between Threshold and Objective values

YELLOW = Performance at Threshold value

RED = Performance below Threshold value

Cost

GREEN = Cost between Threshold and Objective values

YELLOW = Cost up to 15 percent over Target value

RED = Cost at or above 15 percent of Target value

Schedule

GREEN = Schedule between Threshold and Objective values

YELLOW = Schedule within 10 percent of Target value

RED = Schedule greater than 10 percent or three months of Target value

Figure 10(b). Assessment Matrix

RFP to IOC

	Achieving Approved Baselines		
Program Execution			
Structure Program			
Execute Program			
Contract Execution			
RFP(s)			
Source Selection(s)			
Execute Contract(s)			
Deliver			
Manage Transition			
Maintain Product			
Post IOC Support			
Advocacy			
Applied Systems Engineering			

Appendix C *Acronym List*

ACO	Administrative Contracting Officer
AF	Award Fee
AoA	Analysis of Alternatives
APB	Acquisition Program Baseline
BoE	Basis of Estimate
C&A	Certification and Accreditation
C2	Command and Control
C4ISR	Command, Control, Computers, Communications, Intelligence, Surveillance, and Reconnaissance
CDRL	Contract Data Requirements List
CE	Chief Engineer
CLIN	Contract Line Item Number
CMMI	Capability Maturity Model Integration
CONOPS	Concept of Operations
CTE	Critical Technology Element
DCMA	Defense Contract Management Agency
DoD	Department of Defense
DT	Developmental Testing
FAR	Federal Acquisition Regulations
FFRDC	Federally Funded Research and Development Center
GFE	Government Furnished Equipment
GFI	Government Furnished Information
IA	Information Assurance
IC	Intelligence Community
IF	Incentive Fee
IMP	Integrated Master Plan
IMS	Integrated Master Schedule
IOC	Initial Operational Capability
ISSE	Information Systems Security Engineer
IT	Information Technology
JCIDS	Joint Capability Integration and Development System
JCTD	Joint Capability Technology Development
JROC	Joint Requirements Oversight Council
KPP	Key Performance Parameter
LCC	Life Cycle Cost
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MS	Milestone
O&S	Operations and Support
OODA	Observe-Orient-Decide-Act
OT	Operational Testing
PCO	Procurement Contracting Officer
PEO	Program Executive Officer
PM	Program Manager
PMO	Program Management Office
POM	Program Objective Memorandum
POR	Program of Record
PPBE	Planning, Programming, Budgeting, and Execution
RDT&E	Research, Development, Test, and Evaluation
RFP	Request for Proposal
S&T	Science and Technology
SDLC	System Development Lifecycle
SE	Systems Engineering
SETA	Systems Engineering and Technical Assistance
SLA	Service-Level Agreement
SME	Subject Matter Expert
SW	Software
T&E	Test and Evaluation
TOC	Total Ownership Cost
TRL	Technology Readiness Levels

NOTES

MITRE