U.S. Army Space and Missile Defense
Technical Center

Technology Program Management Model (TPMM) Guidebook

August 2001

FOREWORD

Technical programs/projects must be carefully managed to ensure that technologies are delivered to the customer not only within time and budget constraints, but also that they provide increased capabilities to meet the needs of the warfighter. To accomplish this, a logical methodology is needed to support Technology Managers (TM) through the planning and development of their program/projects. The Technology Program Management Model (TPMM) provides that methodology.

The TPPM offers its users a standardized approach to technology development. It is a simple and flexible management tool for translating technological opportunities, based on validated mission needs and requirements, into stable, affordable, and well-managed acquisition programs. This approach is comprehensive. It consolidates the complex activities inherent in the development of all technology programs as well as the many varying approaches to technology development used in the past. The model offers many benefits, both to the TM and to Technical Center management. It provides the TM a guide to program evolution that is concise, easy to understand and interpret, and is flexible. The model provides a menu of key activities that can be tailored to the precise requirements of the project. By following its timeline, the TM is more assured of achieving project requirements and is able to demonstrate its readiness to transition to the next level/phase. It also facilitates management oversight and ultimate project evolution/validation through the Technology Readiness Levels.

The TPMM provides TM and the Technical Center as a whole with the following benefits:

- Strengthened Technology Program/Project justification to increase customer acceptance and funding support
- Facilitated review and prioritization among Technology Programs/Projects in a constrained resource environment
- Improved documentation process to support the STO/ATD/ACTD nomination process or transition to a acquisition program
- Better program execution through detailed management planning with emphasis on cost, schedule, and performance goals
- Improved technology development process efficiency (less time/resources) and effectiveness (high technology transfer ratio)

To assist TMs through the transition phase and the continued application of the TPMM, I am providing you with this TPMM Guidebook. The Guidebook is an excellent tool for assisting us in facing future challenges and will produce positive results for the Technology Center and ultimately the soldier. I look forward to working with you as we implement the TPMM and continue transitioning technologies to operational systems.

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SECTION I. PURPOSE AND OBJECTIVES

All technology development, to include streamlined initiatives such as Advanced Concept Technology Demonstrations (ACTDs), Science and Technology Objectives (STOs), Advance Technology Demonstrations (ATDs), Fast Track Programs, etc., requires planning to integrate into the Acquisition Management Process. The development of any product should have a logical process with a starting point and an ending point. The process requires a logical flow from discovery of an idea, based on a military need, to customer integration satisfying that need. Research and development is a creative process, however there must be a way to ensure that the right questions are being asked, at the right times, in developing advanced technologies for successful transition to the customer. The Technology Program Management Model (TPMM) provides that process.

1.1 PURPOSE

The purpose of the TPMM is to provide a logical methodology to guide Technology Managers (TM's) through the planning and development of their programs or projects. The TPMM standardizes planning, documentation, and review of Technology Programs/Projects. It provides a vision for the transition of technologies to a customer, Program Manager, or into an Acquisition Program itself. The TPMM also assists TM's in assessing military utility early in the process, which helps in identifying potential customers who then become involved throughout the entire process.

The purpose of this Guidebook is to assist the TM in applying the TPMM to Technology Programs/Projects. It applies to all Technology Programs/Projects managed by the organizations and elements of the United States Army Space and Missile Defense Command's Space and Missile Defense Technical Center (SMDTC).

1.2 OBJECTIVE

The objective of the TPMM is to establish a simplified and flexible management tool for translating technological opportunities, based on validated mission needs and requirements, into stable, affordable, and well-managed acquisition programs, including weapon systems and automated information systems.

SECTION II. SMDTC MISSION AND STRATEGIES

2.1 MISSION

The mission of the Space and Missile Defense Technical Center (SMDTC) is to develop imaginative, innovative and often high risk research ideas, offering significant technological solutions beyond the normal evolutionary developmental approaches; and to pursue these ideas for feasibilities, for current and future customer's requirements, and assist in technology transition to operational systems.

2.2 STRATEGIES

The SMDTC uses three main strategies to execute its mission. The first strategy is to identify new technology opportunities to support Space and Missile Defense Missions or to support other National Defense Priorities. The second is to mature the right technology at the right time to defend against evolving threats, reduce costs, and/or increase performance of Space and Missile Defense Missions or to support other National Defense Priorities. The third strategy is to implement a command wide, analytically based technology development process to focus efforts toward customers and identify areas for Command synergism.

2.3 TPMM SUPPORT OF SMDTC STRATEGIES

The TPMM assists the SMDTC in implementing its strategies in support of its overall mission. First, the model identifies the close working relationship with Project Managers (PMs), Industry, Academia, and Battle Labs to continuously target new technology requirements/opportunities. Second, the TPPM advocates the development of new technology based on Threat Analysis, Future Operational Capability Requirement, user need, or other relevant sources. This linkage of new technology to applications with a significant military utility ensures the right technology is developed. Third, the TPMM supports implementation of an analytically based technology development process. The use of Technology Readiness Levels (TRLs) and system engineering principles increases the effectiveness of program planning and the review process. Finally, the early identification of a customer and the use of planned phases to mark progress allow for command synergism by effectively tracking programs/projects by customer and/or phase of technology development.

SECTION III. TECHNOLOGY PROGRAM MANAGEMENT MODEL OVERVIEW

3.1 BENEFITS

The TPMM establishes a general approach for managing Technology Programs/ Projects, acknowledging that every program or project is unique. This uniqueness may require tailoring of the process to best address critical Technology Program/Project issues along the evolutionary path to achieving user needs. Key benefits that can be obtained from the use of the TPMM are: strengthened justification for funding support, increased customer acceptance, and improved execution and transition of the technology to the customer.

3.2 DEFINITIONS

The terms **customer**, **user, sponsor, Program Plan, and Program Plan Schedule** are used extensively in this Guidebook. The following definitions are provided for clarification. These definitions are intended for use within the scope of the TPMM.

Customer(s): An organization or individual that will accept the technology program/project normally at the end of the transition phase. A customer who is also providing the funding for the technology program/project may also be referred to as the sponsor.

Sponsor(s): An organization or individual that provides funding or other support for the Technology Program/Project. Typically, the Sponsor does not accept the Technology Program/Project.

User: An organization or individual that will operationally employ the technology.

Program Plan: The primary planning document for technologies containing all of the important elements necessary to accomplish development and transition of the technologies to the customer(s).

Program Plan Schedule: A time phased representation of the Program Plan containing all the necessary activities and milestones required to successfully develop and transition technologies to the customer(s).

3.3 PRINCIPLES

The following principles are the basis of the TPMM:

- Consistent with current Department of Defense (DoD) Acquisition Process and Policies
- Provide for multiple entry/transition points based on maturity of the technology

- Require documentation based on the technology scope but supporting STO / ATD / ACTD nominations and the formal Acquisition Process for transition to the customer
- Tailor and streamline documentation for each Technology Program/Project but still provide the needed information to make informed decisions
- Use the Technology Difficulty Index (TDI) to provide an early indication of technology risk (Appendix H-1 contains a TDI Reference Table)
- Use Technology Readiness Levels (TRLs) to evaluate technology growth (Appendix H-2 contains a TRL Reference Table)
- Tailor the TRLs for the specific technology being developed
- Assign TRL 6 as the goal for Transition to the customer
- Develop requirements for Technology Program/Project covering all areas: System Performance, Form/Fit/Function, Logistic Supportability, Operational Readiness, Interoperability, and Producibility, as some examples
- Provide "PROOF" - Documentation, Results, Plans - at every review to support entry into the next phase
- Increase the level of detail for "PROOF" requirements as technology progresses from concept to a prototype ready for the customer
- Review Technology Program/Project progress and approve entry into the next phase through a Technology Process Review (TPR)
- Determine the size and composition of the TPR and detail of documentation required based on the Technology Program/Project complexity, funding level, and phase

3.4 DoD ACQUISITION PROCESS AND POLICIES

The first principle of the TPMM is that it is consistent with current DoD acquisition processes and policies. The following are DoD policies on science and technology as stated in DoD 5000.1:

- The fundamental role of the DoD Science and Technology (S&T) program is to enable a technologically superior military force
- The S&T program shall address user needs; maintain a broad-based program spanning all Defense-relevant sciences and technologies to anticipate future needs and those not being pursued by civil or commercial communities; preserve long-range research; and enable rapid transition from the S&T base to useful military products
- The S&T projects shall focus on increasing the effectiveness of a capability while decreasing cost, increasing operational life, and incrementally improving products through planned upgrades
- The S&T executives shall encourage the use of initiatives, such as Advanced Technology Demonstrations, designed to accelerate the transition from the S&T base to useful military products

Additionally, the DoD 5000.2 Technology Transition Objective is to mature technology programs to a TRL that is acceptable to the receiving Milestone Decision

Authority (MDA) and puts the MDA at low risk for systems integration. The process to mature a technology continues until successful transition or until the MDA is no longer considering the technology.

3.5 TECHNOLOGY PROGRAM MANAGEMENT MODEL (TPMM)

Based on the previously mentioned principles and DoD process and policies, the TPMM is designed to take a technology program from an idea through a series of steps, or phases, to final transition. TRLs, the formal acquisition process, and system engineering principles were used in developing the phases of technology development that logically lead to a capability ready for transition to the customer. The ACTD would be an exception in some cases in terms of transitioning to customer management as will be explained later.

The TPMM, see foldout in guidebook pocket, consists of seven phases: Discovery, Formulation, Exploration, Development, Demonstration, Transition, and Customer Management. The model provides Considerations/Actions (C/A) that address the major functions in each phase of the technology development process. This facilitates the development of a program strategy, documented in a Program Plan. Following the model methodology and carefully considering the C/A the Program Plan is developed during the Exploration phase and updated during subsequent phases. The Program Plan format is located in Appendix E. Additionally, the TM develops a Program Plan Schedule to show the timing of activities and milestones leading to successful transition to the customer. Figure 3.2 provides a sample format for a Program Plan Schedule.

Since the ACTD are demonstrations jointly sponsored and implemented by the operational user and materiel development communities, with approval and oversight guidance from the Deputy Under Secretary of Defense for Advanced Technology (DUSD(AT)) it would not require a TPMM program plan. The principal management tool for the ACTD is the ACTD Management Plan. This management plan is intended to maintain a flexible approach to the advanced development process and avoid excessive rigidity and formality in the documentation process. The content of each Management Plan should be tailored to meet the diverse needs of the ACTD. For specific guidance on the ACTD management plan and its format see the Defense Acquisition Deskbook (DAD).

The TPMM establishes success criteria consistent with the use of TRLs and DoD Acquisition Policies. The model provides Exit Criteria and Deliverables indicating what is necessary to meet the requirements of each Technology Phase. The implementation of the model's Technology Process Reviews (TPRs) ensures that Technology Program/Project are reviewed to assess technical progress, ability to meet customer needs, and fiscal soundness. The TM provides key information at the TPRs for the Decision Authority to make informed management decisions concerning the program's progress and its suitability for continued effort.

There is no one best way to implement the objectives of this Guidebook. Proposed Technology Programs/Projects, for example, may enter the TPMM process at various TPR points, depending on the concept and technological maturity. Section V provides guidance to determine where to enter the model. Decision Authorities and TM's should tailor strategies to fit the particular conditions of an individual Technology Program/Project, consistent with common sense, sound business management practice, applicable laws and regulations, and the time-sensitive nature of the user's requirement. Tailoring shall be applied to various aspects of the program/project, including documentation, phases, the timing and scope of TPRs, and TPR Decision Authority levels.

Figure 3.1. Technology Program Management Model

(Readable Foldout Is Located In Guidebook Pocket)

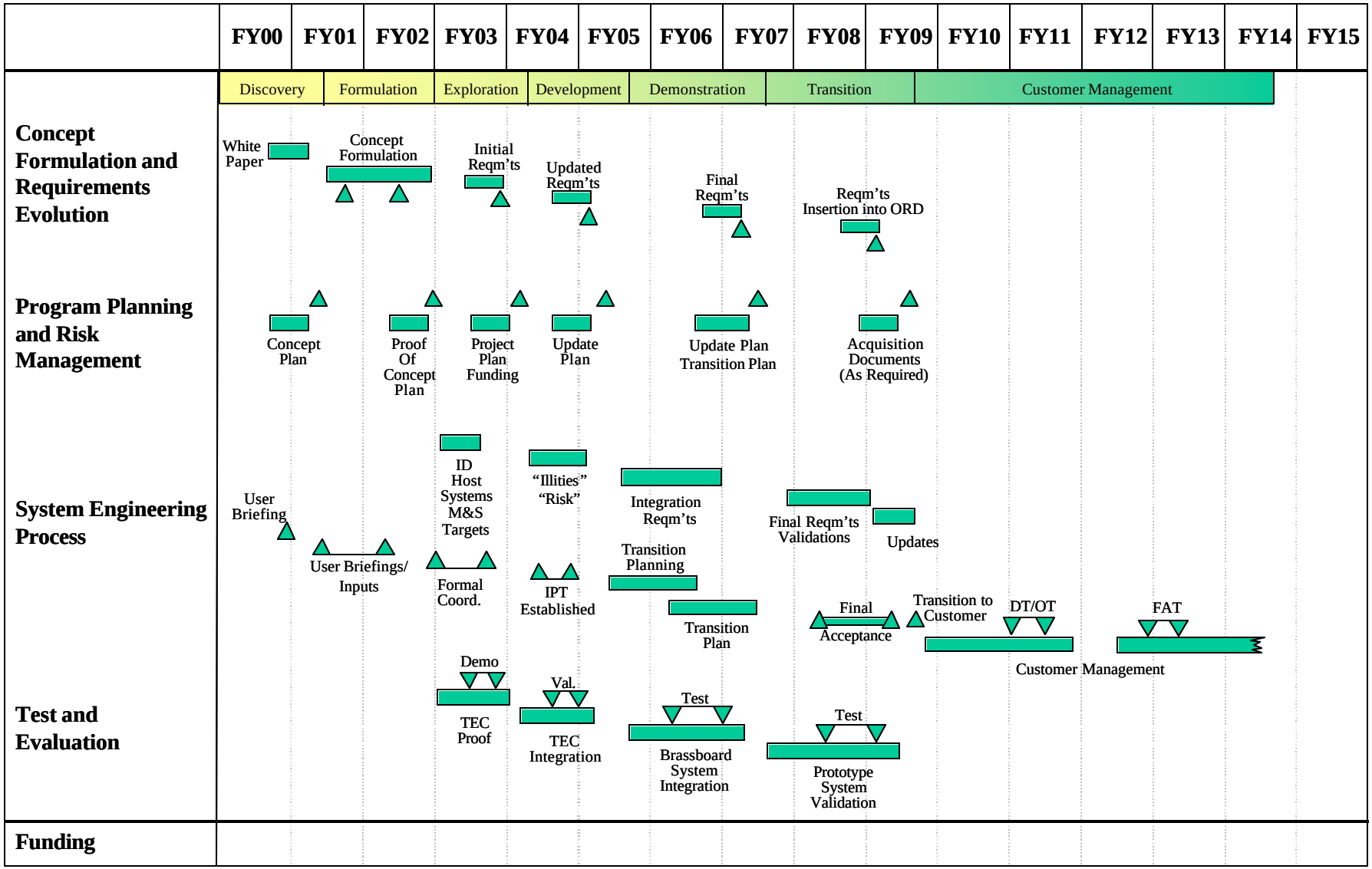


Figure 3-2. Program Plan Schedule - An Important Part of the Technology Program Management Model Process

SECTION IV. TECHNOLOGY PROGRAM MANAGEMENT MODEL BY PHASE

This section provides a detailed description of each phase of the TPMM. Each phase consists of a Phase Description, or Considerations/Actions, an outline of Deliverables, and generalized Exit Criteria. A diagram is also included to clarify where each phase begins, what is accomplished during the phase, and where the phase finishes. Please note that the Considerations/Actions for all of the phases are not to be construed as all inclusive and some may not pertain to a particular technology. The TM should use best judgment to determine if a particular action or question pertains to the technology and should ask the following: Is there anything else that I should consider? The chart in Figure 4.1 is a simplified overview version of the TPMM. Additionally, the numbers assigned to the Considerations/Actions are for reference only and don't necessarily imply a required order.

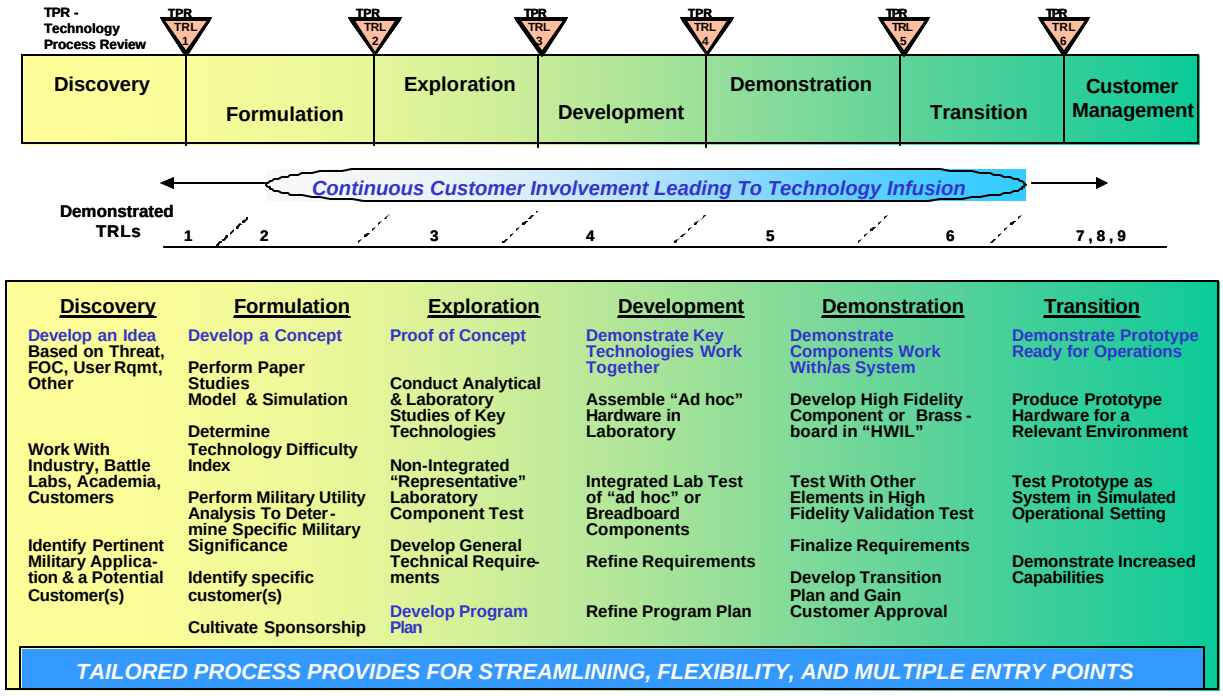
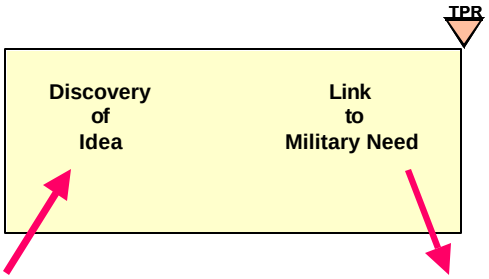


Figure 4-1. Simplified Model Chart

4.1 DISCOVERY PHASE

The Discovery Phase begins with the development of an idea for a new technology based on Threat Analysis, Future Operational Capability Requirement, User need, or other relevant sources. Discovery links the idea for new technology to a military need (or opportunity). During this phase a literature search is performed and information is developed describing the effort, the basic principles/properties involved, and identifying the known or perceived need/application along with potential customer(s)/sponsor(s). Toward the end of this phase, a white paper is developed describing the effort, the basic principles/properties involved, and the known or perceived military need/application along with potential customer(s)/sponsor(s). Additionally, a brief Concept Formulation Plan is developed to identify the process and funding for the next phase. The Discovery Phase is normally funded only for completion of the activities necessary to reach the end of the phase.

Discovery Phase



Begins With

- Work With Industry, Battle Labs, Academia, and Customers
- Discovery of New Technology Idea Customer Requirements

Accomplishments

- Links New Technology Idea to Military Need
- Performs Literature Search
- Develops Information to Describe
  - Technology Effort
  - Basic Properties
  - Military Need
  - Customer

Finishes With

- White Paper Describing
  - Effort,
  - Basic Principles,
  - Need, and
  - Potential Customer
- Concept Formulation Plan

Discovery Phase Considerations/Actions:

1. What are the primary science and technology objectives and principles that will be investigated in this phase?
2. What known or perceived military need drives this effort?
3. What are the results of your literature search?
4. What identical or similar investigations are underway elsewhere?
5. Who are the potential customers?
6. Who are the potential sponsors?

7. What organizations are involved with this phase?
8. How is this phase of the program effort to be funded?
9. Develop a white paper describing the effort to include basic principles/properties involved.
10. Develop a Concept Formulation Plan for the next phase.
11. Prepare a study funding request for the next phase.

***Deliverables*:**

1. White Paper
2. Concept Formulation Plan

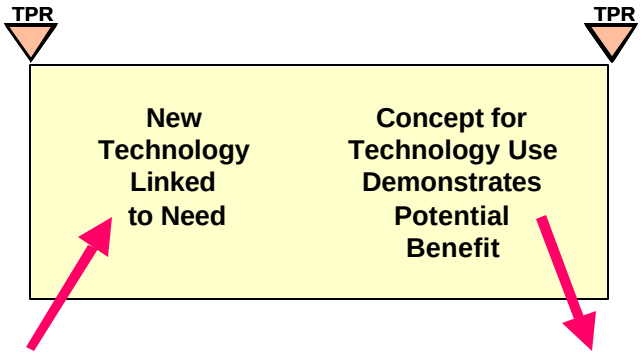
***Exit Criteria Met When*:**

- Literature search demonstrates that this concept has potential and is not a duplication of other efforts
- White paper adequately describes the research effort
- Basic principles/properties involved are clearly stated in White Paper
- Known or perceived military need or application is identified
- Potential customer(s) and/or sponsor(s) are identified
- Funding for the next phase is acceptable and supportable.
- Concept Formulation Plan adequately describes the process for the next phase

4.2 FORMULATION PHASE

The Formulation Phase begins with identified basic properties for a new technology linked to a potential military need. During this phase, concepts for application of the technology are formulated that will demonstrate a practical military utility. A Concept Formulation paper study is conducted to identify key technologies, evaluate alternatives, select the best feasible solution, determine the Technology Difficulty Index (TDI) (see Appendix H-1), and analyze the potential benefit over current technology. A Military Utility Analysis is initiated to determine what the value of a technology, system, or concept will be in an operational environment. Also, specific customer(s)/sponsor(s) is/are identified and are involved throughout the remaining phases. Toward the end of this phase the study is documented in a Concept Formulation analysis report and a Proof of Concept Plan is developed, identifying what models and simulations, or other means, exist to conduct a proof of principle of the required key technology(ies) along with a funding estimate for the next phase.

Formulation Phase



Begins With

- New Technology Idea Linked to Potential Military Need

Accomplishments

- Formulates and Analyzes Concepts which Demonstrate Military Application
- Identifies Key Technology(ies)
- Determines TDI
- Identifies Specific Customer/Sponsor

Finishes With

- Concept Formulation Analysis Paper Documenting Results of Study Effort
- Proof of Concept Plan Describing the Means to Prove Key Technology

Formulation Phase Considerations/Actions:

1. What organizations should be involved with this phase?
2. Initiate a Military Utility Analysis to identify benefits to the warfighter.
3. What potential military application exists?
4. What operational scenarios have been developed for evaluation and are they realistic?
5. What alternative competing concepts (if any), using the key technologies, have been identified?
6. What is the "best feasible" technology concept and how will it be applied to satisfy the identified need?
7. How does this program provide a significant improvement in capability over the current technology?
8. What is the Technology Difficulty Index for this program?
9. Update the study funding request as required: part of concept formulation plan.
10. Prepare a Concept Formulation Analysis Report.
11. Who is/are the specific customer(s)?
12. Who is/are the specific sponsor(s)?
13. Develop a Proof of Concept Plan to include required funding for the next phase.
14. What models and simulations exist to evaluate the 'goodness' of the concept, and are they applicable to the analysis to be performed in the next phase?
15. What functional models need to be developed to assess the system performance?

***Deliverables*:**

1. Concept Formulation Analysis Report
2. Proof of Concept Plan

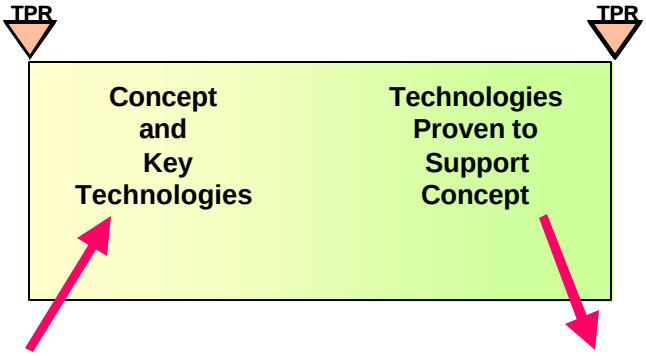
Exit Criteria Met When:

- Military Utility Analysis initiated
- Key technologies are clearly identified and described
- Selection of the "best feasible" concept is based on evaluation/comparison of alternatives
- Scenarios used in evaluation are traceable to realistic situations
- Selected concept demonstrates a potential benefit over current technology
- Technology Difficulty Index is determined as first step in risk management
- Specific customer(s)/sponsor(s) is/are identified
- Proof of Concept Plan (PCP) identifies models and simulations, or other means, to conduct a proof of principle of the required key technology(ies)
- Funding request for next phase of research is acceptable and supportable (included in the PCP).

4.3 EXPLORATION PHASE

The Exploration Phase begins with a selected technology concept for military application and identification of the new key technology(ies) required. This phase explores the key technology(ies) to demonstrate its/their capability to support the concept. Active research and development, including analytical and laboratory studies, provides physical validation and documentation that the key technologies work as envisioned and their capabilities support the requirements of the concept study. Toward the end of this phase, key preliminary (draft) performance and technical parameters are identified and documented. The major deliverable developed during this phase is the Program Plan. The Program Plan is the principle management tool for the TPMM. The Program Plan along with the Program Plan Schedule is updated prior to each TPR until the program/project is transitioned to the Customer.

EXPLORATION PHASE



Begins With

- Selected Concept Providing Military Application
- Identified Key Technology(ies)

Accomplishments

- Demonstrates Key Technology Supports Concept Results
- Conducts Non-Integrated Lab Testing
- Develops General Requirements
- Develops Information for Program Plan

Finishes With

- Key Performance Parameters Documented (Draft)
- Proof of Concept Analysis Report
- Program Plan and Funding Estimate for the Remaining Effort

Exploration Phase Considerations/Actions:

1. What organizations should be involved with this phase?
2. What are the key performance parameters?
3. Develop a Requirements Document for this technology.
4. What historical data have been collected and analyzed to determine probability of successful performance?
5. What critical functions/issues must be evaluated?
6. What laboratory test will be conducted?
7. What 'representative' components will be used in the test?
8. Where will the test(s) be conducted?
9. Who will conduct the test(s)?
10. Will the customer observe the test or be briefed on the outcome?
11. What analytical studies will be conducted?
12. Develop/update/validate models and simulations based on studies and laboratory test results.
13. Prepare a Proof of Concept Analysis Report
14. Has the sponsor/customer been briefed and agreed to fund the technology development program?
15. Prepare a program plan outlining the program through transition.
16. Develop a program plan schedule.
17. What contracting strategies have been selected for the remainder of the program?
18. What is the estimated cost of this technology development program?
19. Develop a Component/Breadboard Laboratory Validation Plan.

***Deliverables*:**

Program Plan to include:

- Requirements Document
- Proof of Concept Analysis Report
- Component/Breadboard Laboratory Validation Plan
- Program funding estimate
- Customer/sponsor briefed and support agreement obtained
- Program Plan Schedule

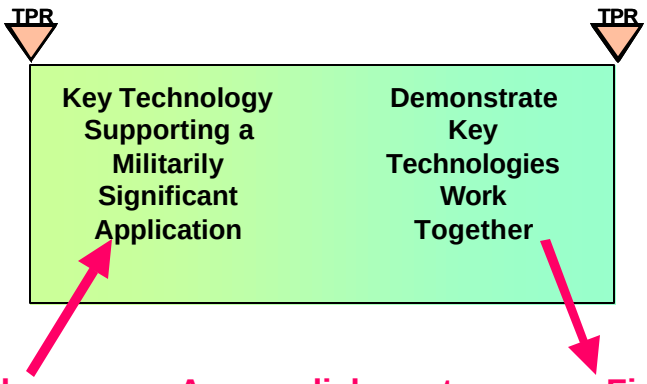
***Exit Criteria Met When*:**

- Key preliminary (draft) performance/technical parameters are identified
- Concept study findings are supported by demonstrated key technology capabilities
- Program Plan adequately outlines remainder of the program through transition
- Technology development program cost estimate is reasonable
- Program Plan Schedule developed and is realistic
- Customer has been briefed on program
- Sponsor agrees to fund technology development program
- Contracting strategy is appropriate for this technology

4.4 DEVELOPMENT PHASE

The Development Phase begins with demonstrated key technology(ies) supporting a concept having a significant military application. This phase integrates the basic key technology components to determine that they will work together. This is accomplished through integration of "ad hoc" hardware in a laboratory "breadboard" setting to validate not only that the technologies work together but also that their performance continues to support the expected concept outcome. During this phase, requirements are further defined and preliminary system engineering begins based on Form, Fit, and Function analysis to include consideration of the "ility" areas. Some examples of "ilities" are: Deployability, Survivability, Reliability, Sustainability, Availability, Maintainability, Safety Human Factors, Supportability, Logistics, Manufacturing, Producibility, Affordability, Interoperability and Environmental. Risk is assessed, a Risk Management Plan is developed, and the Program Plan is updated with increasing levels of detail for all remaining phases.

Development Phase



Begins With

- A Concept Supported by Demonstrated Key Technology(ies)
- Concept and Technology(ies) Provide Significant Military Capabilities

Accomplishments

- Integrates Key Technology Components
- Demonstrates "ad-hoc" Hardware Performance in Laboratory Supports Concept Outcome
- Starts System Engineering Activities

Finishes With

- Component Laboratory Validation Report
- Updated Requirements
- System Engineering Analysis Planned
- Continuing Customer Support
- Updated Program Plan with Increased Detail

Development Phase Considerations/Actions:

1. What organizations should be involved with this phase?
2. What technological 'breadboard' elements need to be integrated in the laboratory?
3. Which components are realistic and which are representative?
4. How will the concept be validated, i.e., by similarity, analysis, simulation or test?
5. Is the validation consistent with potential system applications?
6. What system capabilities have been identified through task analysis and/or timeline studies?
7. How will achievement of concept-enabling levels of performance be demonstrated?
8. What laboratory environment will be used?
9. Who will conduct the validation?
10. Will the customer observe the validation or be briefed on the outcome?
11. Prepare the Component/Breadboard Laboratory Validation Report
12. Prepare an "ilities Analysis Plan
13. What form, fit and function analysis have been performed to assure technology is compatible with customer(s) system(s)?
14. Develop a Risk Management Plan indicating the risk management strategy (including risk planning, assessment, analysis and mitigation) for this program?
15. What is the allocation of system functions to personnel, equipment, software, etc.?
16. What methods have been developed to track hazard identification and analysis?
17. Develop safety requirements that are consistent with the potential utilization of the technology.
18. Develop a Component/Brassboard Relevant Environment Validation Plan
19. What updates are necessary to the technology program funding estimate?
20. What updates are necessary to the program plan?

***Deliverables*:**

Program Plan (Updated) to include:

- Requirements Document (Updated)
- Component/Breadboard Laboratory Validation Report
- Component/Brassboard Relevant Environment Validation Plan
- An "ilities Analysis Plan
- Program funding estimate (Updated)
- Risk Management Plan
- Continuing customer/sponsor support agreement

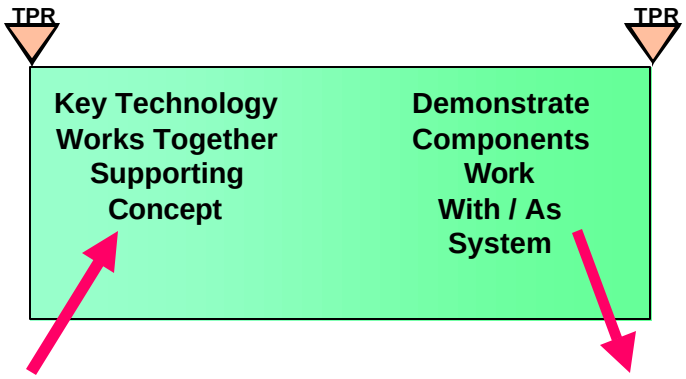
***Exit Criteria Met When*:**

- Validation that the technologies work together
- Technology performance to date continues to support expected concept outcome
- Requirements are further defined based on technology performance to date
- Preliminary system engineering analysis, including “ility” areas consideration, is started and documented
- Preliminary risk assessment completed
- Program Plan update includes increasing levels of detail for all remaining phases
- Sponsor has agreed to continue to fund program
- Customer has been briefed on program status

4.5 DEMONSTRATION PHASE

The Demonstration Phase begins with validated integrated key technology(ies) that continue to support the requirements of a concept with military significance. This phase demonstrates that the technology concept works as a whole with (or as) its intended system. This validation takes place in a relevant simulated environment where the basic technological "brassboard" components are successfully integrated with reasonably realistic supporting elements. Test data collection, analysis, reporting, corrective action, and re-testing as required are performed. During this phase, engineering model/prototype design begins taking into consideration system engineering integration issues and the results from the completed "ility" analysis. Final requirements that fully support the planned concept outcome are documented. In addition, the Program Plan is updated and a Transition Plan is developed with customer input and approval.

Demonstration Phase



Begins With

- Performance of Key Technology Continues to Support Concept Outcome
- Initial System Engineering Analysis

Accomplishments

- Develop High Fidelity Components or Brassboard
- Tests with Other Elements in "HWIL" or Other Relevant Environment
- Develops Transition Plan

Finishes With

- Final Requirements Documented
- Performance Validation Report
- Transition Plan Completed with Customer Concurrence
- Program Plan Updated

Demonstration Phase Considerations/Actions

1. What organizations should be involved with this phase?
2. What, if any, new technologies are introduced in this demonstration?
3. What part of the intended system will be simulated and what part will be reasonably realistic for this demonstration?
4. Which representative, 'ad hoc' components previously utilized have been replaced by realistic components?
5. Will the system-level application be demonstrated? If no, why not?
6. How does this demonstration represent the expected environment?
7. Who will conduct the demonstration and where will it be conducted?
8. Will the customer observe the demonstration or be briefed on the outcome?
9. What analysis has been performed to determine failure modes, effects and criticality issues?
10. Prepare a Component/Brassboard Relevant Environment Validation Report
11. Have the key performance parameters and requirements been updated/finalized?
12. Have all potential risk areas been identified and assessed for program impact?
13. What updates are necessary to the risk management plan?
14. What system maintenance model has been developed to examine alternative configurations, methods and test techniques to minimize downtime and maintenance cost?
15. What methods have been developed to track safety requirements, standards, procedures and certification?
16. What analysis has been performed to identify design criteria, and what are the criteria?
17. What is the manufacturing strategy for this program, and its associated cost?
18. What are the critical technologies and materials needed for manufacturing and production?
19. What is the availability of critical technologies and materials needed for production?
20. Quantify the feasibility of the production for this program.
21. Has a logistics and supportability concept been defined?
22. What updates are necessary to the program plan?
23. What updates are necessary to the technology program funding estimate?
24. Develop a Prototype relevant environment Demonstration Plan.
25. Prepare the transition plan and coordinate with the customer.
26. Does the technology have a planned insertion date?

***Deliverables*:**

Program Plan (Updated) to include:

- Requirements Document (Final)
- Component/Brassboard Relevant Environment Validation Report
- An "ilities" Analysis Report
- Prototype Relevant Environment Demonstration Plan

- Program funding estimate (Updated)
- Risk Management Plan (Updated)
- Transition Plan approved by customer

***Exit Criteria Met When*:**

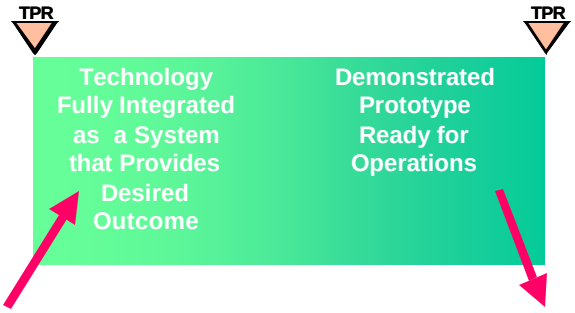
- Technological components successfully integrated with reasonably realistic supporting elements in a relevant simulated environment
- Technology concept demonstrated as a component with its intended system (or as a system itself)
- Engineering model/prototype design takes into consideration integration issues
- An “ilities” analysis completed and results adequately addressed
- Final requirements developed
- Program Plan is updated to reflect results of this phase
- Transition Plan is developed with customer input and approval
- Sponsor has agreed to continue to fund program

4.6 TRANSITION PHASE

The Transition Phase begins with technology components that work as (with) the intended system and support requirements that produce the desired concept outcome. To prepare for transition into the customer system, technology model/prototypes are produced and tested in a relevant environment, or simulated operational environment to validate the system works and all required transition activities are complete. During this phase, transition from design to production begins with manufacturing and producibility issues being addressed. All other "ilities" planning, that supports the transition of the technology into the system, are validated. Customer acceptance and funding is in place and the Transition Plan is updated, as required.

For ACTDs, even though they may never transition to an acquisition program, the TPMM process remains a valid method for planning and executing the technology program/project. There are some differences however, for example, the Technology Readiness Level (TRL) goal of a non-ACTD/ACTD for transition to customer management is TRL 6. Sometimes the ACTD remains under a Technology program/project through TRL 7 and is left behind for a two-year extended user evaluation without a transition to Customer Management. There are even cases where a technology pull could allow a technology program/project to transition as early as TRL 4 or 5.

Transition Phase



Begins With

- Technology Components Working as/with Intended System
- All System Engineering Areas Addressed and Ready for Validation

Accomplishments

- Produces Prototype Hardware
- Conducts Tests in a Relevant or "Operational" Setting
- Validates of All Transition Requirements
- Receives Final Approval of Transition Activities

Finishes With

- Prototype Performance Documented in Validation Report
- All "ilities" Verified and/or Addressed
- Customer Satisfied with Results and Ready for Transition
- Transition Funding in Place

Transition Phase Considerations/Actions

1. What organizations should be involved with this phase?
2. Develop a representative model or prototype.
3. How are the technologies going to be presented in this demonstration?
4. What portions of the demonstration are simulated?
5. How will the demonstration be conducted in a relevant environment, i.e., Hardware-in-the-Loop (HWIL) test bed?
6. What methods have been developed to track reliability growth, qualification, test, and acceptance?
7. What methods have been developed to track failure diagnosis, fault isolation, removal, replacement/repair, retest and verification?
8. Who will conduct the demonstration?
9. Will the customer observe the demonstration or be briefed on the outcome?
10. Prepare a Prototype Relevant Environment Demonstration Report
11. What procedure has been developed to monitor and control sub-contractors and suppliers?
12. How are producibility issues addressed and what are the producibility exit criteria for this phase of the program?
13. How will production readiness be determined for this program?
14. Is there a need for long lead procurement for this program?
15. How are manufacturing issues addressed for this program?
16. What updates are necessary to the program plan?
17. Develop a Transition Memorandum of Agreement (MOA) indicating how the customer will assume responsibility for the system.
18. What updates are necessary to the transition plan?

***Deliverables*:**

Program Plan (Updated) to include:
- Prototype Relevant Environment Demonstration Report
- Program funding estimate (Updated)
- Transition Plan (Updated)
- Transition Memorandum of Agreement (MOA) signed by customer

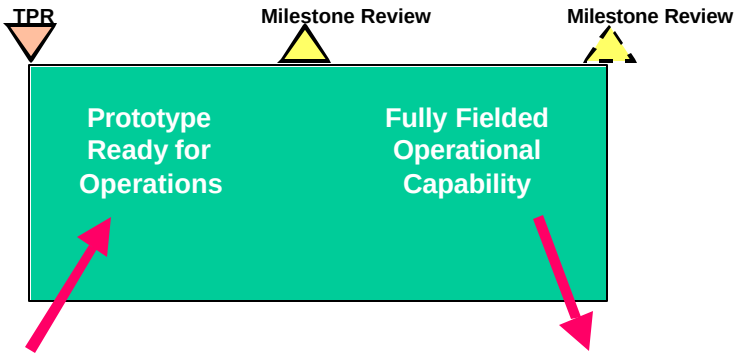
***Exit Criteria Met When*:**

- Technology model/prototype(s) produced and tested in a relevant environment, or simulated operational environment, validating accomplishment of requirements
- Manufacturing and producibility issues are addressed
- All other “ilities planning supporting the transition are validated
- Customer is satisfied that the demonstration is a success and technology is ready for transition
- All required transition activities are complete
- Program plan is updated, as required
- Sponsor has agreed to continue to fund program to transition
- Transition Plan is updated, finalized, and a MOA is agreed to by customer

4.7 CUSTOMER MANAGEMENT

The Customer Management Phase begins with the transfer of the prototype from the TM to a customer such as an Acquisition Program/Project Management Office (PMO) or establishment of its own PMO. The prototype is near or at its planned system operational capability. Demonstration in an operational environment of the system prototype is conducted, most likely in a test bed, to prove the technology will work in its final form under expected conditions. Next, to determine if it meets design specification, the technology is subjected to Developmental Test and Evaluation (DT&E) in its intended weapon system. To determine if the technology can perform as expected under mission conditions DT&E is followed by an Operational Test and Evaluation (OT&E). Upon successful completion of all testing, the technology is incorporated into the designated system. All actions during the Customer Management Phase must comply with the DoD Systems Acquisition Management Model, if applicable.

Customer Management Phase



Begins With

- Transfer of Prototype to Customer
- Prototype near or at Planned System Operational Levels
- All Transition Planning Activities Completed

Accomplishments

- Completes Activities Identified in the DoD 5000 Acquisition Management Regulations

Finishes With

- Technology Fully Incorporated into Designated System and Fielding Activities Accomplished

Customer Management Phase TRL-7 Considerations/Actions

1. How does the prototype adequately represent the actual system?
2. Has the system prototype been demonstrated in a real environment, i.e., ground or flight test?
3. Who will conduct the demonstration?
4. What organizations should be involved with this phase?
5. Is customer funding in place for this effort?

***Exit Criteria 7 Met When*:**

- Program plan is incorporated into customer system program documentation
- Funding for this program has been allocated
- Criteria developed in accordance with Systems Acquisition Management requirements of the DoD 5000 Series

Customer Management Phase TRL-8 Considerations/Actions

1. How will system-engineering analysis be conducted on the system to cover all aspects of integration of the prototype into the system?
2. How is producibility addressed and what are the producibility exit criteria for this phase of the program?
3. Is there a need for production of spares for this program?
4. What alternative materials and processes, if any, have been identified?
5. Where will the production line be established?
6. If a new production line were required, how will it be established?
7. How will the new production line be validated?
8. Are any hazardous or toxic materials used in production, and if yes, what effects will these materials have on the production schedule?
9. How have the design, production and range safety issues been resolved?
10. What are the plans for 'cut-in' to system production?
11. Will low rate production be initiated?
12. When will the qualification test be performed?
13. When will a production line unit be flight tested?
14. What plans have been made for the Pre-Planned Product Improvement (P3I) program, if required?
15. How will logistical support functions be evaluated?

***Exit Criteria 8 Met When*:**

- Criteria developed in accordance with Systems Acquisition Management requirements of the DoD 5000 Series

Customer Management Phase TRL-9 Considerations/Actions

1. When will the First Unit Equipped (FUE) be fielded?
2. When will the Pre-Planned Product Improvements (P3I) program be finalized?
3. When will logistical support functions be implemented?
4. When will the system be proven in war games or actual battlefield conditions?

Exit Criteria 9 Met When:

Criteria developed in accordance with Systems Acquisition Management requirements of the DoD 5000 Series

SECTION V. MODEL IMPLEMENTATION

5.1 IMPLEMENTATION STEPS

Implementation of the TPMM is a very flexible process that can be tailored for any Technology Program/Project. Since all programs or projects do not start in the same stage of development, the TM must determine where in the model their Technology Program/Project most appropriately fits. The following are the general steps for implementing the TPMM.

5.1.1 Determine where in the model to start

Although the TPMM is new, the processes and building blocks of the model, which are consistent with the DoD acquisition processes and policies, are not. The TPMM Phase descriptions and corresponding TRLs provide a logical grouping of time phased activities and milestones that must be accomplished for successful development and transition of a technology to the customer.

These same TRLs and Phase descriptions, along with Exit Criteria, provide the basis for determining what phase to enter the model. First, the Technology Manager determines what TRL the Technology Program/Project has achieved by reviewing the phase descriptions and Exit Criteria of all of the phases starting with the Discovery phase. When all of the criteria for a given phase have been met and can be validated with experimental or analytical information, the review continues on to the next phase and so on until a phase is reached where all of the criteria have not yet been met.

Second, the Technology Manager then plans to enter the model at the beginning of the phase where all of the criteria have not yet been met. As an example, if all of the criteria for both the Discovery and Formulation phases have been met but not for the Exploration phase then the TM would plan to enter the model at the Exploration phase. Actual entry into the TPMM starts with *a* Technology Process Review (TPR) that would have occurred at the end of the previous phase where the Technology Manager feels all of the criteria have been met. In our example, this would be at the end of the Formulation phase. The TPR serves to validate that all of the requirements of the previous phase (Formulation phase in our example) have been successfully met and that planning and funding for the next phase (Exploration phase in our example), the phase being entered, is complete and satisfactory.

Once the TPR has given approval, the TM would begin work to accomplish all of the appropriate requirements of the phase entered and continue to follow the model through transition to the customer.

When a program has multiple sub-technologies, the TM has to determine not only the TRL of each separate technology but also the overall program TRL. Each of these sub-technologies are assessed using the previously described method for determining

the TRL. The overall program Technology Readiness Level will be the same as that sub-technology that has been rated with the lowest TRL. For example, a Program consisting of three sub-technologies, two at TRL 3 and one at TRL 2, will have a overall program TRL of 2 because it is the lowest TRL within the program.

5.1.2 Determine what activities need to be planned and accomplished

Planning is a continuous activity throughout the model, taking into consideration the needs and requirements of subsequent phases. If the Technology Program/Project is entering the early stages of the model (Discovery, Formulation) planning for only the next phase is required. However, programs/projects entering in later phases (Exploration, Development) must plan for all activities required through transition to Customer Management of the technology. Proper planning helps to identify more accurately the funding necessary to accomplish requirements. Planning is also important in preparing for TPRs. The TPR Decision Authority must be convinced that there is a plan for the next phase and resources are available to execute that plan.

After selection and TPR approval of the entry phase, the Technology Manager determines what activities need to be planned and accomplished. Start by reviewing the description and Exit Criteria of the proposed entry phase and the remaining phases of the model to determine how the Technology Readiness Levels should be tailored for this technology. Develop a Technology Maturity Matrix similar to the LADAR Example, (located in Figure 5.1) showing the specific tailored criteria to meet each of the Technology Readiness Levels along with how that tailored criteria will be validated.

Next, use sound system engineering principles, the Technology Maturity Matrix, the phase Considerations/Actions, and the Major Activities/Phase Matrix (located in Figure 5.2) as a guide to determine what activities are required in each phase. Careful consideration of the above steps will provide the Technology Manager with a comprehensive list of activities to plan and schedule. Remember, the TPMM is a flexible process, which is tailored for each Technology Program/Project.

5.1.3 Document the accomplishments and the planning

After the selection of the entry point, determination of activities, and planning for their execution, the Technology Manager documents the program/project accomplishments and plans. First, review the Deliverables required for the phase in which the program/project enters the model. This review will identify the documents required to provide adequate information for the Decision Authority during the TPR. Upon initial entry into the model, some of the existing documentation may not be an exact match by name, but the content will provide much of the needed information. Second, review the documentation guidelines in Section VI and the formats located in the Appendices of this guidebook. Finally, develop the Technology Program/Project documentation based on the guidelines and formats. The primary objectives of this

documentation are to assist the TM in planning, scheduling and executing their programs; and for distribution to the TPR Decision Authority prior to a TPR.

The primary planning document for the TPMM is the Program Plan (Appendix E). It contains all of the important elements of what is necessary to accomplish successful development and transition of the technology to the customer. The Program Plan is developed during the Exploration Phase and refined in each of the subsequent phases. The Program Plan Schedule is developed in conjunction with the Program Plan and provides the Technology Manager with an excellent tool for tracking progress on the Technology Program/Project. The TPR Decision Authority also relies on the Program Plan Schedule for reviewing the status of a program/project.

5.1.4 Review

As indicated above, entry into the TPMM starts with a Technology Process Review. The TPR serves to validate that all of the requirements of the previous phase have been met. Technology Programs/Projects must show continuous progress towards completion of a successful transition to the customer. This progress is reported to the TPR Decision Authority at the end of each phase.

The documentation required in each phase is used to provide information concerning the completion of the Exit Criteria for that phase. These Exit Criteria provide a means for measurement by the TPR Decision Authority in determining actual progress versus planned and what action should be taken. Section VII and Appendix F contain information on how to prepare for Technology Process Reviews.

5.1.5 Execute

Upon receiving approval of the TPR to enter the model, as described in par 5.1.1 above, the Technology Manager would start to accomplish all of the appropriate requirements of the phase entered and continue to follow the model through transition to the customer. Details for the technical execution of Technology Programs/ Projects are beyond the scope and intent of this Guidebook. However, there are numerous documents available on the actual execution of a program. Also, there is a wealth of expertise and knowledge resident within the Space and Missile Defense Technology Center upon which the Technology Manager can rely.

5.1.6 Update the Plan

The Technology Manager updates and refines the appropriate Technology Program/Project documentation toward the completion of each phase. This is based on results of tests and evaluations, analytical studies, and other accomplishments. Next, the Technology Manager determines what activities need to be planned and accomplished during the next phase of the TPMM. The appropriate plan needed for the next phase is then developed. As an example, the “Proof of Concept Plan,” needed for the Exploration phase, would be developed before completion of the formulation phase.

The primary planning document, the Program Plan, once it is developed in the Exploration phase, is updated during all remaining phases. All TPMM plans are reviewed and approved at the appropriate TPR.

TRL	Criteria	Tailored LADAR Criteria	Validation
9	Actual system, mission proven	Flight test against C2 + threats	Fly production unit against C2 + threats
8	Actual system, mission qualified	First production unit flight test	Fly production unit LADAR in actual interceptor in a C2 demo
7	System prototype demo, hi-fi environment	Development test flight unit integratable in interceptor	Flight test in space environment
6	System/subsystem prototype demonstration in relevant environment	Develop prototype with required performance and weight traceability	Test prototype on ground or in airborne demonstrations
5	Subsystem/module validation in relevant environment	Develop and test complete brassboard in simulated environment	Conduct high fidelity field experiments
4	Subsystem/module validation in lab environment	Validate performance of partial breadboard	Conduct hardware feasibility tests at AMOR or in field
3	Analytic/experimental proof of concept	Validate performance of all components of conceptual design	Conduct laboratory experiments validating component performance
2	Technology concept, synthetic data	Develop requirements for LADAR using a system flow down process	Develop LADAR conceptual design
1	Basic principles, concepts	Conduct literature search on	Develop LADAR utility

Figure 5-1. Technology Maturity Matrix LADAR Example

		Technology Program Phase						
	Activities	**Discovery**	**Formulation**	**Exploration**	**Development**	**Demonstration**	**Transition**	**Customer Management**
A	**Concept Formulation/ Requirements Evolution**							
	1 Basic Principles/properties defined	X	X					
	2 Military Utility Analysis		X	X	X	X	X	X
	3 Concept Definition		X	X	X			
	4 Key Performance Parameters			X	X	X	X	X
	5 Performance Thresholds/Objectives				X	X	X	X
	6 Customer System Requirements Considerations			X	X	X	X	X
B	**Program Planning and Risk Management**							
	1 Program Plan (Cost, Schedule, Performance)			X	X	X	X	X
	2 Risk Assessment and Risk Management Plan				X	X	X	X
	3 Budgeting and Funds Management	X	X	X	X	X	X	X
	4 Reviews and Assessments	X	X	X	X	X	X	X
	5 Contract Management		X	X	X	X	X	X
	6 Transition/Fielding Considerations				X	X	X	X
	7 Project/System Cost Estimations			X	X	X	X	X
	8 Customer Involvement			X	X	X	X	X
C	**System Engineering Process**							
	1 System Design and Affordability		X	X	X	X	X	X
	2 Software Engineering			X	X	X	X	X
	3 Reliability, Availability, & Maintainability				X	X	X	X
	4 Manufacturing and Production					X	X	X
	5 Interoperability				X	X	X	X
	6 Logistics				X	X	X	X
	7 Human Systems Integration				X	X	X	X
	8 Environmental, Safety, and Health				X	X	X	X
	9 Transition Considerations			X	X	X	X	X
D	**Test and Evaluation**							
	1 Analytical and Simulation Tools (Planning and Acquisition)		X	X	X	X	X	X
	2 Planning		X	X	X	X	X	X
	3 Conduct/Perform Analyses and Simulation		X	X	X	X	X	X
	4 Perform Hardware, Software, & System Testing			X	X	X	X	X
	5 Assess/Report Performance			X	X	X	X	X

Figure 5.2 Major Activities/Phase Matrix

SECTION VI. DOCUMENTATION GUIDELINES

This Guidebook provides the TM with a step-by-step process to move a technology through the various phases of development with the ultimate objective being to transition the Technology Program/Project into an acquisition program. There are many deliverables along the way. These deliverables, primarily in the form of documentation, are required not only for the effective management of the technology development effort but also to support the STO, ATD, and ACTD nomination process and to provide the basis for documentation required as the technology transitions into the formal acquisition process.

The following are some guidelines for consideration in the development of documentation to support the Technology Program/Project as it moves through the TPMM.

- The documentation should be tailored and streamlined for the individual Technology Program/Project.
- The documentation must still provide the needed information to make informed decisions.
- The documentation details should "grow" as the technology progresses from idea to a prototype ready for the customer. In other words, concentrate on documenting the information known at the time; in the Formulation Phase this may be a small amount but increases as the technology moves towards the Transition Phase.
- The documentation must provide the "proof" - Results, Requirements, Risks, and Plans - at every review to support entry in to next phase.

The principal tenet of the TPMM philosophy is to maintain a flexible approach to the technology development process and to avoid excessive rigidity and formality in the documentation and review process. Hence, it is intended that the principal management tool for the TPMM, the Program Plan, (see appendix E) be an executive-level document written in informal language (preferably less than 25 pages). Detailed documentation, as needed, for a phase of the effort will be provided as Annexes to the Program Plan. The TM will generally draft the Plan in coordination with the customer and other participants. The Program Plan is a plan; it is not intended to be immutable as modifications may be warranted from time to time. However, all substantive (i.e., schedule, funding, content, objectives) changes require approval by the TPR Decision Authority.

The principal management tool for the ACTD is the ACTD Management Plan. The guidelines for developing the ACTD Management Plan are provided in the Acquisition Deskbook (www.deskbook.osd.mil). The ACTD Management Plan provides a top-level description of the demonstration with sufficient detail of the vital objectives, approach, critical events, participants, schedule, and funding. The ACTD Management Plan will generally be drafted jointly by the primary acquisition and user organizations for the ACTD, with assistance from other participants. The ACTD Management Plan is evolutionary and is expected to reflect any significant changes, such as in objectives, approach, or critical events.

The primary objective of the documentation is to ensure that the TM has all of the information necessary to successfully execute the program and that it is also available for the Technology Process Reviews. The goal of supporting an informed decision process is much more important than the format of the documentation. Figure 6-1 provides a matrix of documentation by TPMM Phase. An additional objective of this documentation is to provide the "starter set" of documentation for transition to a future acquisition Program/Project Manager (PM) that is consistent with current acquisition policy and processes.

Good documentation provides information that can be used to quickly answer inquiries or other requirements from customers, sponsors, DOD, and Congress, etc. Generally, having the answers to the following ten questions, will provide a ready reference to respond to such inquiries:

Ten Questions for Technology Programs

1. What is the problem?
2. What are the barriers to solving this problem?
3. How will you overcome those barriers?
4. What is the capability you are developing and where is it described?
5. What is the product of this STO?
6. How will success be measured? (Quantitative Metric)
7. What is the Warfighter Payoff?
8. What are the key Transition Milestones?
9. What endorsements have been received?
10. How are you leveraging Non-Army Funding?

Phase	*Discovery*	*Formulation*	*Exploration*	*Development*	*Demonstration*	*Transition*	*PMO*
Technology Readiness Level Achieved During Phase	**1 & 2**	**1 & 2**	**3**	**4**	**5**	**6**	**7, 8 & 9**
Technology Program Management Model Documentation							
White Paper	X						
Concept Formulation Plan	X						
Concept Formulation Analysis Report		X					
Proof of Concept Plan		X					
Program Plan			X	U	U		
Requirements			X	U	U		
Reports and Assessments							
Reports							
Proof of Concept Analysis Report			X				
Component / Breadboard Laboratory Validation Report				X			
Component / Brassboard Relevant Environment Validation Report					X		
Prototype Relevant Environment Demonstration Report						X	
Assessments							
illities Assessment					X		
Plans							
Component / Breadboard Laboratory Validation Plan			X				
Component / Brassboard Relevant Environment Validation Plan				X			
Prototype Relevant Environment Demonstration Plan					X		
illities Analysis Plan				X			
Contracting Information							
Statement of Work for each Phase			X	X	X	X	
Work Breakdown Structure for Each Phase			X	X	X	X	
Contracting / Acquisition Strategy			X	X	X	X	
Funding			X	U	U	U	
Risk Management							
Risk Management Plan				X	U		
Transition							
Customer / Support Briefing and Support Agreement			X	U	U	U	
Transition Plan					X	U	
Transition Memorandum of Agreement (MOA)						X	
Other Considerations							
Technology Process Review Information	X	U	U	U	U	U	

X - Initial
U - Update

Figure 6-1. Documentation by Phase Matrix

SECTION VII. TECHNOLOGY PROCESS REVIEWS

The technology process review (TPR) not only review a technology programs ability to meet the customers needs and fiscal soundness, but it also provides guidance and assistance to help ensure success of the program. A TPR will be conducted at the end of each phase.

The TPR Decision Authority has the option to continue the project or program in its current phase, modify the project or program, terminate the project or program, or proceed into the next phase. The size, composition, and level of the TPR Decision Authority are dependent on the complexity of the technology, the TPMM Phase, and the level of funding involved in the effort. To ensure customer involvement throughout the entire process, the customer should be a sitting member of the TPR. The TPR Decision Authority shall promote flexible, tailored approaches to oversight and review based on mutual trust and a program's dollar value, risk, and complexity.

The objectives of the Technology Process Review (TPR) are to:

- Ensure that the SMDTC is pursuing the most practicable technology path to correct an operational deficiency, or respond to a threat, with full appreciation of limited resources
- Ensure sound tailoring of the technology management strategy to meet the specific needs of the individual program
- Emphasize early life cycle planning for the successful transition of the technology to the customer
- Review the results of technology evaluations pertaining to the assessment of the programs progress towards achieving effectiveness, suitability, and survivability requirements for the technology phase for which the review is held
- Ensure Risks are considered
- Ensure adequate funding is identified for the next phase
- Provide the Decision Authority accurate and timely program information to enable firm decisions and clear guidance

In support of these objectives the membership of the TPR must have the necessary information to assist them to in reviewing the need, progress, risks, and future plans for the technology. The typical questions to be addressed during a TPR may consist of the following:

- What is the technology?
- What need does it address?
- Who is the customer?
- What are the required capabilities to meet the need in a significant way?
- What capabilities have been demonstrated?
- What are the risks?
- What is the plan (including cost and schedule) for the rest of the effort?

- What are the exit criteria for the next phase?
- What funding is allocated?
- Are there any unfunded requirements?

Examples of TPR information and outlines are provided in Appendix F.

The TPR Decision Authority may hold other reviews to adjust plans, review progress, or determine how best to proceed toward a favorable transition to the customer. The purpose of an interim progress review is to confirm that the program is progressing within the phase as planned or to adjust the program due to changes in requirements/funding. If the adjustment involves changing the technology management strategy, the TPR Decision Authority must approve the change. There is no required information necessary for interim progress reviews other than the information specifically requested by the TPR Decision Authority.

SECTION VIII. SUMMARY

The purpose of the TPMM is to provide a logical methodology to guide TM's through the planning and documentation of their programs. The TPMM standardizes planning, documentation, and review of Technology Programs/Projects. It provides a vision for the transition of technologies to a customer, Program Manager, or as an Acquisition Program. The TPMM also assists TM's in determining military utility early in the process, which helps in identifying potential users and customers who are then involved throughout the entire process.

The purpose of this Guidebook is to provide a source of information that the TM should find useful in developing, structuring, and documenting their program. However, this Guidebook alone does not provide the TM with a definitive management strategy for his/her program. Well informed, educated, and innovative applications and judgments concerning the particular technology are necessary to structure a successful management plan. TM's should continue to seek guidance, data, and assistance from available sources as they prepare and revise their Technology Program Plan.

The TPMM establishes a general approach for managing Technology Programs/Projects while acknowledging that every Technology Program/Project is unique. The TPMM process benefits the Space and Missile Defense Technology Center and the individual TM because of the potential to:

- Strengthen Technology Program/Project justification to increase customer acceptance and funding support
- Facilitate review and prioritization among Technology Programs/Projects in a constrained resource environment
- Improve the documentation process to support the STO / ATD / ACTD Nomination Process or Transition to an Acquisition Program
- Support better program execution through detailed management planning with emphasis on Cost, Schedule, and Performance Goals
- Improve Technology Development Process Efficiency (Less Time/Resources) and Effectiveness (High Technology Transfer Ratio)

APPENDIX A. WHITE PAPER

The White Paper is developed during the Discovery Phase after conducting a literature search. The paper describes the effort, the basic principles/properties involved, and identifies the known or perceived need/application along with potential customers(s)/sponsor(s). The white paper is a key reference for development of the Program Plan during the Exploration Phase. The following are questions that should be answered prior to preparing the White Paper.

- What is the Problem?
- What are the barriers to solving this problem?
  - Identify key technical and manufacturing barriers to success
- How will you overcome those barriers?
- What is the capability you are developing and where is it described?
  - Army Vision, Investment Guidance, Mission Needs Statement, etc. .
- What are the basic principles/properties involved?
- What is the product of this Technology Program / Project?
- Quantitative Metrics:
  - Current achievable capability: start TRL,
  - Minimum acceptable capability: end TRL
- What is the Warfighter Payoff?
- Endorsements?
- How are you leveraging non-Army funding?

Format

1. Title
2. Description
3. Objective
4. Need, Significance, and Opportunities
5. Potential Customer/Sponsorship/Endorsement
6. Technology Capability Requirements
7. Technology System Engineering Approach
8. Relationship to Other Service or Agency Related Programs
9. Funding Requirement
10. Other Considerations

APPENDIX B. CONCEPT FORMULATION PLAN

1. Brief description of the technology and the potential military needs/benefits

2. Description of Concept Formulation Process
   a. Identify how the potential concepts will be defined for the technology and how the associated practical military application will be determined.
   b. Identify the approach for identifying key technologies for this program.

3. Description of Analysis and Evaluation of Feasible Alternatives Plan
   a. Describe the plan for how the analysis will be accomplished
   b. Describe the conceptual formulation studies that will be considered and analyzed.
   c. Describe the analytical tools that will be used for the assessment
   d. Describe the key performance parameters and other criteria that will be used to select the preferred concept.
   e. Approach to determine the Technology Difficulty Index
   f. Discuss how the military benefits and performance potential will be determined
   g. Process to identify specific customer(s)/sponsor(s)

4. Other Factors
   a. Identify costs for concept formulation/definition
   b. Present schedule for concept formulation effort
   c. Identify organizations that should be participating

APPENDIX C. CONCEPT FORMULATION ANALYSIS REPORT

1. Brief description of the technology and the potential military needs/benefits

2. Description of Concept Formulation Effort
   a. Identify potential concepts that were defined for the technology and the associated practical military application.
   b. Identify the key technologies resulting from the concept formulation

3. Description of analysis and evaluation of feasible alternatives results
   a. Describe the concepts and feasible alternatives that were considered
   b. Describe the results of the analysis
   c. Describe the conceptual formulation studies that were conducted
   d. Describe the analytical tools that were used for the assessment
   e. Describe the key performance parameters and other criteria and their values that were used to select the preferred concept (s)
   f. The Technology Difficulty Index for The Preferred Concepts
   g. Describe the military benefits and performance potential for the preferred concept (s)
   h. Describe the potential customer(s)/sponsor(s)

4. Other Factors
   a. Identify costs for the next phase
   b. Present schedule for the next phase
   c. Identify organizations participating in the next phase

5. Recommended Best Feasible Concepts

APPENDIX D. PROOF OF CONCEPT PLAN

1. Summary of the technology/system concept

2. Summary Description of Alternatives To Be Considered
   a. Describe how the alternate concepts will be defined and concepts already known
   b. Describe the analytical tools that will be used for the assessment.
   c. Describe the key performance parameters and other criteria that will be used to select the preferred concept.

3. Analysis Plan
   a. Describe the plan for how the analysis will be accomplished
   b. Describe the conceptual design tradeoff studies that will be considered and analyzed.
   c. Describe how the results of the analyses and tradeoffs will be used to determine the most promising candidate concepts/designs in terms of Key Performance Parameters (KPPs), technology verification requirements for future phases, cost, schedule, and risk.
   d. Discuss how the sensitivities from tradeoffs that require tightening or loosening of design/performance requirements will be accomplished,

4. Descriptions of how the preferred alternatives would be presented/defined and the process for finalizing the design/technology concept and determining the technology verification requirements for future phases. Discuss how cost, producibility, and supportability will be addressed.

5. Describe how the assessment of risk and plan for managing risks will be accomplished.

6. Other Factors
   a. Identify costs for accomplishing the proof of concept
   b. Present schedule for proof of concept effort
   c. Identify organizations participating

APPENDIX E. PROGRAM PLAN

The principal management tool for the Technology Program Management Model (TPMM) is the Technology Program Plan, the guidelines for which are given below. The TM should draw on information from previous documentation, ie. White Paper as a starting point for developing the Program Plan. A tenet of the TPMM philosophy is to maintain a flexible approach to the technology development process and to avoid excessive rigidity and formality in documentation and process. Hence, it is intended that this Plan be an executive-level document (preferably less than 25 pages), written in non-technical language. Detailed documentation, as needed, for a phase of the effort will be provided as an Annex to the Plan. The TM will generally draft the Plan in coordination with the customer and other participants. The Technology Program Plan is a plan; it is not intended to be immutable, as modifications may be warranted from time to time. However, all substantive (i.e., schedule, funding, content, objectives) changes require approval at the Technology Process Review.

1. Title: Proposed program title. Provide also the existing or proposed nomination Science and Technology Objective (STO) number, if applicable.

2. Description:

a. A short easily understood executive summary of the program. Avoid acronyms and technical jargon. Use clear English.

b. Quad Chart: A summary of information in a quad-chart format with each quadrant showing (clockwise from upper left-hand corner): (1) objective and justification including customer/Program Manager (PM) support, (2) proposed concept (picture or diagram), (3) approach and applications, and (4) program schedule and funding. A format is not provided in this guidebook. However the TM should check with the JCTI for the latest format required for the QSR.

c. Concept Diagram: A Color concept diagram or photo to represent the program in viewgraph form.

3. Objective:

a. Purpose and Goal: A concise statement of the program's overall purpose and goal including the operational context.

b. Technical Concept: A short description of the technologies to be demonstrated.

c. Demonstration Concept: A short description of the planned environment for the validation of the technologies proposed.

4. Need, Significance, and Opportunities:

a. Military Need: A short description of the future capabilities required and addressed by the program. Indicate the materiel deficiencies, operational deficiencies, or the threats that are addressed by the program.

b. Military Significance: Provide a short description of the operational payoffs based on the results of Military Utility Analysis. This includes descriptions of the improvements to an existing capability, and/or the new operational capability, and the implications related to affordability, cost, maintainability, and sustainability. Specifically, address the beneficial impact this will have on the military user, i.e. will it afford more time to react, be easier to use, provide greater safety or protect or, reduce costs, etc? Include any other relevant points.

c. Logistics Implications: Indicate the program's logistics impacts on manpower, maintenance, supply, transportation, training, facilities and other logistics system concepts and doctrine.

d. Horizontal Technology Integration (HTI) Opportunities: Identify HTI opportunities. HTI is the common application of standardized components and subsystems across multiple systems to minimize support burdens, reduce life cycle cost, and increase total force effectiveness.

5. Customer/Sponsorship/Endorsement: Identify the customer(s), sponsor(s) and/or the endorsing organization(s). Outline the support/interest of these groups and the PM to whom the technology might transition. When appropriate, include a concurrence sheet showing the name (minimum O-6 level), organization, office symbol, telephone and fax numbers, and electronic mailing address of the interested/supporting organizations.

6. Technology Capability Requirements: Summarize the identified performance parameters (capabilities and characteristics) required. Operational performance parameters include performance in an operational environment. Articulate requirements in operational, output-oriented, and measurable terms. Specify each performance parameter in terms of a minimum acceptable value (threshold) required to satisfy the capability need. Objectives, if stated, should represent a measurable, beneficial increase in capability or operations and support above the threshold. Give rationale separately for every requirement and include that in the body immediately following the requirement it supports (e.g., “The XYZ requires X. Rationale: The XYZ must be able to operate ...”). If objectives are stated, provide rationale that justifies the objective as well as the threshold. State the rationale in operational language providing a credible audit trail explaining the operational significance of each requirement. The rationale should not refer to Army regulations, military standards, or military specifications. (Provide a detailed Requirements Document as Annex A)

7. Technology System Engineering Approach:

a. Technology Maturity: Describe the maturity of key technologies and components (use Technology Readiness Level descriptions). Identify the improvements needed before the program can transition to the customer. Identify and describe the Technology Difficulty Index rating that applies to the program and addresses risks as part of the Risk Management Plan. (Provide details of technology readiness level assessment in Annex B)

b. Provide summary of how a sound system engineering approach will be used to accomplish the technology maturity needed and to fully support the translation of the needs and requirements into an operationally suitable system. The operationally suitable system should fulfill all the requirements to smoothly transition into the customer's system. The approach should consist of a top-down, iterative process of requirements analysis, functional analysis and allocation, design synthesis and verification, and analysis and control. In a summary narrative, describe the process for transforming needs and requirements into an integrated design solution through concurrent consideration of all life-cycle needs to include: development, manufacturing, test and evaluation, deployment, operations, support, and training. The approach should address the scope of the technical effort required to develop the technology(ies) by answering the basic questions of "who will do what" and "when (Provide details of plans in Annex C)

c. Briefly describe how the planned technology system engineering approach will include the coordination with related activities such as; verification testing, integrated logistics support planning, design producibility, and interoperability issues. (Provide details of analysis or plans in Annex C)

8. Technology Program Execution:

a. Acquisition Plan: Describe the acquisition plan that will guide program execution from initiation through transition. The acquisition plan should evolve through an iterative process and become increasingly more definitive in describing the relationship of the essential elements of a program. A primary goal of the plan is to minimize the time and cost it takes, consistent with common sense and sound business practices, to satisfy identified, validated needs for technologies, products, and services, and to maximize affordability throughout a program's useful life cycle. The acquisition plan should provide a complete picture of the program, to include system engineering and contracting actions, for the decision-makers who will be asked to coordinate on or approve the program. Ensure the plan is in sufficient detail to identify, address, describe, summarize, or otherwise document specific, major aspects or issues of the program or strategy. (Provide an outline of contract information Annex D)

b. Proposed Program Schedule by Fiscal Year (FY) with Major Milestones: Show all major activities and milestones/time lines in a tabular or Gantt chart format, including proposed TRADOC or Battle Lab experiment(s), accurate to within a quarter of a FY. (Provide in graphic form as part of this section)

c. Funding Required: Show funding required by FY, by Program Element (PE)/ Project. Identify any shortfalls and approaches to resolution of shortfalls. (Provide summary cost funding line as part of program schedule graphic in this section. Provide summary details of funding analysis and estimate in Annex E)

d. Integrated Product and Process Development (IPPD) Plan: Describe the plan for implementing the IPPD process, the elements of that process, and the plan for including IPPD in the contracting statement of work. IPPD shall be employed to the maximum extent practicable. IPPD considers and integrates program activities throughout the entire program life cycle, including systems management, development, manufacturing, testing, deployment, operations, support, training, and eventual disposal. Using IPPD, multi-disciplined Integrated Product Teams (IPTs) should simultaneously optimize the product, product manufacturing, and supportability to meet system cost and performance objectives.

e. Principal Performers and Roles: Identify the points of contact (POCs), e.g., Technology Program Manager, Battle Labs (BL) or Director of Combat Developments (DCD), and other participants as appropriate by name, organization, office symbol, telephone, and fax numbers, and electronic mailing address. List also the Government, and academic groups who will perform the program support functions. When the effort is dependent on products developed outside of the direct management of the Technology Program Manager, attach an appendix identifying the individuals, and their organizations responsible for the delivery of these products.

f. Leveraging: Identify and describe the technology and/or resources external from the Army used in this program from the other services, DoD and non-DoD agencies, universities, non-profit organizations, federal labs, U.S. industry, and foreign sources. Describe any dependencies (specific deliverables, needed performance levels, and delivery dates) on programs (Army or not) external to the effort.

g. Risk Management and Mitigation: (Provide detail Risk Management Plan in Annex F)

(1) Program Execution Risk. Provide a narrative summary of the risks and a risk mitigation approach for each of the following: technical, performance, cost (are funds adequate considering the risk identified), and schedule.
(2) Acquisition Program Risk Identify any transition risks for the technology developed by the program.
(3) Cost Risk. Assess affordability and manufacturability risks.
(4) Risk Mitigation Plan. Provide summary details of the risk mitigation effort.

9. Transition Plan: Describe in general terms the actions required to transition the technology to the customer. The primary TM's will generally draft the Transition Plan, with assistance and in coordination with the customer and other participants. List

windows of opportunity to transition the technology (components, subsystems, and software) into new or existing systems, as well as outlining the interest and support of the combat developer and the PM(s) for the technology. If HTI opportunities were identified in paragraph 4.4, describe the efforts to aid in planning HTI transition or designation. (Provide details of transition planning in Annex G)

a. Joint Technical Architecture - Army: Address the relationship between the technology and the Joint Technical Architecture - Army.

b. Potential Acquisition Program Manager: Identify the potential Acquisition System/Program Manager(s) that may transition the technology (viz., to whom will the successfully demonstrated technology transition for implementation?).

c. Contracting/Acquisition Strategy: Address the contracting/acquisition strategy for the transition of the technology in to the acquisition program.

d. PMO Concurrence: When appropriate, include a concurrence sheet showing the name (minimum O-6 level), organization, office symbol, telephone and fax numbers, and electronic mailing address of the Program Manager to whom the technology will transition.

10. Relationship to Other Service or Agency Related Programs: Identify the technology's relationship to any other service/DARPA/national Labs/OSD programs that appear to be related to the effort or that have developed relevant "seed" technology. Address any program relationships that could be perceived as duplication or complementary.

11. Other Considerations: Address other issues not included above but considered important. (If needed provide details or plans in Annex H)

a. Simulation Support Plan (SSP) Summary: If the program includes significant simulations/simulator support as part of the execution plan, then a SSP must be developed.

ANNEXES:

A. Requirements

B. Reports and Assessments
   1. Reports
      a. Proof of concept analysis report (Proof of TRL 3)
      b. Component / Breadboard laboratory validation Report (Proof of TRL 4)
      c. Component / Brassboard relevant environment validation report (Proof of TRL 5)
      d. Prototype relevant environment demonstration report (Proof of TRL 6)
   2. Assessments

C. Plans
   1. Component / Breadboard laboratory validation plan
   2. Component / Brassboard relevant environment Validation plan
   3. Prototype relevant environment demonstration plan
   4. “ilities” analysis plan

D. Contracting information
   1. Statement of Work of each Phase
   2. Work Breakdown Structure for Each Phase
   3. Contract / Acquisition Strategy

E. Funding

F. Risk Management
   1. Risk Management Plan

G. Transition
   1. Customer / Support Briefing and Support Agreement
   2. Transition Plan
   3. Transition Memorandum of Agreement (MOA)

H. Other Considerations

Annex A: Requirements

Requirements Document (Draft / Updates / Final)

All versions will be coordinated with the Customer/User and reflect their requirements.

1. General Description of Required Technology.
   a. Summarize the technology need
   b. Describe what warfighting mission areas and/or existing defense systems will benefit from the technology program
   c. Describe the proposed concept for the technology
   d. Describe the analysis that supports the technology concept and benefits
   e. Define the functions that the proposed system will be tasked to accomplish
   f. Operations, support, and "ilities considerations/requirements
   g. Describe any plans for evolutionary technology growth and when a certain level is needed

2. Threat. Summarize the threat to be countered and projected threat environment.

3. Shortcomings of Existing Systems and Technologies. Describe why existing technologies and operational systems cannot meet current or projected requirements.

4. Capabilities required.
   a. General Guidelines for developing the table of required capabilities:
      (1) Identify the operational performance parameters (capabilities and characteristics) required for the proposed system
      (2) State the requirements in measurable terms. Use Threshold/Objective format, and provide criteria and rationale for each requirement
      (3) Timing of requirements should specify the time-based nature of the need and the events that are driving that need
   b. Table of Key Performance Parameters (KPPs). Develop the threshold and objective KPP goals for the technology program and include a table summarizing them

Table xxx KPPs for: Title of Technology Program

Key Performance Parameter	Threshold Values	Objective Values

c. “ilities.
   (1) Identify combat support requirements to include possible interfacing systems, interoperability requirements, standardization, and support equipment
   (2) Identify other System Characteristics: Including design, cost and risk drivers

5. Schedule. Define what actions, when complete, will constitute attainment of initial and final technology requirements.

6. Program Affordability. Cost constraints and affordability should be considered early in the technology program.

Annex B: Reports and Assessments

B-1. Reports

B-1-a. Proof of Concept Analysis Report (Proof of TRL 3)

1. Summary of the technology/system concept
2. Summary Description of Alternatives Considered - describe the alternate concepts and conceptual design tradeoff studies that were considered and analyzed.
3. Describe the analytical tools used for the assessment.
4. Analysis Results - present the results of analysis for the promising candidate concepts/designs in terms of KPPs, technology verification requirements for future phases, cost, schedule, and risk. Include sensitivities from tradeoffs that require tightening or loosening of design/performance requirements.
5. Descriptions of Preferred Alternatives and process for finalizing the design/technology concept and determining the technology verification requirements for future phases.
6. Assessment of risk and plan for managing risks
7. Draft Specification Tree, ICD Scope Sheets, and Program Work Breakdown Structure for Development Phase

B-1-b. Component / Breadboard Laboratory Validation Report (Proof of TRL 4)

B-1-c. Component / Brassboard Relevant Environment Validation Report (Proof of TRL 5)

B-1-d. Prototype Relevant Environment Demonstration Report (Proof of TRL 6)

These report outlines will be the same, but will differ in the particular details of the breadboard/prototype and the extent of the test environment during the testing.

Validation/Demonstration Report for _____

1. Introduction
   a. Purpose
      1). Objectives
      2). Scope
      3). Summary of Results
         (a) Objectives/KPP Results
         (b) Conclusions
         (c) Recommendations
      4). System Description (Objective System, Test System, and System Concept)
         (a) Objective System/Technology Description
         (b) Key Features and Subsystems of Brassboard/Prototype
   b. System Concept

2. Description of Threat or Future Operational Capability

3. Test Setup. (Laboratory/Field Configuration and set-up procedures at Test Facility)
   a. Item(s) Tested/System Set-up
   b. Hardware Tested/Set-up
   c. Algorithms/Software Tested/Set-up
   d. Threat Representation
   e. Environment
   f. Instrumentation
   g. Special Test Equipment
   h. External Systems Participating
   i. Organizations Participating

4. Test Conduct
   a. Test Location(s)
   b. System checkout
   c. Anomalies/Deviations from Test Plan
   d. Discussion for Each Test/Subtest
   e. Date(s)
   f. Configuration Description
   g. Subtest Objectives
   h. Test and Evaluation Events
   i. Scope of Analyses, Simulations and Tests
   j. Basic Scenarios
   k. Test Environment
   l. Operational Considerations
   m. Limitations

5. Technical Assessment/Results (Summary and for Each Subtest)
   (Subtests are subdivided by Objectives, Criteria, Test Procedure, Test Findings, and Technical Analysis).
   a. Description of Analyses and Simulations Performed
   b. Technical results
   c. Technical problems

6. Conclusions

7. Recommendations

TAB

A - Test Criteria
B - Test Data
C - Preliminary Determination of Deficiencies, Shortcomings, and Suggested Improvements
D - Performance Results Matrix
E - References
F - Abbreviations

B-2. Assessments

"ilities" Analysis Assessment Report

1. System Introduction
   a. System Concept
   b. Summary Description of Threat or Future Operational Capability
   c. Measures of Effectiveness (MOEs) and Suitability
   d. System Description (Brief description of Key Features and Subsystems, Functions Performed
   e. Interfaces
   f. Critical Technical Parameters

2. Supportability Strategy
   a. Determine the extent of support-related parameters or specifications to be addressed during each phase
   b. Identify supportability analyses and tradeoffs to be conducted for each ILS element:
      (1) Design Influence
      (2) Maintenance planning.
      (3) Manpower and personnel.
      (4) Supply support.
      (5) Support Equipment.
      (6) Technical data.
      (7) Training and training devices
      (8) Transportation and Transportability
      (9) Computer resources support
      (10) Standardization and interoperability, reliability, Availability and Maintainability (RAM)
      (11) Materiel Fielding Planning
      (12) Facilities.
      (13) Packaging, handling, and storage

3. Manufacturing and Producibility Strategy

Annex C: Plans

C-1. Component / Breadboard Laboratory Validation Plan
(Laboratory Validation Plan evolves into the Relevant Environment Plan

C-2. Component / Brassboard Relevant Environment Validation Plan
(Update of Laboratory Validation Plan to Reflect Testing In Relevant Environment)

C-3. Prototype Relevant Environment Demonstration Plan

These plan outlines will be the same, but will differ in the particular details of the brassboard/prototype and the extent of the test environment.

Validation/Demonstration Plan for _____

1. Introduction
   a. Purpose
   b. Objectives
   c. Scope
   d. Objectives/KPPs To Be Validated/Demonstrated
2. System Description (Objective System, Test System, and System Concept)
   a. Objective System/Technology Description
   b. Key Features and Subsystems of Breadboard/Prototype
   c. System Concept
3. Description of Threat or Future Operational Capability
4. Test Setup. (Laboratory/Field Configuration and set-up procedures at Test Facility)
   a. Item(s) To Be Tested/System Set-up
   b. Hardware To Be Tested/Set-up
   c. Algorithms/Software To Be Tested/Set-up
   d. Threat Representation
   e. Environment
   f. Instrumentation
   g. Special Test Equipment
   h. External Systems Participating
   i. Organizations Participating
   j. Test/Requirements Crosswalk
5. Describe How Test Will Be Conducted
   a. Test Location(s)
   b. System checkout Procedures
   c. Data to Be Collected
   d. Discussion for Each Test/Subtest
      1). Date(s)
      2). Configuration Description
      3). Subtest Objectives

4). Test Description
5). Analyses, Simulations and Tests To Be Performed
6). Basic Scenarios
7). Test Environment
8). Operational Considerations
9). Limitations

6. Describe How Results Will Be Determined

(Subtests are subdivided by Objectives, Criteria, Test Procedure, Test Findings, and Technical Analysis).

TABS

A - Test Criteria
B - Test Data
C - Preliminary Determination of Deficiencies, Shortcomings, and Suggested Improvements
D - Performance Results Matrix
E - References
F - Abbreviations

C-4 "ilities" Analysis Plan

1. Introduction
   a. Purpose
   b. Objectives
   c. Scope
2. System Description
   a. Objective System/Technology Description
   b. Key Features and Subsystems of Brassboard/Prototype
   c. System Concept
3. Description of Threat or Future Operational Capability
4. Supportability Strategy
   a. Determine the extent of support-related parameters or specifications to be addressed during each phase
   b. Identify supportability analyses and tradeoffs to be conducted for each ILS element:
      1. Maintenance planning.
      2. Manpower and personnel.
      3. Supply support.
      4. Equipment support.
      5. Technical data.
      6. Training and training support.
      7. Computer resources support.
      8. Facilities.
      9. Packaging, handling, storage, and transportation.
      10. Design interface.
      11. Battlelab and other exercises needed to understand user/operator needs and support

Annex D: Contracting Information

D-1. Statement of Work for Each Phase

D-2. Work Breakdown Structure (WBS) For Each Phase

D-3. Contracting/Acquisition Strategy

Discuss approach for contracting during each phase and how solicitations will be accomplished and the contract will be structured. This will includes such things as:

1. Industry Involvement In The Program To Date

2. Major Contract (s) Planned (Contracting Approach Through Program Life, e.g., New Competition For Each Phase, Initial Award With Priced Options For Subsequent Phases, etc.)

3. Type of solicitation: e.g., RFI, BAA, and Standard Contract Solicitation

4. Competition
   a. Market Research Conducted and/or Planned (RFIs)
   b. Identify Potential Sources
   c. Plans for Full and Open Competition, or Reasons and Plans for Other than Full and Open Competition

5. Contract Structure
   a. Basic Contract (what it buys; major deliverable items definition)
   b. Options, if any

6. Contract Type
   a. Basis for selection (in terms of FAR Part 16)
   b. Linkage to program risk assessment

7. Meeting or exceeding program cost objectives

8. Performance

9. Special Contract Terms and Conditions

Annex E: Funding

1. Basis/Methodology For Funding Estimate. Provide justification in sufficient detail as to how the estimate was developed. Describe what models/methods were used.
   a. Cost-Estimating Relationship (CER) Method. Describe CER(s) used and cite the source and/or the model and the set of data with which it was calibrated.
   b. Delphi/Subjective Judgments Method. Identify/explain the use of subjective judgments to adjust estimates made by analogy with other systems or components of systems.
   c. Environmental Cost Considerations. Describe what environmental factors were considered in the cost estimates.
   d. Cost Estimates Based on Analogous Programs. Describe the actual cost history from past or present contracts or analogous programs that were used.
   e. Other. Identify other methods used to identify required risk reduction costs to include identifying areas of uncertainty and system sensitivities.

Cost Estimates Breakdown Tables that present program costs by FY. The breakdown should follow a work breakdown structure for government and contract costs and include cost for each major element of the technology program to include contractor development of the hardware/software, test costs, system engineering, government oversight, etc.

Annex F: Risk Management

Risk management is concerned with the identification of uncertainties that threaten cost, schedule, and performance objectives, and the development and implementation of actions to best deal with those uncertainties within established limits. Its primary focus is to identify and manage risk so that program objectives can best be achieved and to support development of an acquisition strategy to meet the user's needs while balancing cost, schedule, performance, and their risk.

Acquisition Risk is defined as a measure of potential inability to achieve program objectives within defined cost/schedule constraints. Each risk event has 2 components; the probability of failing to achieve a particular outcome and the consequences of failing to achieve that outcome

F-1. Risk Management Plan

1. **INTRODUCTION.** This section should address the purpose and objective of the plan, and provide a brief summary of the program, to include the approach being used to manage the program, and the technology development strategy.

2. **PROGRAM SUMMARY.** This section contains a brief description of the program, including the program management approach.

3. **DEFINITIONS.** Definitions used should be consistent with DoD definitions for ease of understanding and consistency. However, the DoD definitions allow flexibility in constructing risk management programs. Therefore, each program's risk management plan may include definitions that expand the DoD definitions to fit its particular needs. For example, each plan should include, among other things, definitions for the ratings used for technical, schedule, and cost risk.

4. **RISK MANAGEMENT STRATEGY AND APPROACH.** Provide an overview of the risk management approach, to include the status of the risk management effort to date, and a description of the risk management strategy.

5. **ORGANIZATION.** Describe the risk management organization of the technology management group / office and list the responsibilities of each of the risk management participants.

6. **RISK MANAGEMENT PROCESS AND PROCEDURES.** Describe the program risk management process to be employed, i.e., risk planning, assessment, handling, monitoring and documentation, and a basic explanation of these components. Address how the information associated with each element of the risk management process will be documented and made available to all participants in the process, and how risks will be tracked, to include the identification of specific metrics if possible.

7. **RISK PLANNING.** This section describes the risk planning process and provides guidance on how it will be accomplished, and the relationship between continuous risk planning and this RMP.

8. **RISK ASSESSMENT.** This section of the plan describes the assessment (identification and analysis) process. It includes procedures for examining the critical risk areas and processes to identify and document the associated risks. It also summarizes the analyses process for each of the risk areas leading to the determination of a risk rating. This rating is a reflection of the potential impact of the risk in terms of its probability of occurrence, its consequence, and its relationship to other risk areas or processes. This section may include:

    - Overview and scope of the assessment process
    - Sources of information
    - Information to be reported and formats
    - Description of how risk information is retained
    - Assessment techniques and tools (see Section 2.5.2.4.2 of the *Deskbook*)

9. **RISK HANDLING.** This section describes the risk handling options, and identifies tools that can assist in implementing the risk handling process.

10. **RISK MONITORING.** This section describes the process and procedures that will be followed to monitor the status of the various risk events identified. It should provide criteria for the selection of risks to be reported on, and the frequency of reporting. Guidance on the selection of metrics should also be included.

11. **RISK MANAGEMENT INFORMATION SYSTEM, DOCUMENTATION AND REPORTS.** This section describes the MIS structure, rules, and procedures that will be used to document the results of the risk management process. It also identifies the risk management documentation and reports that will be prepared and assigns responsibility for their preparation.

Annex G: Transition

G-1. Customer / Sponsor Briefing and Support Agreement

G-2. Transition Plan

The TM in conjunction with the Customer/Sponsor develops the transition plan. The customer/sponsors are briefed and the support agreement is completed and signed. The Transition Plan is developed during the Demonstration Phase and updated throughout the technology program. The Transition Plan and updates require approval by the Customer/Sponsor. A Transition Memorandum of Agreement (MOA) is prepared and signed by Customer.

Transition Plan

1. **Purpose.** Indicate name of program/system(s) to transition, gaining organization, and the effective date.

2. **Program/System Description.** Include function and technical description of the technology program/system to transition.

3. **Program Status.** Include the life cycle phase.

4. **Organizational Responsibilities.** Identify those management responsibilities and tasks that the gaining organization will need to continue after transition. When appropriate, address any provisions required to facilitate the transition of the program/system from Technology management to Program Office management. Areas to be addressed in this paragraph include the following:
   a. Item Documentation and Records
   b. Configuration Management
   c. Engineering Responsibility, Engineering Data and Technical Data Package
   d. Integrated Logistics Support
   e. Software
   f. Transportation and Packaging
   g. Product Assurance Responsibility
   h. Safety
   i. Human Systems Integration
   j. Security Classification Guidance
   k. Environmental Documentation

5. **Assumptions.**

6. **Contract Status.** Open contracts/contractor(s)/time to completion/contract amount(s)/type dollars. Also include description of acquisition/ procurement activities, status of contracts, and contract-related responsibilities pertinent to the transition process.

7. **Funding summary.** RDT&E/Procurement/OMA/Future Year Defense Plan. Include portrayal of the overall budgeting and funding to include funds necessary for transition of the program/PMO and any anticipated future funding needs.

8. **Personnel Summary.** Include proposed disposition of all manpower spaces and personnel involved in the transition

9. **Plan For Transition Actions/Milestones.** Document the transition process. Identify tasks and milestones for activities involved in transition.

10. **Agreements And Commitments.** Identify any Memoranda of Agreement/Understanding that supports the program/system being transitioned.

G-3. Transition Memorandum of Agreement (MOA) Signed by Customer (See MOA Format in Reference H-3, page H-5)

Annex H: Other Considerations

To Be Published as Needed

APPENDIX F: Technology Process Review Information

F-1. Technology Program Schedule and Funding Summary

a). Program Title
b). Technology Program Objectives (From Updated Quad Chart)
c). Justification (Justification including customer/PM support from Updated Quad Chart)
d). Concept (Proposed concept (Concept Diagram, Picture, and/or Photo) from Updated Quad Chart and/or from Paragraph 2.c.
e). Approach and Applications (From Updated Quad Chart)
f). Program Schedule (Proposed Program by Fiscal Year with Major Milestones from Paragraph 8.b of Program Plan (unless too detailed for the level of reviewers then do one level up in detail.)
g). Funding (Show funding by Fiscal Year, by Program Element (PE)/Project from Program Plan Paragraph 8.c of Program Plan. Identify shortfalls by FY/Program Total and approaches to resolution of shortfalls.)

F-2. Technology Program Baseline

Technology Program Baseline (TPB): The TPB provides an essential reference baseline for maintaining, measuring, and reporting the status of technology program performance, cost, and schedule implementation. The Baseline constitutes an agreement between the SMDTC TM and the SMDC Technical Center Director.

COVER PAGE

TECHNOLOGY PROGRAM BASELINE AGREEMENT

Title of Technology Program

Provide a sentence that states that the Technology Program Baseline is approved by the undersigned TPDA and TM. Also provide several sentences that state the agreement and any qualifications. Identify any conditions that would require further reporting to or review by the TPDA.

Signature and Signature Block for the SMDTC Technology Manager

Signature and Signature Block for Relevant Director of the directorate to which the TM is assigned.

Signature and Signature Block for the Technology Program Decision Authority

TECHNOLOGY PROGRAM XXX BASELINE OUTLINE

SECTION I: PERFORMANCE

A. Reference 1/: Requirements Annex dated MM/DD/YY

B. Table of Key Parameters and Program Characteristics:

Provide a tabular list of key performance parameters and those other program characteristics, which, if the thresholds values are not met during this and subsequent phases of the technology program, would require program reevaluation and a decision on whether to continue the technology program. Performance includes operational, technical, and supportability parameters. Format should be similar to the KPP Table in Annex A of the Program Plan.

SECTION II: SCHEDULE (Dates)

Dates of key events must be shown along with those other dates necessary to adequately describe the program. Dates will be specified as MON YR. If an event (milestone) is scheduled for a quarter of fiscal year, the date will be converted to the last month of the quarter or the fiscal year. The schedule parameters shall include technology program initiation, major TPR decision points and transition to the customer.

SECTION III: COST

Provide the total cost (by then-year and base-year dollars in millions. Cost data reflected in the baseline must reflect realistic cost estimates.

F-3. Exit Criteria

Define and describe the Technology Program/Project exit criteria. Provide a narrative description for each parameter and explicitly describe all assumptions. Include clear definition of characteristics and rationale.

F-4. Technology Program Decision Memorandum

To be supplied for Technology Process Reviews. Outline the decision requested (i.e. proceed to next phase), any management issues to resolve, and provide as an attachment the exit criteria for successful completion of the next phase. (Format is on page F-3).

Office Symbol

MEMORANDUM FOR ***Name of Responsible SMDTC Organization***

SUBJECT: ***Name of Technology Program*** **Technology Decision Memorandum**

1. Based upon the recommendation of the Technology Review Board (TRB), Validation Report Results for Current Technology Phase, Add ***Other Concurring Organizations (Customer, User, etc),*** the entry into the ***Name of Next Technology Phase*** for the ***Name of Technology Program (Is/Is Not)*** approved. The ***Name of Technology Program*** Technology Program Baseline, dated dd/mm/yyyy and the Exit Criteria for the ____ Phase are approved.

2. The following direction is provided for the ***Name of Technology Program*** Technology Manager.

a. **Concise Statement of Authorization Granted By Decision.** "Authorization is granted to proceed with {listing of scope of approval with respect to contract actions, expenditure of funds, execution of next technology phase, conduct of laboratory tests, etc.)."

b. **Concise Statement of Restrictions and Conditions to the Authorization.** "No actions will be taken to {list of constrained and/or forbidden activities and what is required to lift/modify constraints}."

APPENDIX G: Acronyms

ACTD	Advanced Concept Technology Demonstrations
ATD	Advanced Technology Demonstration
BAA	Broad Agency Announcement
BL	Battle Lab
C/A	Considerations / Actions
CER	Cost-Estimating Relationship
DARPA	Defense Advanced Research Projects Agency
DCD	Directorate of Combat Developments
DoD	Department of Defense
DT&E	Developmental Test and Evaluation
DT/OT	Development Test / Operational Test
FAR	Federal Acquisition Regulation
FAT	First Article Test
FUE	First Unit Equipped
FY	Fiscal Year
HTI	Horizontal Technology Integration
HWIL	Hardware-in-the-Loop
ICD	Interface Control Drawing
IPPD	Integrated Product and Process Development
IPT	Integrated Product Teams
JCTI	Joint Center of Technology Integration
KPP	Key Performance Parameters
MDA	Milestone Decision Authority
MOA	Memorandum of Agreement
MOE	Measures of Effectiveness
ORD	Operational Requirements Document
OSD	Office of the Secretary of Defense
OT&E	Operational Test and Evaluation
P3I	Pre-Planned Product Improvement
PCP	Proof of Concept Plan
PE	Program Element
PM	Program or Product Manager

PMO	Program Management Office
POC	Point of Contact
R&D	Research and Development
RDT&E	Research Development Test and Experimentation
RFI	Request For Information
S&T	Science and Technology
SMDTC	Space and Missile Defense Technical Center
SSP	Simulation Support Plan
STO	Science and Technology Objectives
TPDA	Technology Program Decision Authority
TDI	Technology Difficulty Index
TM	Technology Manager
TPMM	Technology Program Management Model
TPB	Technology Program Baseline
TPR	Technology Process Review
TRADOC	Training and Doctrine Command
TRB	Technology Review Board
TRL	Technology Readiness Level
TY$	Then Year Dollars
WBS	Work Breakdown Structure

APPENDIX H: References

H-1 Technology Difficulty Index

H-2 Technology Readiness Levels / Key Term Definitions

H-3 Transition Memorandum of Agreement (MOA)

TECHNOLOGY DIFFICULTY INDEX

Difficulty in Achieving Research And Development (R&D) Objectives

Index	Degree of Difficulty	Probability of Success in "Normal" R&D Effort
TD-1	Very Low	**99%**
TD-2	Moderate	**90%**
TD-3	High	**80%**
TD-4	Very High	**50%**
TD-5	Fundamental Breakthrough	**20%**

- **Provides early indication of risk**
- **Facilitates Prioritization Among Technology Programs In A Constrained Resource Environment**

Technology Readiness Levels
DoD 5000.2-R

1. Basic principles observed and reported.	Lowest level to technology readiness. Scientific research begins to be translated into technology's basic properties.
2. Technology concept and/or application formulated	Invention begins. Once basic principles are observed, practical applications can be inverted. The application is speculative and there is no proof or detailed analysis to support the assumption. Examples are still limited to paper studies.
3. Analytical and experimental critical function and/or characteristic proof of concept.	Active research and development is initiated. This includes analytical studies and laboratory studies to physically validate analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative.
4. Component and/or breadboard validation in laboratory environment.	Basic technological components are integrated to establish that the pieces will work together. This is relatively "low fidelity" compared to the eventual system. Examples include integration of "ad hoc" hardware in a laboratory.
5. Component and/or breadboard (brassboard)[1] validation in relevant environment.	Fidelity of breadboard technology increases significantly. The basic technological components are integrated with reasonably realistic supporting elements so that the technology can be tested simulated environment. Examples include "high fidelity" lab oratory integration of components.
6. System/subsystem model or prototype demonstration in a relevant environment.	Representative model or prototype system, which is well beyond the breadboard tested for level 5, is tested in a relevant environment. Represents a major step up in a technology's demonstrated readiness. Examples include testing a prototype in a high fidelity laboratory environment or in simulated operational environment.
7. System prototype demonstration in an operational environment.	Prototype near or at planned operational system. Represents a major step up from level 6, requiring the demonstration of an actual system prototype in an operational environment. Examples include testing the prototype in a test bed aircraft.
8. Actual system completed and qualified through test and demonstration.	Technology has been proven to work in its final form and under expected conditions. In almost all cases, this level represents the end of true system development. Examples include developmental test and evaluation of the system in its intended weapon system to determine if it meets design specs.
9. Actual system proven through successful mission operations.	Actual application of the technology in its final form and under mission conditions, such as those encountered in operational test and evaluation. Examples include using the system under operational mission conditions.

* Key definitions are on following page.

[1] TPMM model uses "Brassboard" terminology versus "Breadboard" at TRL 5.

Technology Readiness Levels
Key Term Definitions

Breadboard: Integrated components that provide a representation of a system/subsystem and which can be used to determine concept feasibility and to develop technical data. Typically configured for laboratory use to demonstrate the technical principles of immediate interest. May resemble final system/subsystem in function only.

Brassboard: An experimental device (or group of devices) used to determine feasibility and to develop technical and operational data. It normally will be a model sufficiently hardened for use outside of laboratory environments to demonstrate the technical and operational principles of immediate interest. It may resemble the end item, but is not intended for use as the end item.

High Fidelity: Addresses from, fit and function. High fidelity laboratory environment would involve testing with equipment that can simulate and validate all system specifications within a laboratory setting.

Low Fidelity: A representative of the component or system that has limited ability to provide anything but first order information about the end product. Low fidelity assessments are used to provide trend analysis.

Model: A reduced scale, functional form of a system, near or at operational specification. Models will be sufficiently hardened to allow demonstration of the technical and operational capabilities required to the final system.

Operational Environment: Environment that addresses all of the operational requirements and specifications required of the final system to include platform/packing.

Prototype: The first early representation of the system, which offers the expected functionality and performance expected of the final implementation. Prototypes will be sufficiently hardened to allow demonstration of the technical and operational environment.

Relevant Environment: Testing environment that simulates the key aspects of the ope4ratioal environment.

Simulated Operational Environmental: Environment that can simulate all of the operational requirements and specifications required of the final system or simulated environment that allows for testing of a virtual prototype to determine whether it meets the operational requirements and specifications of the final system.

Transition Memorandum of Agreement (MOA)

Basic Transition Agreement

1. Description or Technology or Capability to be Delivered.

2. Target Acquisition Program.

3. Acquisition Program Technology Need

4. Integration Strategy (include a transition date)

5. Program Manager/Project Officer

6. Technology Manager

Technical Details and Programmatics

1. Technology – Current Status

a. Summary - Status

b. Risk Analysis

Top Risks	Brief Description	Mitigation Strategy

2. Technology Development Strategy.

3. Key Measures of Transition Readiness

Attribute/Parameter	Current	Interim (w/Est Date)	Final Objective

4. Program Plan

SIGNATURES:

Acquisition PM **Technology Manager (T M)**