4. Overview of technical reviews and audits

4.1 Technical reviews and audits defined

Technical reviews and audits are a foundation element of an effective systems engineering (SE) approach and form the backbone of a robust technical assessment process. Technical reviews and audits provide a venue for baselining technical requirements, evaluating the system's technical maturity, and identifying and assessing risks to system performance, cost, and schedule.

4.2 The role of technical reviews and audits in the US DoD acquisition life cycle

The ISO/IEC/IEEE 15288 Life Cycle Concepts subclause points out that every system has a life cycle and that per ISO/IEC/IEEE TR 24748-1 [B6], the typical system life-cycle stages include concept, development, production, utilization, support and retirement.[7] The stages describe the major progress and achievement milestones of the system through its life cycle and give rise to the primary decision gates of the life cycle. Organizations, in turn, use these decision gates to understand and manage the inherent uncertainties and risks associated with costs, schedule, and functionality when creating or utilizing a system.

Phases of the DoD acquisition life cycle include materiel solution analysis, technology maturation, and risk reduction (TMRR), engineering and manufacturing development (EMD), production and deployment (P&D), and operations and support (O&S). Technical reviews and audits are assessment tools that the DoD program organization uses to provide decision-makers sufficient information on the program's technical readiness to proceed to the next phase or to the next decision point within a phase.

Program affordability is and will be for the foreseeable future a major consideration in DoD programs. In that regard, all technical reviews should place some focus on affordability, address compliance with affordability goals, and assess the impact of affordability constraints.

NOTE—The Technical Reviews and Audits Overview section of the Defense Acquisition Guidebook [B2], Chapter 4, Systems Engineering, provides an illustration of the integration of the technical reviews and audits across the US DoD acquisition life cycle.

4.3 Technical reviews and audits in the context of Technical Management processes

ISO/IEC/IEEE 15288's Technical Management processes are concerned with managing the resources and assets allocated by an organization's management and with applying them to fulfill the agreements into which the organization enters. They are applied to the technical effort of projects, particularly to the planning in terms of cost, timescales and achievements; to the checking of actions that helps ensure they comply with plans and performance criteria; and to the identification and selection of corrective actions that recover shortfalls in progress and achievement.

Technical reviews and audits are system engineering activities that support the "assess the project" activity of the ISO/IEC/IEEE 15288 Project Assessment and Control process. The purpose of the Project Assessment and Control process is to help ensure that the program plans are aligned and feasible, to determine project status, technical and process performance, and to direct program execution to help ensure

[7] The numbers in brackets correspond to those of the bibliography in Annex E.

that performance is according to plans and schedules, within projected budgets and satisfies technical objectives.

During the DoD acquisition life cycle, a properly tailored series of technical reviews and audits provides key points throughout the life cycle to evaluate significant achievements and to assess technical maturity and risk. Project assessment is performed at major project decision points by means of these reviews and audits, and the results inform a project's technical management to enable any required project control actions that might include redirecting project activities and tasks as appropriate to correct identified deficiencies. Redirection may include re-planning as appropriate.

In order for a project's technical management to have a balanced information basis on which to base any required project control actions, each technical review or audit should be conducted from an integrated program viewpoint, including technical status and progress, cost and schedule status, and impacts and risk assessment, to help ensure that technical review decisions do not create unrecognized and unacceptable future program impacts.

4.4 Key participants for technical reviews and audits

4.4.1 General

Each technical review or audit should include knowledgeable participants as well as participants with sufficient objectivity to assess satisfaction of the pre-established review criteria. Based on the purpose and level of the review, the participants may include representatives from the acquirer or supplier organizations, or from both. A description of possible participants is provided in the paragraphs below.

4.4.2 Program manager

The program manager is the person responsible for the overall planning, budgeting, scheduling, execution, and control of all technical and management tasks required to produce and deliver a system. This includes oversight and management of the corresponding tasks of any suppliers with whom the acquirer has established agreements for delivery of products.

4.4.3 Systems engineer

The *Systems Engineer* (SE) refers to the program lead systems engineer, the chief engineer, or lead engineer with SE responsibility, and the SE staff responsible for SE processes and who plan, conduct, or manage SE activities in the program.

4.4.4 Review or audit chair

The chair is the person appointed in accordance with the policies and guidance of the acquirer (i.e., service or defense agency) to oversee and approve the technical review or audit preparatory actions, chair the technical review meeting(s) and manage the technical review or audit members, and coordinate and approve the closure actions and summary report.

4.4.5 Recorder

The recorder is the person charged with capturing the minutes of the technical review or audit meeting(s) and any other formal records directed by the chair.

4.4.6 Supplier

The supplier role is fulfilled by one or more people from the supplier's organization whose selection is dependent on the actions described in the specific Clause 6 table.

4.4.7 Program test lead

The program test lead is the person responsible for the overall program test and evaluation effort for development and operational tests. The program test lead for government organizations is typically called the chief developmental tester.

4.4.8 Program technical leads

The program technical leads for all relevant functional and specialty engineering areas are the people responsible for the overall program technical development effort for the system to be developed.

4.5 Program considerations for technical reviews and audits

4.5.1 Requirements for technical reviews and audits

Part of the defined content of the Systems Engineering Plan (SEP) that is required of all acquisition programs is a description of the program's overall technical approach, including the timing and criteria for the conduct of technical reviews and audits.

4.5.2 Technical reviews and audits across the program life cycle

The acquirer's SEP, and the supplier's Systems Engineering Management Plan (SEMP) where applicable, should define the technical reviews and audits selected for the program and their specific phasing across the program's life cycle. This standard provides application content for the following technical reviews and audits:

- Alternative systems review (ASR)
- System requirements review (SRR)
- System functional review (SFR)
- Preliminary design review (PDR)
- Critical design review (CDR)
- Test readiness review (TRR) [contained within the program's Test and Evaluation Master Plan (TEMP)]
- Functional configuration audit (FCA)
- System verification review (SVR)
- Production readiness review (PRR)
- Physical configuration audit (PCA)

Figure 1 depicts the relationship between these reviews and audits and the technical baselines across the acquisition life cycle.

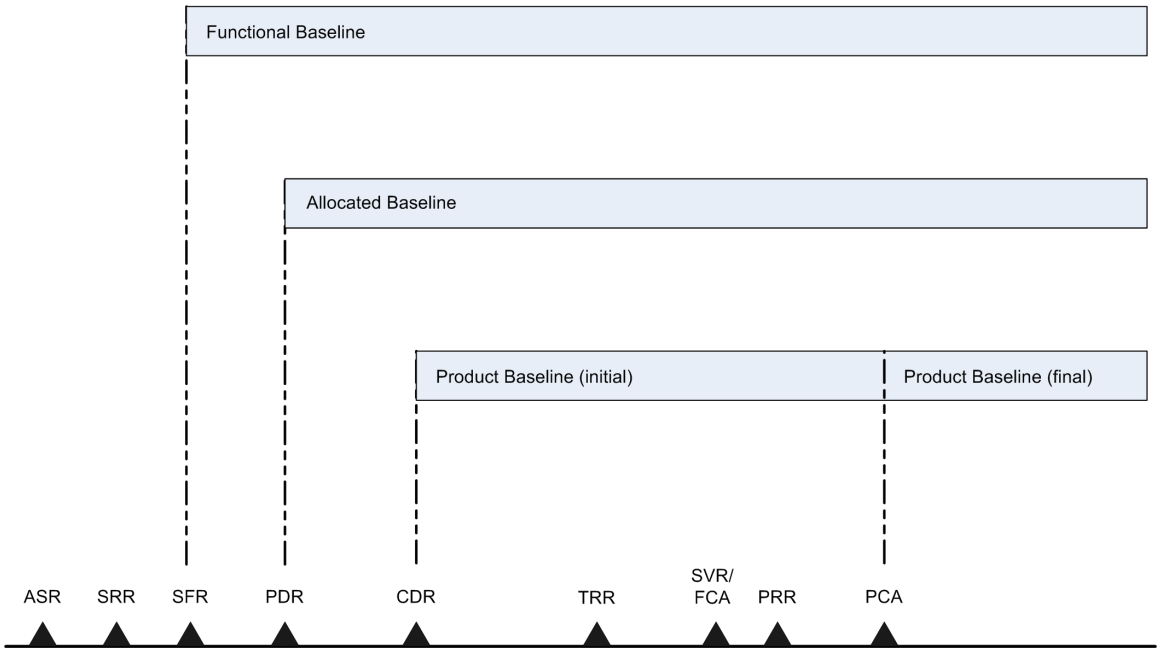

Figure 1— Relationship between technical reviews and audits and the technical baselines across the acquisition life cycle

Additionally, there are four annexes that contain examples of other technical reviews that DoD acquisition programs may find useful, based on the complexity, nature, and domain of the systems being developed or acquired by those programs. These annexes are as follows:

— Annex A: Software requirements and architecture review (SAR)

— Annex B: Software specification review (SSR)

— Annex C: Integration readiness review (IRR)

— Annex D: Flight readiness review (FRR)

4.5.3 Application of technical reviews and audits

The systems engineer for any given program should coordinate with the program manager and with the various program functional area experts (configuration manager, test manager, logistics manager, etc.) to ensure that planning for the program's technical reviews and audits is fully integrated with the overall program plans. Additionally, the systems engineer should coordinate this planning with the appropriate program executive office (PEO) personnel as applicable.

4.5.4 Multiple instances of technical reviews and audits

For complex systems, the acquirer may choose to conduct certain reviews and audits for one or more system elements depending on the interdependencies involved. These incremental system-element-level reviews or audits lead to an overall system-level technical review or audit.

This standard takes a minimalistic approach to defining the content of each technical review and audit such that the content for any given technical review or audit is intended to be sufficient to support each instance of that technical review or audit conducted by a given program.

4.5.5 Event-driven technical reviews and audits

Technical reviews of program progress should be event driven, and should be conducted when the system under development meets the review entrance criteria as documented in the SEP.

Technical reviews and audits are structured to be a comprehensive review (and in some instances approval) of the program's technical and cost baselines, and to provide confidence that each technical or cost baseline is mature enough to progress to the next stage of the program. Each technical review or audit should have defined entry and exit criteria tied to the required level of design/development maturity and applied across all requirements and technical disciplines.

In addition to entrance criteria, the program SEP should detail the specific chronology for the program's technical reviews and audits. This is especially important for evolutionary acquisition strategies using incremental development processes, or, for multi-component programs, i.e., joint service, interagency, or integration efforts with multiple independent contracts where the government is the integrator. The SEP's chronology should provide the planned sequence of technical reviews and audits and a notional placement of each one in the program's Integrated Master Schedule (IMS). The actual date for conducting any given technical review or audit will depend on satisfaction of the SEP's entrance criteria.

One good method for scheduling technical reviews or audits is to relate them to the documentation requirements for the specific technical review or audit. For example, schedule a PDR after the required system and hardware development specifications or software logical architecture, preliminary design and draft test plans are available, since the essence of the PDR is to assess the supplier's approach to meeting the requirements in these documents.

4.5.6 Systems engineering technical review team

The technical review team is the body responsible for conducting the technical review or audit. Under direction of the chair, the review team ensures the entrance criteria are met, evaluates the technical products under review, and documents action items as required to correct deficiencies found during the technical review or audit.

The review team is typically appointed by the program manager and normally includes the chair, systems engineer, various program functional and specialty engineering area experts (engineering, configuration manager, test manager, logistics manager, financial manager, contracting officer, etc.), system users and maintainers, certification authorities, and legal counsel as required.

The review team conducts the technical review or audit and assesses the review products according to the tailored acceptability criteria, in concert with the focus of the specific technical review or audit.

NOTE—The TRR will be documented within the program TEMP and chaired by the chief developmental tester.

4.5.7 Technical review or audit desired outcomes

A properly tailored series of technical reviews and audits provides key points throughout a program's acquisition life cycle to evaluate significant achievements and to assess technical maturity and risk. Successful completion of this series of reviews and audits provides the PEOs and program management offices (PMO) with several major desired outcomes:

a) A disciplined sequence of activities to define, assess, and control the maturity of the system's design and technical baseline, reducing risk over time

b) Confidence that the acquired system will meet all of its specification requirements

c) Confidence that the acquired system will be validated operationally effective and operationally suitable when deployed

d) Assessment results that support successful achievement of the outcomes listed for the ISO/IEC/IEEE 15288 Project Assessment and Control process

4.5.8 Elimination or combination of technical reviews and audits

Programs should not conduct technical reviews or audits that are unnecessary given the structure of the program's acquisition life cycle, e.g., where in the acquisition cycle the program will enter, or one-of-a-kind programs without a production requirement.

Eliminating or combining reviews or audits within the program's acquisition life cycle should be coordinated with the PEO and should be approved by the Milestone Decision Authority as documented in the program's approved SEP and acquisition strategy. The SEP should document when the acquirer will approve the critical work elements, products, and maturity metrics associated with the combined or deleted reviews or audits.

4.5.9 Technical review and audit risk assessment checklists

In order to help ensure the highest probability of success in conducting the selected list of technical reviews and audits for a given program, the systems engineer, in collaboration with the program's functional area experts, should document the following risk assessment checklists that help assess the risk of conducting any of the program's reviews or audits:

a) A "BEFORE" risk assessment checklist that documents the entry criteria necessary to start the technical review and the activities necessary to prepare for the review.

b) A "DURING" risk assessment checklist that documents the items to be addressed in the technical review agenda and the exit criteria necessary to close the review.

c) An "AFTER" risk assessment checklist that documents the follow-up actions after technical review completion.

4.5.10 Technical review and audit action items

All action items generated at a technical review or audit should be captured. Suggested action item categories are discussed below. Any action item that is satisfied prior to the conclusion of the review should be captured in the appropriate category below with a disposition of "Closed" with the appropriate supporting information.

a) *Request for action:* Critical action item required to close the technical review or audit.

b) *Request for information:* Action item to provide only information/data in support of the current technical review. Not required to close the technical review or audit.

c) *Action to minutes:* Action items that are not required to close each technical review or audit. Planned close-out date should be tied as an entry or completion criterion to a future milestone.

d) *Not accepted:* Category used to document any action items generated at a technical review or audit that were duplicates of other accepted action items or otherwise declined by the technical review or audit chair. A clear statement should be included in the action item database to indicate why each action item was categorized as "not accepted." This category should not be used to capture action items that were satisfied or closed prior to conclusion of the technical review.

4.5.11 Technical review and audit approval

At any given technical review or audit, the chair oversees and manages the review or audit. The technical review or audit itself is conducted by the technical review team and approved by the chair. Chair approval of any given technical review or audit should include the following:

a) Satisfying the exit criteria agreed upon for the technical review or audit

b) Approval of the disposition of the action items generated during the technical review or audit

c) Approval of the technical baseline, and cost baseline as applicable, evaluated during the technical review or audit

d) Confidence that the maturity of the technical baseline (and cost baseline as applicable) is sufficient to proceed to the next stage of the program

e) Assessment that the risks associated with the system are documented, have resourced and funded mitigation plans, and are at an acceptable level to support completing the technical review or audit

f) Chair approval in the formal closure documentation

4.5.12 Technical review and audit planning/conduct/reporting

4.5.12.1 General

In order to help provide sufficient quality in the assessment results that support successfully achieving the desired outcomes of a program's series of technical reviews and audits, the acquirer should ensure that certain tasks are accomplished across the planning, conduct, and reporting stages of that series of reviews and audits.

The program's systems engineer, as the person responsible for the overall program technical effort and performance, should coordinate the content and performance of the suggested tasks listed below with the assistance of the program's various functional area experts and subject matter experts (SME).

4.5.12.2 Technical review and audit planning

During technical review and audit planning, the acquirer should

a) Ensure that program acquisition plans and strategies provide for the conduct of the applicable technical reviews and audits, and that they are integrated into the milestone decision-making process.

b) Ensure that the program SEP contains the required content for the tailored series of technical reviews and audits. The TRR will be documented within the program TEMP.

c) Ensure that the required support from suppliers, including documentation and other applicable data, for each technical review or audit is incorporated in the applicable acquirer-supplier agreement(s).

d) Ensure that each technical review and audit is addressed in the IMS.

4.5.12.3 Technical review and audit conduct

During technical review and audit conduct, the acquirer should

a) Ensure that the applicable acquirer-organization SMEs and other applicable stakeholders are identified and notified with sufficient lead time to attend and contribute to the reviews and audits.

b) Ensure that the supplier provides the required supporting data in sufficient time prior to the reviews and audits for SME review prior to conducting the technical review session(s).

c) Develop, coordinate, and execute, in cooperation with the supplier, individual technical review and audit content agendas, exit criteria, and arrangements for the conduct of each technical review and audit.

d) Ensure that the preparation of appropriate technical review or audit material is coordinated with all review contributors and participants.

e) Organize and supervise the documentation of action items.

f) Ensure that the acquirer-supplier team satisfies the exit criteria for the technical review or audit.

NOTE—Although some of the actions in the list above typically are associated with the planning aspect for each technical review or audit in this standard, conduct of the technical review or audit includes some of the planning leading up to the review, not just the meeting that many associate with the term *conduct*.

4.5.12.4 Technical review and audit reporting

As part of technical review and audit reporting, the acquirer should

a) Ensure that the technical review or audit closure and approval (including the applicable content) are documented.

b) Ensure that the technical review or audit summary report is approved and distributed.

4.5.13 Technical reviews and audits in acquirer-supplier agreements

The required supplier support tasks for all program technical reviews and audits should be defined in the acquirer-supplier agreement. Careful consideration should be given before using the conduct of individual reviews or audits as a basis for progress or performance-based payments contained in the agreement. However, payments for successful closure of specific reviews or audits as part of the established award fee criteria may be considered.

Unless specifically provided for in the acquirer-supplier agreements, successful completion of technical reviews or audits does not affect the requirements, terms, and conditions set forth in those agreement(s).

Technical reviews and audits should not be used to

a) Constitute official acquirer acceptance of the design according to the acquirer-supplier agreement

b) Change responsibility as set forth in the acquirer-supplier agreement(s)

c) Change or affect ownership of the design

d) Relieve the supplier from meeting specification requirements as set forth in the acquirer-supplier agreement