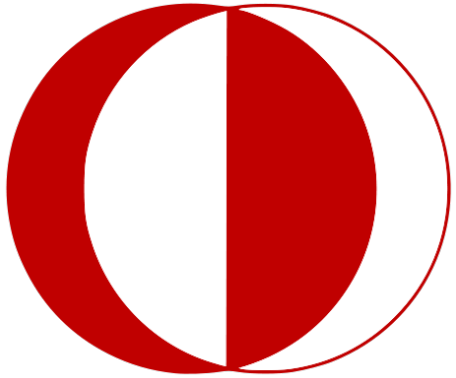

IS722 - Systems Engineering

Technical Reviews and Audits

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Outline

- Technical Reviews and Audits
- Alternative Systems Review (ASR)
- System Requirements Review (SRR)
- System Functional Review (SFR)
- Preliminary Design Review (PDR)
- Critical Design Review (CDR)

Outline

- Test Readiness Review (TRR)
- Functional Configuration Audit (FCA)
- System Verification Review (SVR)
- Production Readiness Review (PRR)
- Physical Configuration Audit (PCA)

Technical Reviews and Audits

- 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
- 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

Technical Reviews and Audits

- For systems development, a **tailored** series of technical reviews and audits provide key points throughout the system development
- Regardless of acquisition pathway, the PM, Systems Engineer, and Lead Engineer work to properly align the applicable technical reviews to support knowledge-based milestone decisions that streamline the acquisition life cycle and save precious taxpayer money
- Technical reviews and audits allow the PM, Systems Engineer, and Lead Engineer to jointly define and control the program's technical effort by establishing the success criteria for each review and audit
- A well-defined program facilitates effective monitoring and control through increasingly mature points

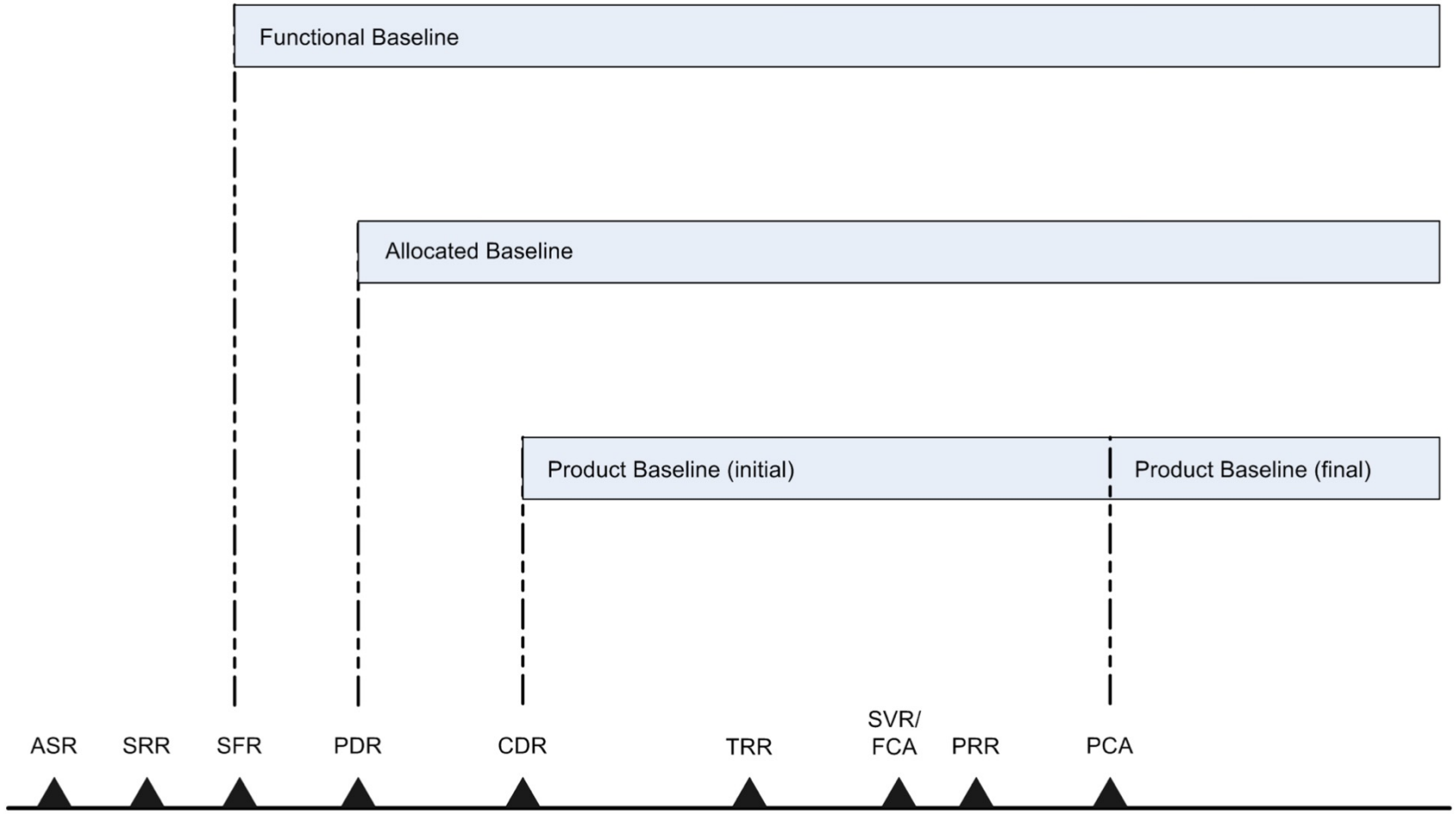
Technical Reviews and Audits

- The extent to which a program adopts a DE approach will not impact "what" technical reviews and audits need to be conducted, but it can have a profound and revolutionary impact upon "how" they are conducted
- A well-defined digital ecosystem, instantiated or leveraged, with an associated authoritative source of truth and static and dynamic models of systems and the battlespace will enable timely and iterative analyses
- By leveraging constructive, virtual, and live simulation tools, the ecosystem can open up the trade space to enable exploration of options not easily analyzed elsewise

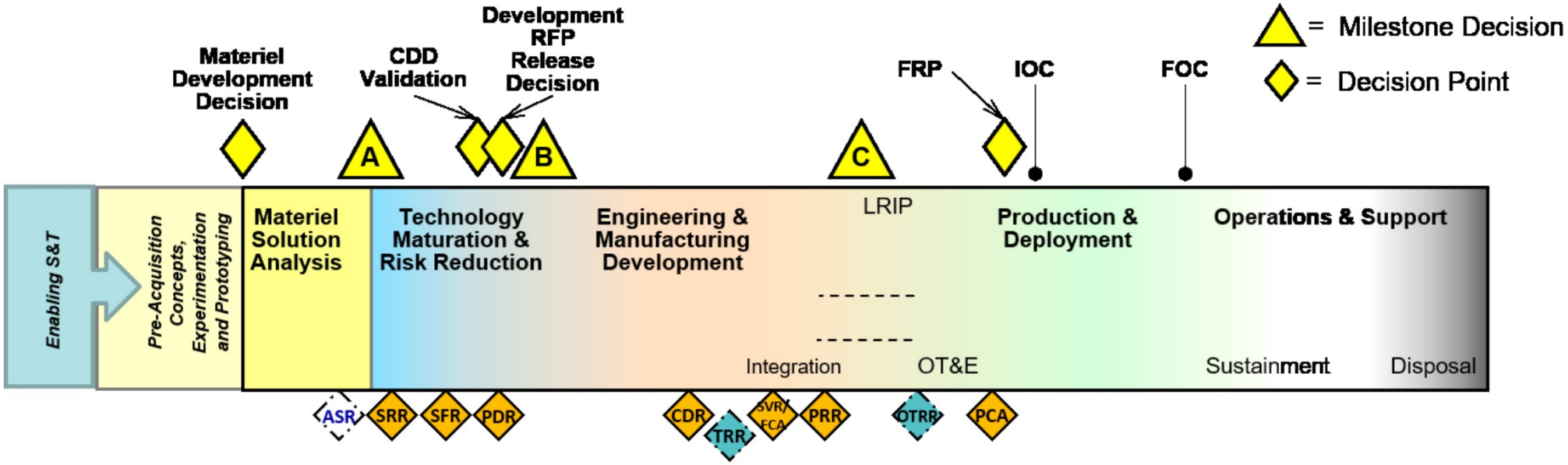
Technical Reviews and Audits

- Technical reviews of program progress should be event driven and conducted when the system under development **meets the review entrance criteria** as documented in the SEP
- An associated activity is to identify technical risks associated with achieving entrance criteria at each of these points
- SE is an **event-driven** process based on successful completion of key events as opposed to arbitrary calendar dates
- While the initial **SEP** and **IMS** have the expected occurrence in the time of various **milestones** (such as overall system CDR), the plan should be updated to reflect changes to the actual timing of SE activities, reviews and decisions

Technical Reviews and Audits



Technical Reviews and Audits



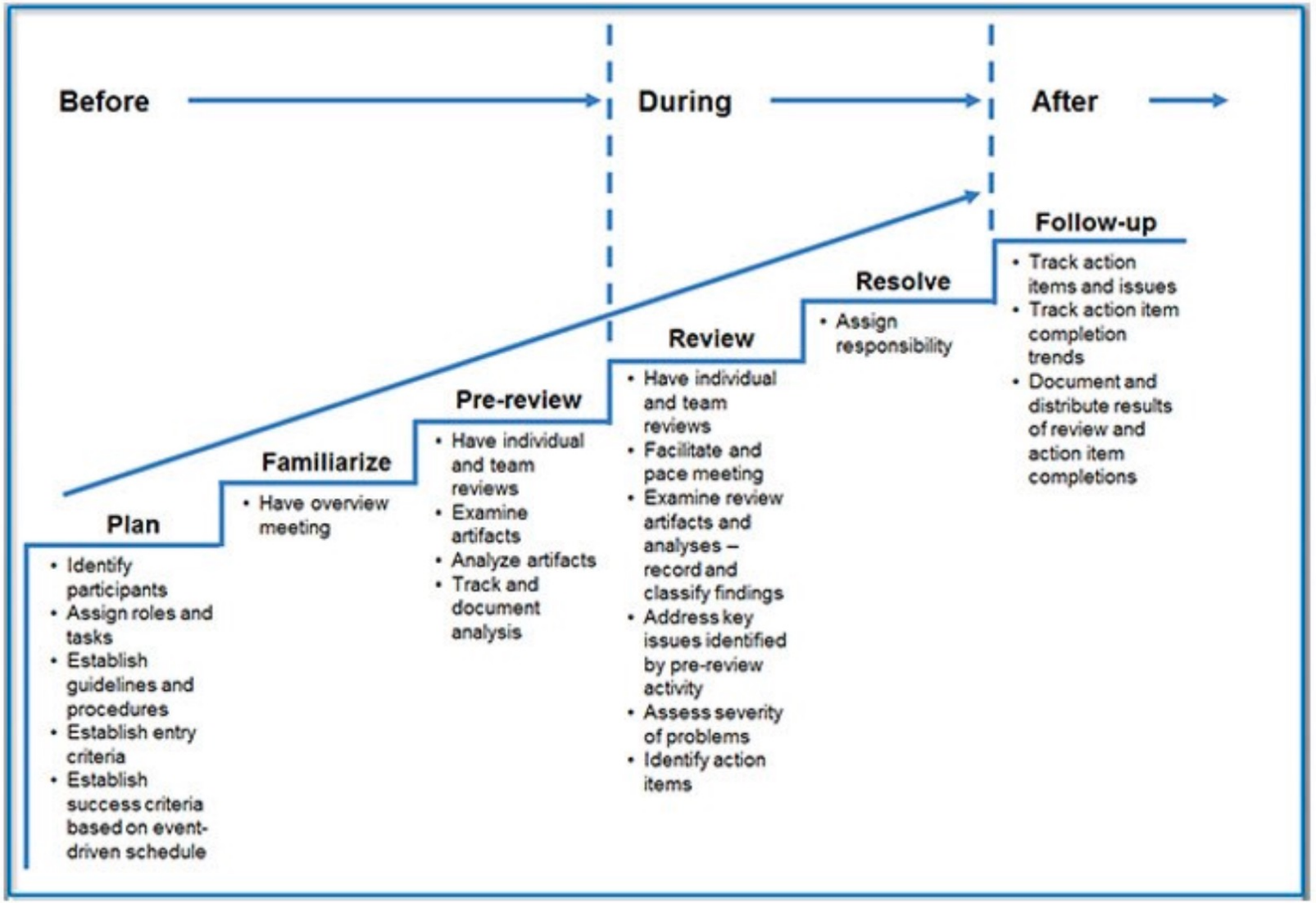
ASR - Alternative Systems Review
CDR - Critical Design Review
FCA - Functional Configuration Audit
FOC - Full Operational Capability
FRP - Full-Rate Production
IOC - Initial Operational Capability
OTRR - Operational Test Readiness Review
PCA - Physical Configuration Audit
PDR - Preliminary Design Review
PRR - Production Readiness Review
SFR - System Functional Review
SRR - System Requirements Review
SVR - System Verification Review
TRR - Test Readiness Review

Mandatory technical reviews

Best practice technical reviews and audits

Test reviews (see T&E Guidance)

Technical Reviews and Audits



Alternative Systems Review (ASR)

- The ASR shall be conducted to help ensure the preferred materiel **solution** has the potential to affordably **meet the user's needs** and expectations, and that there is sufficient understanding of the technical maturity, feasibility, and risk of the proposed materiel solution
- The ASR shall be held **after the system parameters for the preferred materiel solution are defined and that solution is balanced with cost, schedule, and risk**

Alternative Systems Review (ASR)

- An **agreement on the preferred solution** to take forward into development
- Logical architectural constraints and drivers to address external interface requirements, standards, and system extensibility requirements
- A comprehensive rationale for the preferred materiel solution, including the results of the AoA that evaluated the relative risks
- An updated (if necessary) risk and opportunity assessment and associated risk mitigation and opportunity handling plans
- Draft system requirements derived from the KPPs and KSAs
- Identification of critical technologies that will be prototyped

System Requirements Review (SRR)

- The SRR shall be conducted to help ensure the level of understanding of **top-level system requirements is adequate** to support further requirements analysis and design activities, and that the system can proceed into initial system design with acceptable risk
- The SRR shall be held **when the level of understanding of top-level system requirements is adequate to support further requirements analysis and design activities**

System Requirements Review (SRR)

- An **approved preliminary system specification**
- A preliminary allocation of system requirements to hardware, human, and software subsystems, with bi-directional traceability between the allocated requirements and the source documents
- Documented external interface requirements
- An approved product support plan (PSP) with updates
- Technical plans that are current and address the full scope of work

System Requirements Review (SRR)

- A software development plan (SDP) that adequately addresses the software-specific acceptability criteria
- An updated (if necessary) risk and opportunity assessment and associated risk mitigation and opportunity handling plans
- A determination that the system requirements, preferred system solution, available technology, and program resources form a satisfactory basis for proceeding

System Functional Review (SFR)

- The SFR shall be conducted to help ensure that the system under review can **proceed into preliminary design** with acceptable risk and that all system requirements and functional performance requirements derived from the approved preliminary system specification are defined and are consistent with the program budget, program schedule, risk, and other program and system constraints
- The SFR shall be held **after the system functionality has been fully defined and all functional baseline documentation is complete**

System Functional Review (SFR)

- An **established system design traceable to the approved system specification (functional baseline)**
- An updated (if necessary) risk and opportunity assessment and associated risk mitigation and opportunity handling plans
- Current data to update the cost analysis requirements description (CARD) document, based on the supplier's proposed system functional baseline
- An updated program development schedule including system and software critical path drivers
- Initial requirement allocations to hardware configuration items (HWCI), software configuration items (SWCI), and humans

Preliminary Design Review (PDR)

- The PDR shall be conducted to help ensure the **preliminary design** for the system under review is **sufficiently mature** and ready to proceed into detailed design and can meet the stated performance requirements within program budget, schedule, risk, and other program and system constraints
- The PDR shall be held **when the acquirer and supplier concur that the system-level preliminary design and allocated baseline documentation are complete, and prior to the beginning of detailed design**

Preliminary Design Review (PDR)

- **Technical data for the allocated baseline that are complete**, satisfy the system specification, and provide a sufficient foundation for detailed design to proceed
- Bi-directional traceability between decomposed and allocated requirements to the lowest level, demonstrating that each and every function in the functional baseline has been allocated to one or more of the system elements, that the physical hierarchy is consistent with the functional baseline, and that there are no orphan system elements
- Technical plans that are current and address the full scope of work
- An updated (if necessary) risk and opportunity assessment, and associated risk mitigation and opportunity handling plans

Preliminary Design Review (PDR)

- Feasibility, budget, and schedule that are determined to be within acceptable risk margins
- A program IMS that has been updated (including systems and software critical path drivers) and includes all activities required to complete CDR (assuming same developer responsible for PDR and CDR)
- Updates to the CARD that reflect the design in the allocated baseline
- Evidence to inform realistic requirements for EMD contract specifications
- Interface requirements contained in system external interface control documentation and internal interface control documentation

Critical Design Review (CDR)

- The CDR shall be conducted to help ensure that the **detailed design** for the system under review is **adequate** to proceed into fabrication, system integration, demonstration and test and can meet stated performance requirements within budget, schedule, risk, and other system constraints
- The CDR shall be held **when the acquirer and supplier concur that the initial product baseline is complete, and when the system design is stable and is expected to meet system performance requirements and affordability goals**

Critical Design Review (CDR)

- A documented **initial product baseline with approved HWCIs and SWCI(s)**
- Detailed design data for the initial product baseline that satisfy the system specification and that are sufficiently complete to support hardware fabrication and continued software implementation
- A documented and approved analysis with rationale supporting the conclusion that the initial product baseline satisfies the CDD

Critical Design Review (CDR)

- Bi-directional traceability between all decomposed and allocated requirements to the lowest level and the system detailed design elements, demonstrating that each and every item in the functional baseline has been allocated to one or more of the elements and that there are no orphan system elements in the detailed design
- Technical plans that are current and that address the full scope of work
- Corrective action plans for issues identified in the CDR
- An updated (if necessary) risk and opportunity assessment and associated risk mitigation and opportunity handling plans

Critical Design Review (CDR)

- Feasibility, budget, and schedule that are determined to be within acceptable risk margins
- A program IMS that has been updated including fabrication, software implementation, test and evaluation, and critical path drivers.
- Updates to the CARD based on the system initial product baseline
- An updated life-cycle sustainment plan (LCSP) including program sustainment development efforts and schedules based on current budgets, test evaluation results and firm supportability design features

Test Readiness Review (TRR)

- The TRR shall be conducted to **assess** test objectives, test methods and procedures, test scope, safety, readiness for acquirer and supplier development test and evaluation (**DT&E**), and whether test resources have been properly identified and obtained
- The TRR shall be held **prior to any formal testing for the record, when the acquirer and supplier agree that all applicable documentation for the system elements under test are sufficiently complete and that all planning for personnel, test facilities, logistics and support equipment is sufficiently robust to support a successful test**

Test Readiness Review (TRR)

- A documented plan for addressing technical issues and obstacles that might occur during conduct of the test
- An updated (if necessary) risk and opportunity assessment and associated risk mitigation and opportunity handling plans
- Lists of potential anomalies, limitations and system vulnerabilities for the planned test event
- Verification that all planned preliminary or informal tests have been conducted and that the **results satisfactorily** indicate that the formal test event can begin

Test Readiness Review (TRR)

- Verification that the system elements under test are sufficiently mature, defined and representative to accomplish the planned test objectives
- Verification that the necessary safety releases from the program office have been provided to the testers prior to any test activities using personnel
- **Completed and approved test plans and procedures for the planned test event**
- Complete identification and allocation of all required test resources to the planned test
- A recommendation on readiness to commence testing

Functional Configuration Audit (FCA)

- The FCA shall be conducted to ascertain that a CI's actual **performance** meets the requirements stated in the **functional** and **allocated** baseline documentation
- The FCA shall be held **when the acquirer and supplier concur that the CI development is complete and actual CI performance as documented in development test (DT), analysis, and simulation data is sufficient to show satisfaction of the functional and allocated baselines**
- A system-level FCA may be held concurrently with SVR

Functional Configuration Audit (FCA)

- Official, approved FCA minutes incorporating at a minimum the following items as part of the **official record**:
- All test plans, specifications, descriptions, procedures, reports, and test data that were reviewed by the FCA team
- A complete list of successfully accomplished functional tests
- A complete list of any functional tests required by the system specification or other test plans that have not yet been performed

Functional Configuration Audit (FCA)

- Partial FCA completion status for any CIs whose functional test completion is contingent on higher-level integration testing
- Audit results for each of the work product categories assessed during the audit
- Configuration identification documentation that comprehensively defines the system product baseline configuration that is the object of the FCA work products
- An FCA team assessment of the CI's satisfaction of its functional and allocated requirements

System Verification Review (SVR)

- The SVR shall be conducted to verify that the **as-tested s**ystem meets the requirements in the system functional baseline and is ready to proceed to the next phase with acceptable risk
- The SVR shall be held **following completion of system-level DT&E, and CI-level FCAs**
- The SVR may be held concurrently with system-level FCA

System Verification Review (SVR)

- Official, approved SVR minutes incorporating at a minimum the following items as part of the official record:
- The specific versions under configuration control of the system functional and product baselines examined during the technical review
- List of all test plans, descriptions, procedures, reports and validated test data that were reviewed by the SVR team
- Review results for each of the work product categories assessed during the technical review

System Verification Review (SVR)

- Verification that system requirements are fully satisfied in the system's current configuration
- An updated (if necessary) risk and opportunity assessment and associated risk mitigation and opportunity handling plans
- An SVR team assessment that the system (as documented in the current product baseline) has a low risk of failure during operational test and evaluation (OT&E)

Production Readiness Review (PRR)

- The PRR shall be conducted to ascertain that the **system design is ready for production** and that the supplier has accomplished adequate production planning for entering low-rate initial production (LRIP) or full-rate production (FRP)
- The PRR shall be held to **support LRIP or FRP decisions**

Production Readiness Review (PRR)

- Official, approved PRR minutes incorporating at a minimum the following items as part of **the official record**:
- Plans, specifications, descriptions, procedures, reports and test data
- A complete list of PRR attendees
- Completed action item forms
- Test results for pre-production and production processes
- Review results for each of the work product categories assessed during the technical review
- Configuration identification documentation that defines the system product baseline that is the object of the PRR work products

Production Readiness Review (PRR)

- A PRR team assessment that the following conditions have been adequately met:
- The final system design is **producible**
- The program's production capability and capacity form a satisfactory basis for proceeding into LRIP and/or FRP
- An updated (if necessary) risk and opportunity assessment, and associated risk mitigation and opportunity handling plans

Physical Configuration Audit (PCA)

- The PCA shall be conducted to determine conformance of the **as-built** configuration of a validated CI with its design documentation, and to verify the product baseline
- The PCA shall be held **after successful completion of OT&E and system validation, but prior to the full- rate production or full deployment (FD) decision review and operational use**

Physical Configuration Audit (PCA)

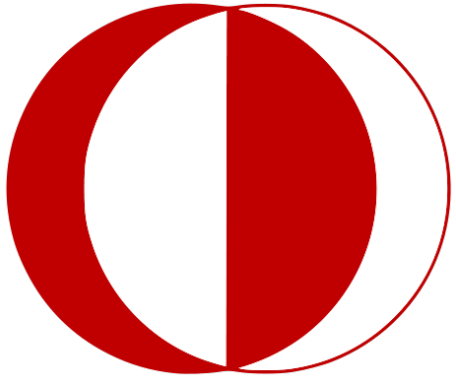
- Official, approved, PCA minutes incorporating at a minimum the following items as part of the **official record**:
- All specifications, drawings, descriptions, procedures, and reports that were reviewed by the PCA team
- A list of any differences between the configuration of the CI(s) qualified and the element(s) being audited
- Audit results for each of the work product categories assessed during the audit
- Configuration identification documentation that completely defines the system product baseline configuration that is the object of the PCA work products

Physical Configuration Audit (PCA)

- Approved hardware and software product baselines, TDP, and other baselined documentation
- Determination that the design and manufacturing documentation matches the formally qualified CI(s) assessed during the PCA
- Determination that the audited documentation can be used for full rate production or full deployment of the audited CI(s), or for replication of one-of-a-kind elements

References

- IEEE Std 15288.2-2014. IEEE Standard for Technical Reviews and Audits on Defense Programs, IEEE Computer Society, The Institute of Electrical and Electronics Engineers, Inc.
- ISO/IEC/IEEE 15288 (2023). Systems and Software Engineering - System Life Cycle Processes, The International Organization for Standardization, The International Electrotechnical Commission, and The Institute of Electrical and Electronics Engineers.



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