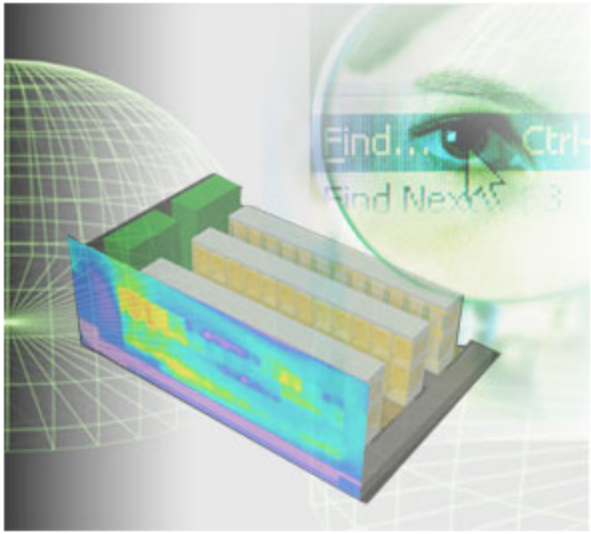
Welcome to Technical Activities

This lesson addresses various technical activities used during the Engineering and Manufacturing Development (EMD) phase. A sub-effort of EMD is the Integrated System Design (ISD) effort which focuses on the Critical Design Review (CDR). As you know, the CDR is a key point in the Acquisition Cycle and is a multi-discipline technical review establishing the initial product baseline to ensure the system under review has a reasonable expectation of satisfying the requirements of the Capability Development Document. During this phase, there are many tools the Life Cycle Logistician (LCL) can use to increase reliability and maintainability of a product.



Objectives

Upon completion of this lesson, you will be able to:

- Identify the LCL's role in defining support-related performance and acceptance criteria for modeling and simulation (M&S) and test and evaluation (T&E).
- Identify the LCL's role in refining logistics support considerations based on the Critical Design Review (CDR).

This lesson will provide you with information regarding the LCL's role in various Technical Activities associated with the Life Cycle Sustainment Plan.

Performance and Acceptance Criteria for Modeling and Simulation (M&S) and Test and Evaluation (T&E)

The LCL is responsible for defining support related performance and acceptance criteria for planned modeling and simulation (M&S) and test and evaluation (T&E) conducted during the Engineering and Manufacturing Development (EMD) phase. The LCL should select criteria that will measure the effectiveness of the product support enterprise that will be established to support the system as designed, produced, and delivered.

The criteria that are developed serve to support the evaluation of operational suitability.

Popup Text

Operational Suitability

Operational suitability is the degree to which a system can be satisfactorily placed in field use, with consideration given to reliability, availability, compatibility, transportability, interoperability, wartime usage rates, maintainability, safety, human factors, manpower supportability, logistics supportability, documentation, and training requirements. Early planning for the suitability evaluation should include any special needs for number of operating hours, environmental testing, maintenance demonstrations, testing profiles, usability of DT data, or other unique test requirements. Operational suitability should be evaluated in a mission context in order to provide meaningful results. For example, maintaining a required OPTEMPO over an extended period while conducting realistic missions gives insight into the interactions of various suitability factors, such as the ability to maintain stealth features during sustained operations.

Categories of Performance and Acceptance Criteria

The support related performance and acceptance criteria can be grouped into three major categories.

Click on each area for further explanation.

Popup Text

Inherent R&M

Criteria for the inherent R&M of the system and its support related features, such as embedded training, autonomic logistics information systems, prognostics and diagnostics, portable maintenance aids, etc... This criteria should be derived from the contract performance specifications that were developed based on meeting operational requirements. Thus, support related criteria for developmental testing and evaluation should be rather straight-forward. Concurrency in testing often creates additional challenges. Also, the less than mature state of the system often results in lower R&M test results. In order to manage risk, it would be useful to identify R&M maturity factors that could be applied to various sub-systems and components so that the product support enterprise could be designed to reflect the projected R&M maturity factors.

Logistics Support Enterprise

Criteria for the support performance of the various facets of the logistics support enterprise, such as the field level support tasks, condition based maintenance, training, etc... The development of performance and acceptance criteria for the various facets of the logistics support enterprise is much more challenging. While the integrated output of the logistics enterprise should meet the warfighter's stated support performance requirements, the allocation of the performance for the individual components must be established based on their contribution to the output.

Integrated Support Performance

Criteria for the integrated support performance should be synonymous with the warfighter specified performance metrics and levels of performance. In addition, there should be an affordability/price of support criterion.

Critical Technical Parameters

The LCL is responsible for identifying and managing critical technical support parameters.

Critical technical parameters are measurable critical system characteristics that, when achieved, allow the attainment of desired operational performance capabilities. They are not user requirements. Rather, they are technical measures derived from desired user capabilities. Failure to achieve a critical technical parameter should be considered a reliable indicator that the system is behind in the planned development schedule or will likely not achieve an operational requirement. Critical technical parameters support critical operational issues. The system specification is usually a good reference for the identification of critical technical parameters.

Typically, a threshold is assigned for each stage of development. Developmental test events are opportunities to measure the performance of the system as it matures. There may be growth metrics established for each phase that can be used to demonstrate progress towards achieving the desired threshold level. The selected metrics may be used as entry or exit criteria at significant milestone decision points.

Critical Operational Issues

The LCL is also responsible for identifying and managing supportability critical operational issues (COIs) assessed during test and evaluation.

During planning efforts, the study of the mission, desired performance capabilities, employment concept, and studies such as analysis of alternatives, lead to a set of COIs and critical live fire test and evaluation (LFT&E) issues whose satisfactory resolution is vital to the system's operational effectiveness, suitability, and survivability evaluation. The COIs should be few in number, operational in nature, observable, and testable. They should address mission accomplishment and survivability at a level (e.g., ship, flight, unit) appropriate to the evaluation required. The COIs should include measurable improvements to the baseline or current mission capability.

Popup Text

Critical Operational Issues

In addition, COIs should be operationally relevant; be overarching, total operational system measures; include all system KPPs; provide no overlap or duplication among criteria; provide few issues and criteria; clearly reflect why the system is being acquired; provide criteria that are true operational “show stoppers”; provide criteria that are achievable and can be evaluated; provide clear guidance on conditions applicable to measuring each criterion and for scoring the results; avoid terms that could be misinterpreted during the analysis and/ or system evaluation - "better, greater than, less than," "at least as good as”; reflect the minimal system acceptable performance for entry into full-rate production; and consider soldier safety.

Knowledge Review

Which of the below choices is the explanation for Inherent Reliability and Maintainability?

- [ ] Covers such areas as field level support tasks, condition based maintenance, training, etc...
- [x] Covers such areas as embedded training, autonomic logistics information systems, prognostics and diagnostics, portable maintenance aids, etc...
- [ ] Synonymous with the warfighter specified performance metrics and level of performance. In addition, there should be an affordability/price of support criterion.
- [ ] All explanations are applicable

Check Answer

Inherent Reliability and Maintainability **covers such areas as embedded training, autonomic logistics information systems, prognostics and diagnostics, portable maintenance aids, etc**....

"Passing the Field Test"

Another type of support related criteria to consider is the ability to "pass the field test." This is also known as operational testing. To the right are some examples from three aircraft systems where operational testing identified Product Support Planning weaknesses.

- C-17A Landing Gear Control Panel
- B-2A Hi-Torque Fasteners
- F-22 Cabin Pressure Regulator
- B-2A Tailpipe Clevis Mounts
- B-2A Support Equipment
- F-22 Feeder Avionics

Popup Text

C-17A Landing Gear Control Panel

A landing gear handle light lens cover can now be ordered and replaced separately on the flight line as a result of a recommendation by an LT&E maintainer, eliminating manpower intensive and time-consuming follow-on maintenance and saving $16,000 per replacement. The lens cover could not be ordered separately, but rather the entire panel had to be removed and sent to the depot for repair. Maintenance of the lens cover therefore necessitated replacement of the entire panel, which has a follow-on operational check requiring a landing gear swing.

B-2A Hi-Torque Fasteners

243 Hi-Torque fasteners were used to secure the B-2A egress hatch, requiring 214 man-hours to remove and replace the hatch to inspect the ejection seat. Maintainers recommended replacing the Hi-Torque fasteners with screws and nutplates. As a result, maintenance time was reduced from 214 to only 18 man-hours, a 92 percent decrease.

F-22 Cabin Pressure Regulator

A revised cabin pressure regulator mounting configuration on F-22 aircraft increased maintenance accessibility and decreased task man-hour time by 40 percent. Initially, maintainers were required to

crawl into the cockpit and reach beyond the rudder pedals to perform maintenance on the cabin pressure regulator. The new easy access through the outside panel reduced the time to accomplish the task by 4.5 man-hours per event.

B-2A Tailpipe Clevis Mounts

Maintainers revised the procedures to remove and install B-2A tailpipe clevis mounts without removing the entire tailpipe assembly. The improved maintenance procedures reduced removal and installation time by 86 percent with a projected savings of 480 man-hours per year.

B-2A Support Equipment

Maintainers identified more than 200 pieces of contractor recommended B-2A peculiar SE as not required. The Air Force had existing SE that would accomplish the task. This nonproliferation of peculiar SE saved the program approximately $1 Billion in life cycle costs.

F-22 Feeder Avionics

For specific maintenance procedures performed on the F-22 feeder avionics, the Logistics Group through test and evaluation discovered that F-16 maintainers were better suited to complete the maintenance procedures than the F-15 maintainers initially recommended by Air Combat Command.

Design Reviews

The LCL must actively participate in program design reviews to ensure that logistics issues are considered in terms of the openness of the design, upgradeability, testability, and commercial technology insertion.

Traditionally, the logisticians often did not have the opportunity or staffing to support the active participation in program design activities and reviews. The renewed emphasis on designing in reliability and maintainability to weapon systems has made participation in design reviews a responsibility of LCLs.

Participation in the design reviews is essential in order to ensure that the Life Cycle Sustainment Planning activity to include BCA is aligned with the current system design and its ensuing logistics requirements.

Once again, the requirement for collaboration with the systems engineering activities is an essential element of the Life Cycle Logistician's responsibilities.

Design Reviews, Cont.

The LCL should participate in and contribute to the two key design reviews: the preliminary design review and the critical design review. The PDR should be completed in the Technology Development phase, but if it was not, it will be completed in the EMD phase, ISD effort prior to moving on to the CDR.

The Preliminary Design Review (PDR) is a multi-disciplined technical review to ensure that the system under review can proceed into detailed design, and can meet the stated performance requirements within cost (program budget), schedule (program schedule), risk, and other system constraints.

The Critical Design Review (CDR) is a multi-disciplined technical review establishing the initial product baseline to ensure that the system under review has a reasonable expectation of satisfying the requirements of the Capability Development Document within the currently allocated budget and schedule.

Popup Text

Preliminary Design Review (PDR)

Generally, this review assesses the system preliminary design as captured in performance specifications for each configuration item in the system (allocated baseline), and ensures that each function in the functional baseline has been allocated to one or more system configuration items. Configuration items may consist of hardware and software elements and include such items as airframes, avionics, weapons, crew systems, engines, trainers/ training, etc.

Critical Design Review (CDR)

Generally this review assesses the system final design as captured in product specifications for each configuration item in the system (product baseline), and ensures that each product in the product baseline has been captured in the detailed design documentation. Product specifications for hardware enable the fabrication of configuration items, and may include production drawings. Product specifications for software (e.g., Software Design Documents) enable coding of a Computer Software Configuration Item. Configuration items may consist of hardware and software elements, and include items such as airframe, avionics, weapons, crew systems, engines, trainers/ training, etc…

Design Reviews, Cont.

The CDR brings closure to technical risk mitigation and alternate design paths in detailed system design. Once the product baseline is established, opportunities to improve performance or reduce life-cycle costs are severely limited.

After completion of the CDR, any changes to support equipment, training requirements, logistics and supply elements, interoperability, and performance can only be accomplished through a formal Engineering Change Proposal.

All technical risk should be reduced to acceptable levels and remaining program execution risks resulting from resource or schedule shortfalls should be addressed quickly or it will jeopardize program success.

Outputs of the CDR Process

Upon completion of the CDR, the following products should be completed:

- An established system initial product baseline,
- An updated risk assessment for EMD,
- An updated CARD (or CARD like document) based on the system product baseline,
- An updated program development schedule including fabrication, test and evaluation, and software coding, critical path drivers, and
- An approved Life-Cycle Sustainment Plan (LCSP) updating program sustainment development efforts and schedules based on current budget, test evaluation results and firm supportability design features

Incremental Critical Design Reviews

For complex Systems, a CDR may be conducted for each subsystem and logistics element. These incremental reviews lead to an overall system CDR. When incremental reviews have been conducted, additional risk is introduced until the overall system CDR establishes the complete system product baseline.

Each incremental CDR closes a functional or physical area of design to modification regardless of when it is held. This completed area of design may need to be reopened if open areas cannot achieve desired performance in isolation. If the schedule is being preserved through parallel design and build decisions, any system deficiencies that lead to reopening design will result in rework and possible material scrap.

LCL's Focus on CDR Successful Criteria

As the LCL assigned to an acquisition program in the EMD phase, it is your responsibility to ensure that the approved CDR baseline and the subsequent Life Cycle Sustainment Plan are supportive of each other. Some of the questions that the LCL should examine are:

1. Has the detailed design satisfied sustainment and Human Systems Integration requirements?
2. Has the system product baseline been established and documented to enable hardware fabrication and software coding to proceed with proper configuration management?
3. From a technical/cost risks perspective, is the program schedule executable?
4. Are materials and tooling available to meet the manufacturing schedule?
5. Have key product characteristics having the most impact on system performance, assembly, cost, reliability, and sustainment or safety been identified?
6. Are long lead procurement plans in place and has the supply chain been assessed to meet support requirements?

While the above examples of question are not considered to be all inclusive of areas needing reviewed, they do show the extremes to which the LCL must analyze to ensure a complete LCSP.

Knowledge Review

Which of the below statements is "True" concerning the LCL's focus during the CDR completed during the EMD phase?

- [ ] Each incremental CDR does not close a functional or physical area of design to modification regardless of when it is held.
- [x] For complex Systems, a CDR may be conducted for each subsystem and logistics element.
- [ ] The CDR does not bring to closure to technical risk mitigation and alternate design paths in detailed system design.
- [ ] Once the product baseline is established, opportunities to improve performance or reduce life-cycle costs are un-limited.

Check Answer

For complex Systems, a CDR may be conducted for each subsystem and logistics element is a true statement concerning the LCL's focus during the CDR completed during the EMD phase.

Technical Activities Summary

You have completed Technical Activities and should now be able to:

- Identify the LCL's role in defining support-related performance and acceptance criteria for M&S and T&E.
- Identify the LCL's role in refining logistics support considerations based on the CDR.

Lesson Completion

You have completed the content for this lesson.

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