LIVEWORX 16™

Session 409

DRIVING AFFORDABILITY CONCEPTS INTO MODEL BASED SYSTEMS ENGINEERING (MBSE) FUNCTIONAL ANALYSIS

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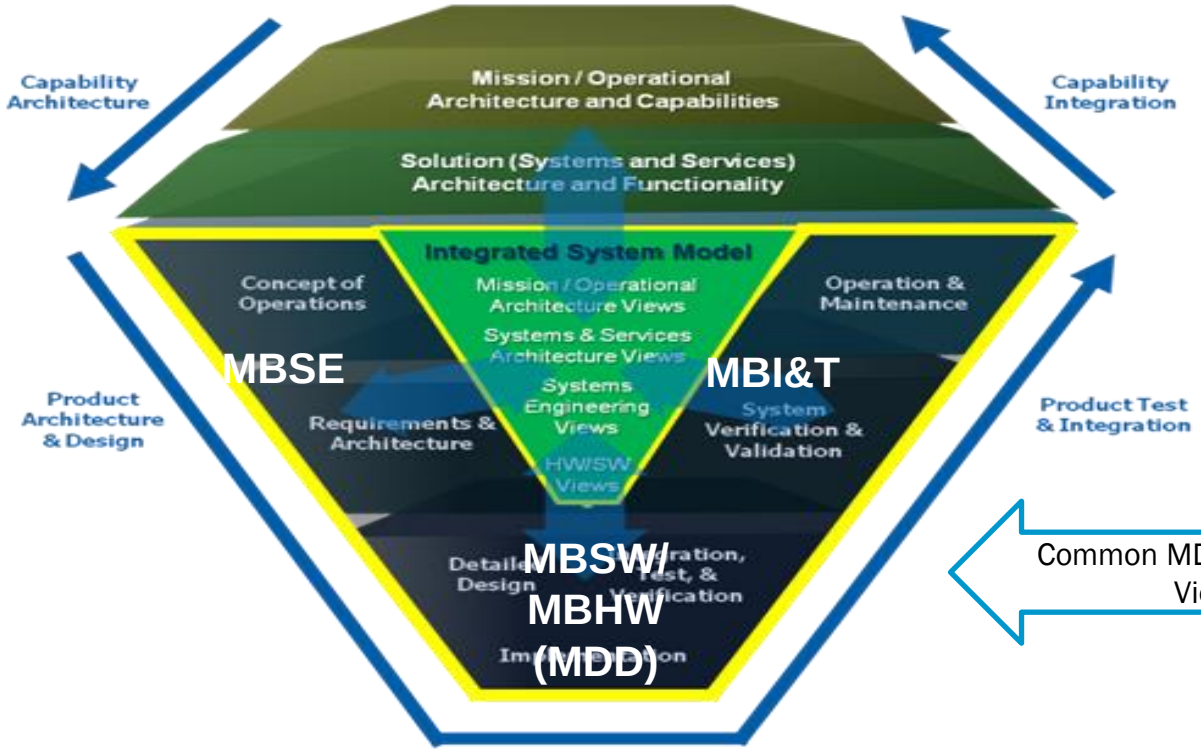
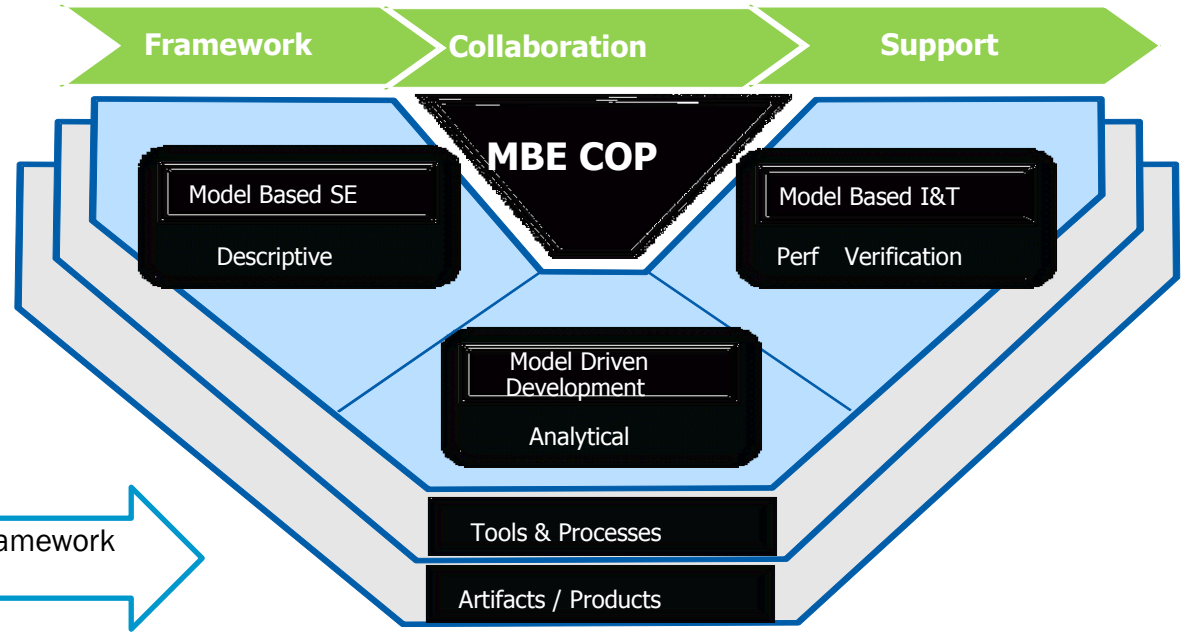
WHAT IS MODEL BASED ENGINEERING?

MBE = MBSE + MDD + MBI&T



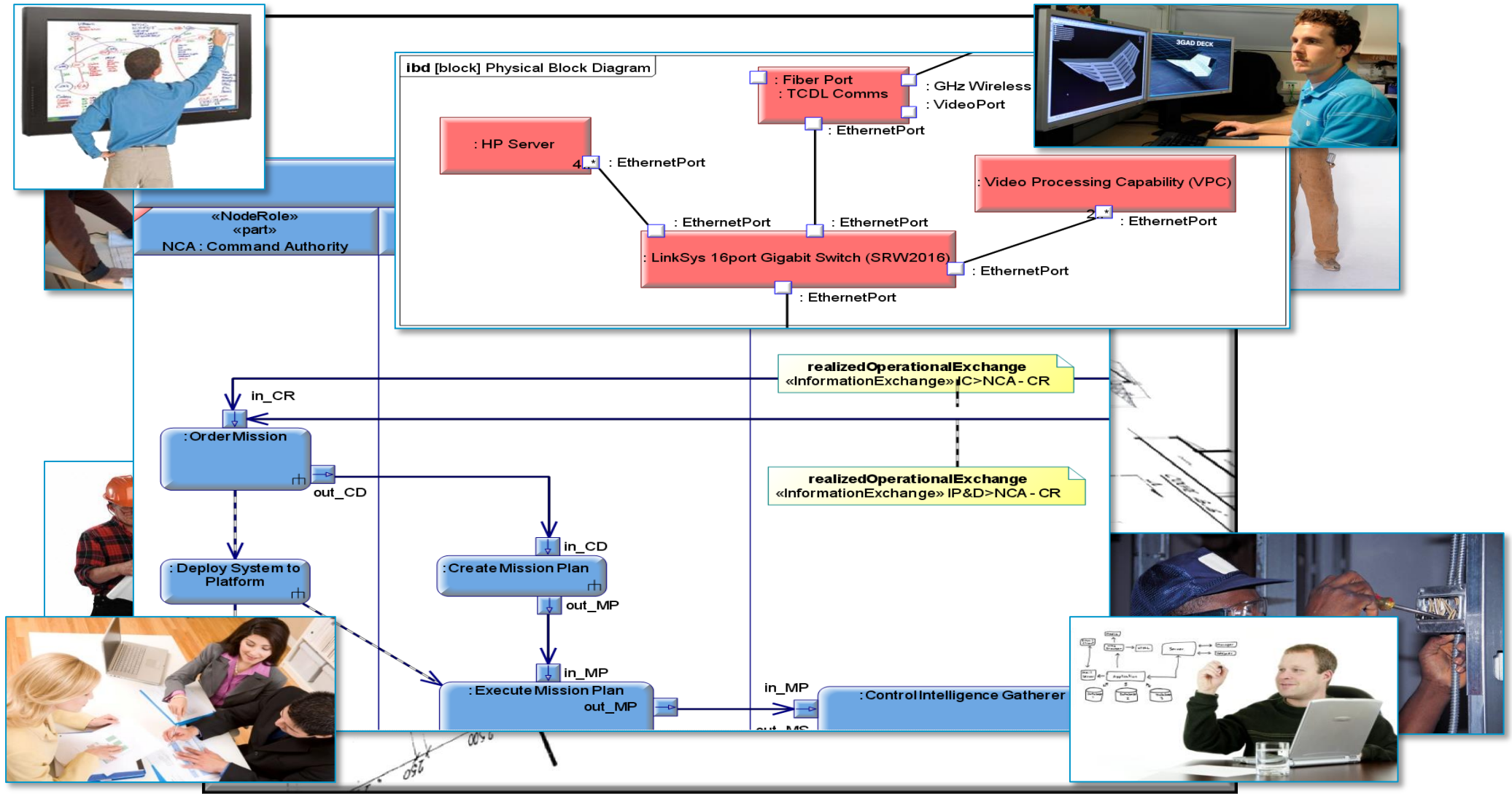


Common MDE Framework Views

MBE includes Model-Based Systems Engineering, Model Driven Development, and Model Based Integration and Test

WHY MODEL BASED ENGINEERING?

"ONE FACT, ONE PLACE"

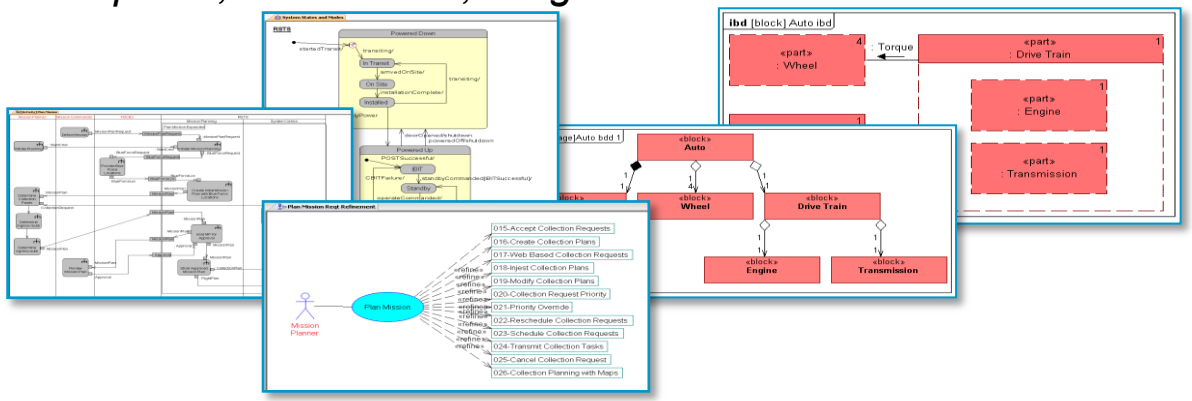


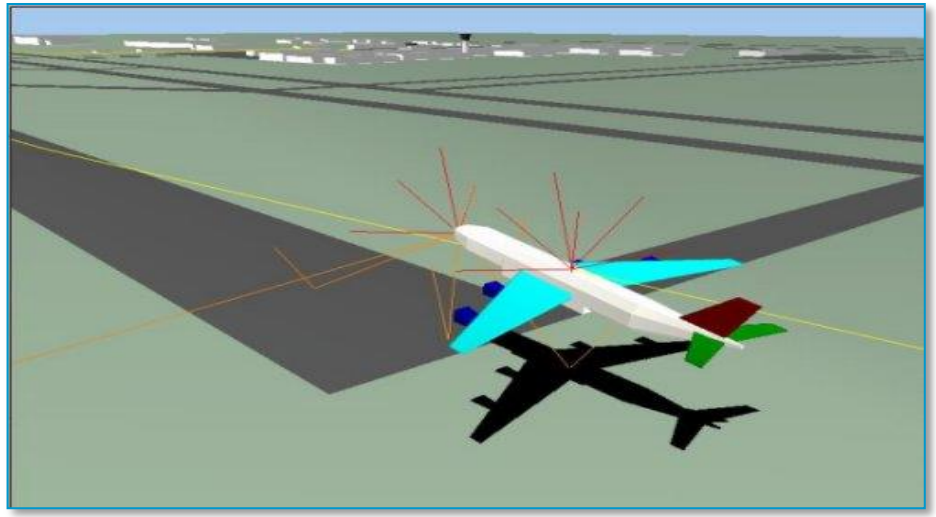
WHAT'S IN A NAME?

DIFFERENT KINDS OF MODELS FOR DIFFERENT PURPOSES

Descriptive"Model" (as in "Model Airplane")

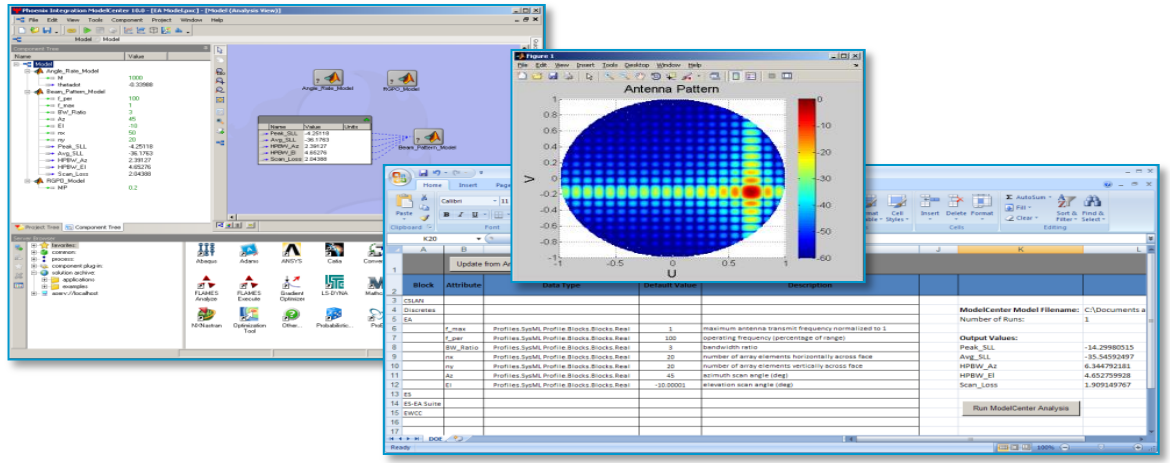
Blueprints, Schematics, Diagrams…



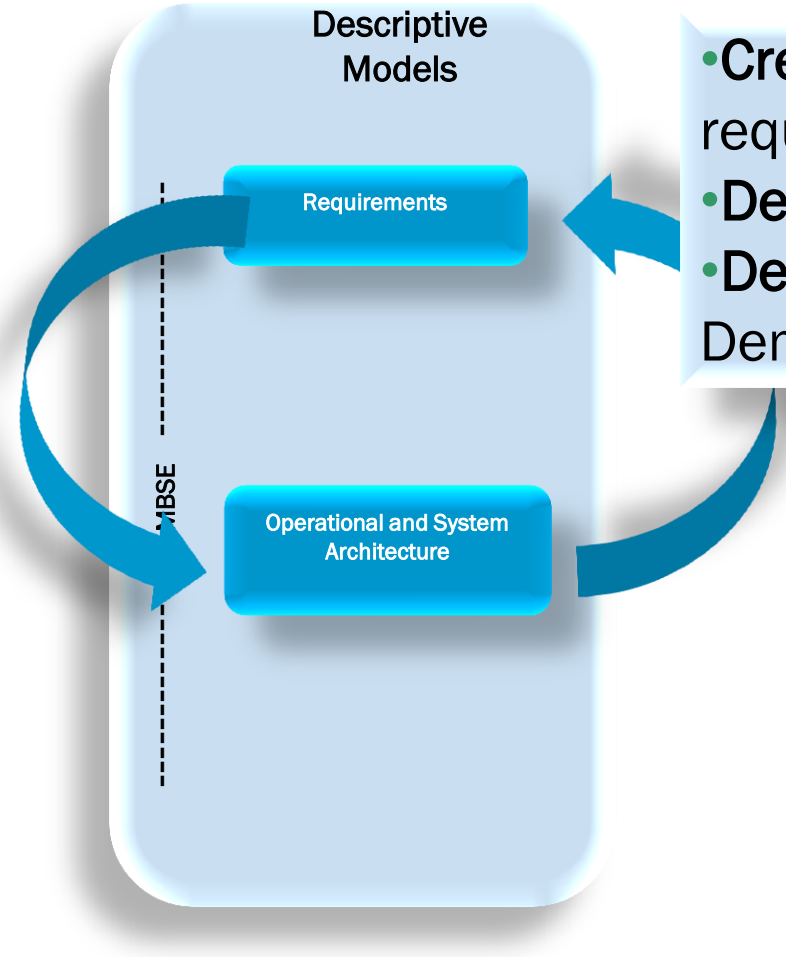


Analytical "Model" (as in "Flight Model")

Computational Models, Simulations…



UTILIZED MBSE METHODOLOGY TO ENSURE TRACEABILITY BETWEEN FUNCTIONAL ARCHITECTURE AND REQUIREMENTS



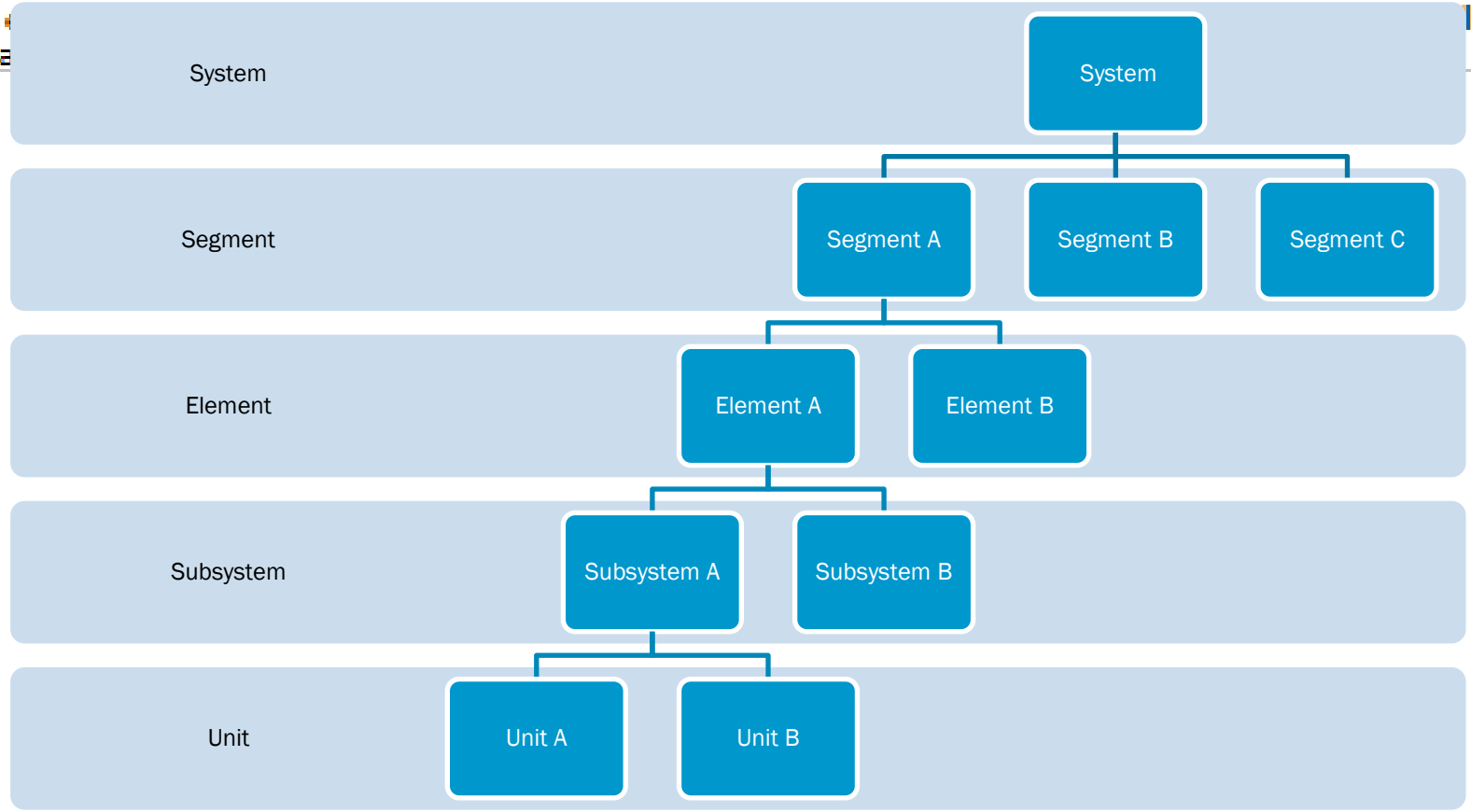
- **Created** bi-directional linkage to push OPSCON artifacts and pull requirements
- **Derived** 91 System Functions from 226 System Requirements
- **Determined** EIS Methodology since high TRL systems to push Test and Demo verification method at element level

Category	Criticality	Extent of Verification
Essential	Establish capabilities necessary for safe mission operations	Normal rigor of verification and demonstration testing
Important	Functional & performance capabilities necessary to conduct and produce important mission products, or to meet TLCs	Limited verification since capabilities achieve can be validated and/or modified before transition to operations
Supporting	Capabilities that will be demonstrate at lower levels and are not *important* for mission operations	Verified by auditing capabilities at design complete only

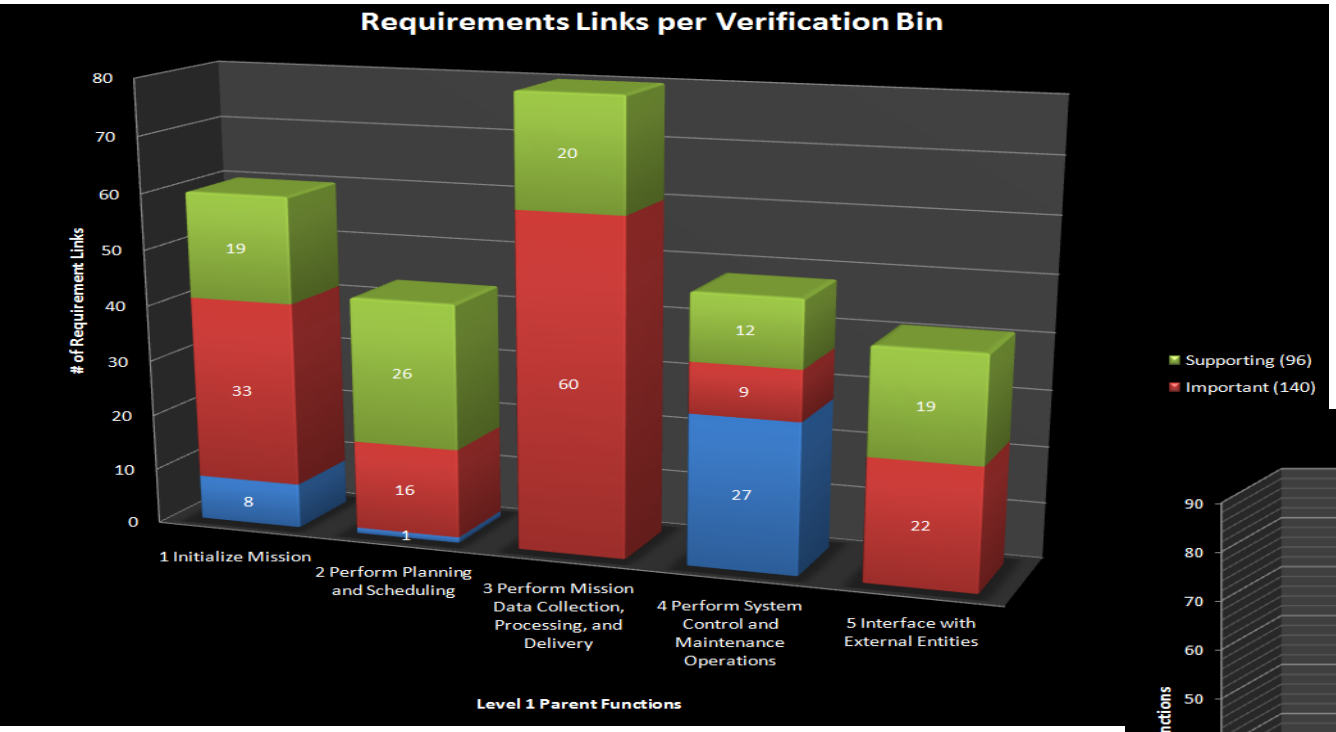
APPLYING EIS WILL ADD VERIFICATION METHOD OF "DESIGN AUDIT" TO REDUCE REDUNDANT REQUIREMENTS AND REWORK

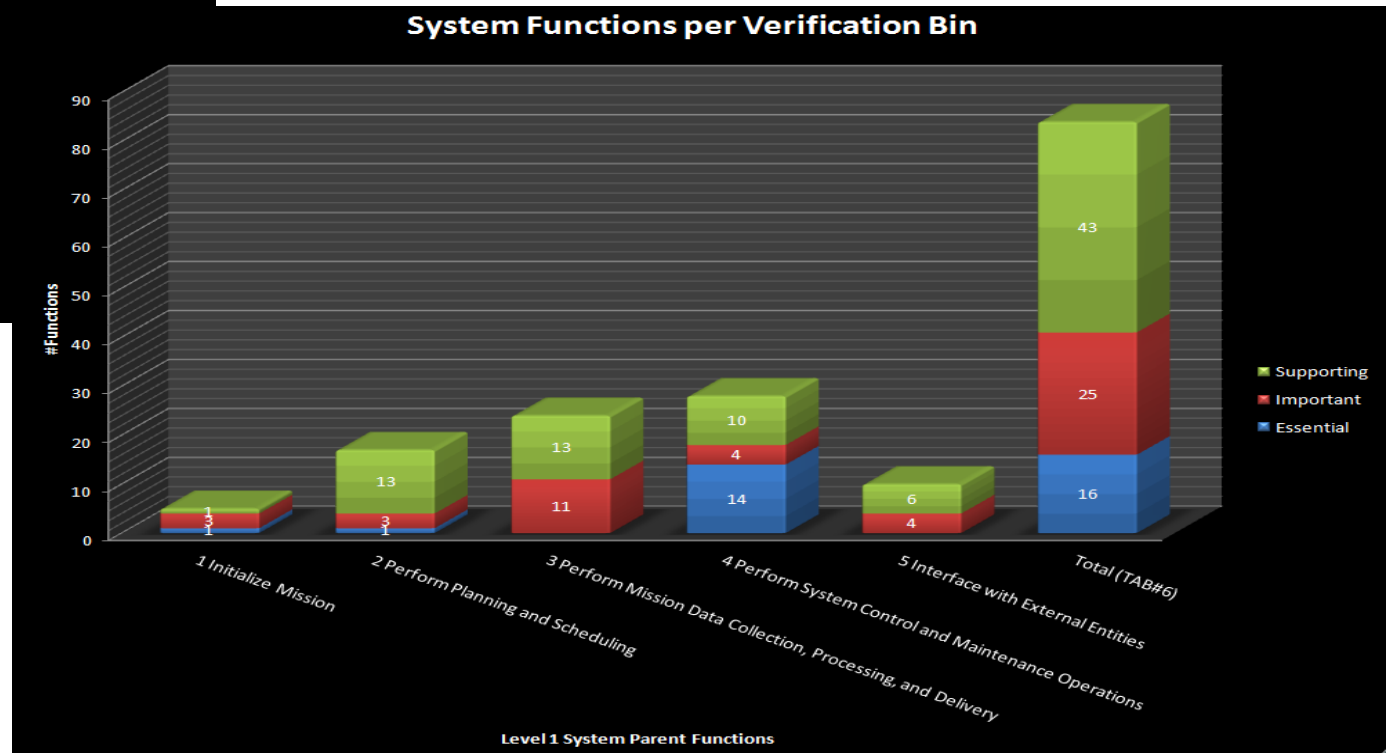
Method	Definition
(DA) Design Audit	An audit of the design performed at the design complete state to determine conformance to requirements. This audit can be an analysis or inspection performed at this state of the design and development phase. Since these requirements are verified at the design complete state, the responsible system engineer will identify as-built parameters to be monitored to validate that the design has not changed at the point of final acceptance review of the elements. The point of final acceptance review (e.g., this may be a pre-ship readiness review for an item provided by a subcontractor or an [illegible] be established for ea[illegible]

- Utilize as much of the existing Element and lower level requirements
- Derive requirement at appropriate system level and show traceability to parent without repeating at each level in the chain
- Eliminates the roll-up of verification at each "level up the chain" or analysis on top of analysis to trace verification back up to the system level



EXAMPLE: ALL SYSTEM REQUIREMENTS ARE TRACED TO SYSTEM FUNCTIONS





EXAMPLE OF SYSTEM *ESSENTIAL* FUNCTION MAPPED TO OPSCON AND SEQUENCE DIAGRAMS TO ENSURE SYSTEM DESIGN VALIDATION

System *Essential* Function

Communicate Using NB

OPSCON Activity Diagram

Execute NB

Air Segment Functions

Receive CMDs
Decrypt CMDs

AS Sequence Diagram

Perform NB Communications

Ground Segment Functions

Transmit CMDs
Encrypt/Decrypt C&T

GS Sequence Diagram

Execute NB

Requirement to Function Report

OPSCON to Functional Hierarchy Report

Activity Diagram Report

Sequence Diagram Report

Behavior Diagram Report

Reports Support System Design Validation Activity

Ensure Consistent Operational/System/Segment Architecture

Figure 2. Baseline UAS Operational View - 1 (OV-1)

Source: http://www.occupy.com/article/north-carolina-deals-setback-drone-surveillance-%E2%80%94-now

EXAMPLE OF SYSTEM *IMPORTANT* FUNCTION WITHIN ARTISAN DB - MAPPED TO OPSCON AND SEQUENCE DIAGRAMS TO ENSURE SYSTEM DESIGN VALIDATION

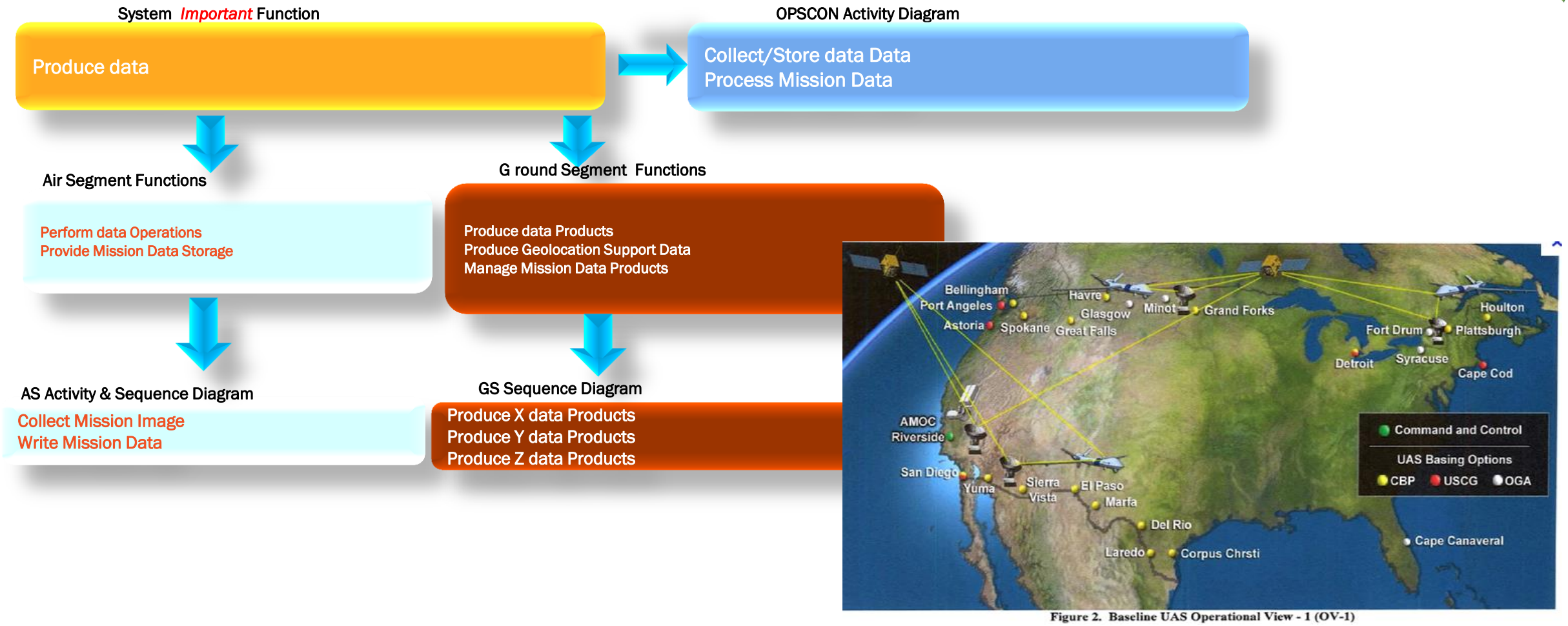


Figure 2. Baseline UAS Operational View - 1 (OV-1)

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EXAMPLE OF SYSTEM *SUPPORTING* FUNCTION WITHIN ARTISAN DB - MAPPED TO OPSCON AND SEQUENCE DIAGRAMS TO ENSURE SYSTEM DESIGN VALIDATION

System *Supporting* Function

Transition from Ancillary to Primary

OPSCON Activity Diagram

Return to Ops

GS Functions

Transition to/from Ancillary

GS Sequence Diagram

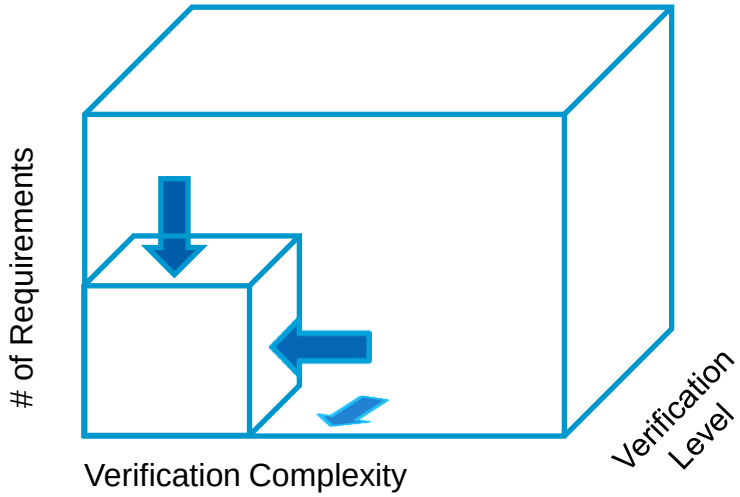
Transition H&S Operations

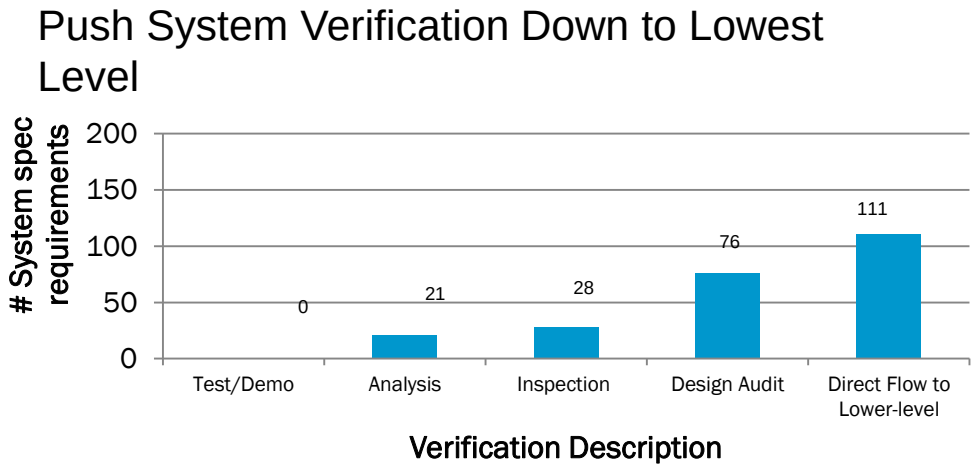
Figure 2. Baseline UAS Operational View - 1 (OV-1)

Source: http://www.occupy.com/article/north-carolina-deals-setback-drone-surveillance-%E2%80%94-now

COMPLETE VERIFICATION ACTIVITIES AS EARLY AS POSSIBLE ON LOW RISK REQUIREMENTS

Reduce Redundant Requirements





Category	% in System Spec	Criticality	Extent of Verification
Essential	15%	Establish capabilities necessary for safe mission ops	Normal rigor of verification and demonstration testing
Important	45%	Functional and performance capabilities necessary to conduct mission and produce system outputs to meet program TLCs	Limited verification since capabilities achieved can be validated and/or modified between IOC and FOC
Supporting	40%	Capabilities that will be demonstrated at lower levels and are not important for mission ops	Verified by auditing capabilities at CDR only – “design audit”

COMPLETE VERIFICATION ACTIVITIES AS EARLY AS POSSIBLE ON LOW RISK REQUIREMENTS

- Analysis or Inspection is performed with the same diligence as if performed as part of the “normal” verification effort
- Verification results are recorded and considered complete
- Verification is only revisited if “As-built” system does not pass its lower level requirements, meaning design was not realized

Design Audit – Verification Method defined to identify Analysis or Inspection performed on Design rather than As-Built System

CONCLUSION

- Affordability objectives
  - How can we learn for our past and take advantage of our experience?
  - What processes can we tailor to provide the best-value to the program?
- Verification is one such area for the right program
  - Capability-Based
  - High reuse of components with high TRLs
  - Experience testing similar systems
- Certain level of risk tolerance on the part of both the internal and external PMO

THE VALUE OF PERFORMANCE.

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