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Implementing a Methodology to Incorporate Operational Realism in CONOPS & Testing

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Agenda

- **Challenge: Incorporate Operational Realism Early in Life Cycle – Today!**
  - What products & when in life cycle
  - Two current projects that address challenge
- **Double Helix Methodology involving CONOPS/Technology Trade-offs**
- **The Methodology Captures Key Acquisition Information**
  - Inputs for TES, TDS, and TDS
  - Use Case involvement
  - Incorporating operations in Test Architecture
- **Lessons Learned at ASSETT**
- **Summary and Conclusions**
- **Q&A**

Challenge: Operational Realism Early in Cycle

- Challenge – NDIA SE Division DT&E Report [April 2008]:
  - **Finding:** Operational realism is often not included or detailed in the earliest phases of acquisition, such as during generation of the CONOPS, ICD, TDS, and TES
  - **Recommendations:**
    - Operational realism must be given due diligence during the generation of the CONOPS, then flowed into the ICD, TDS, and TES
    - CONOPS should have iterative updates beginning when technology constraints are identified…
    - These updates need to flow into the ICD, TDS, and TES or their respective follow-on documentation.

- ***In the following charts, the approach being done by a small business, ASSETT, is shown to be accomplishing the recommendations.***

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Operational Realism and CONOPS

- Operational Realism – The tasks and activities, operational elements, and information exchanges required to conduct operations
  - DODAF Operational View in a System Architecture
    - Includes high level operational concepts [e.g. CONOPS],
    - Operational activities sequence and timing descriptions
    - Activity and Logical data models
  - Trade-offs between operations and technologies

- CONOPS – *A Concept of Operations is defined as a description of how a set of capabilities may be employed to achieve mission objectives or a particular end state for a specific scenario*
  - A CONOPS for critical mission segments should be in place for all mission scenarios
  - Currently, a CONOPS is not updated for a platform even though a technology improvement is installed or a new capability made available…CONOPS should change

Operational Realism Products Evolve Early in Acquisition and SE Process

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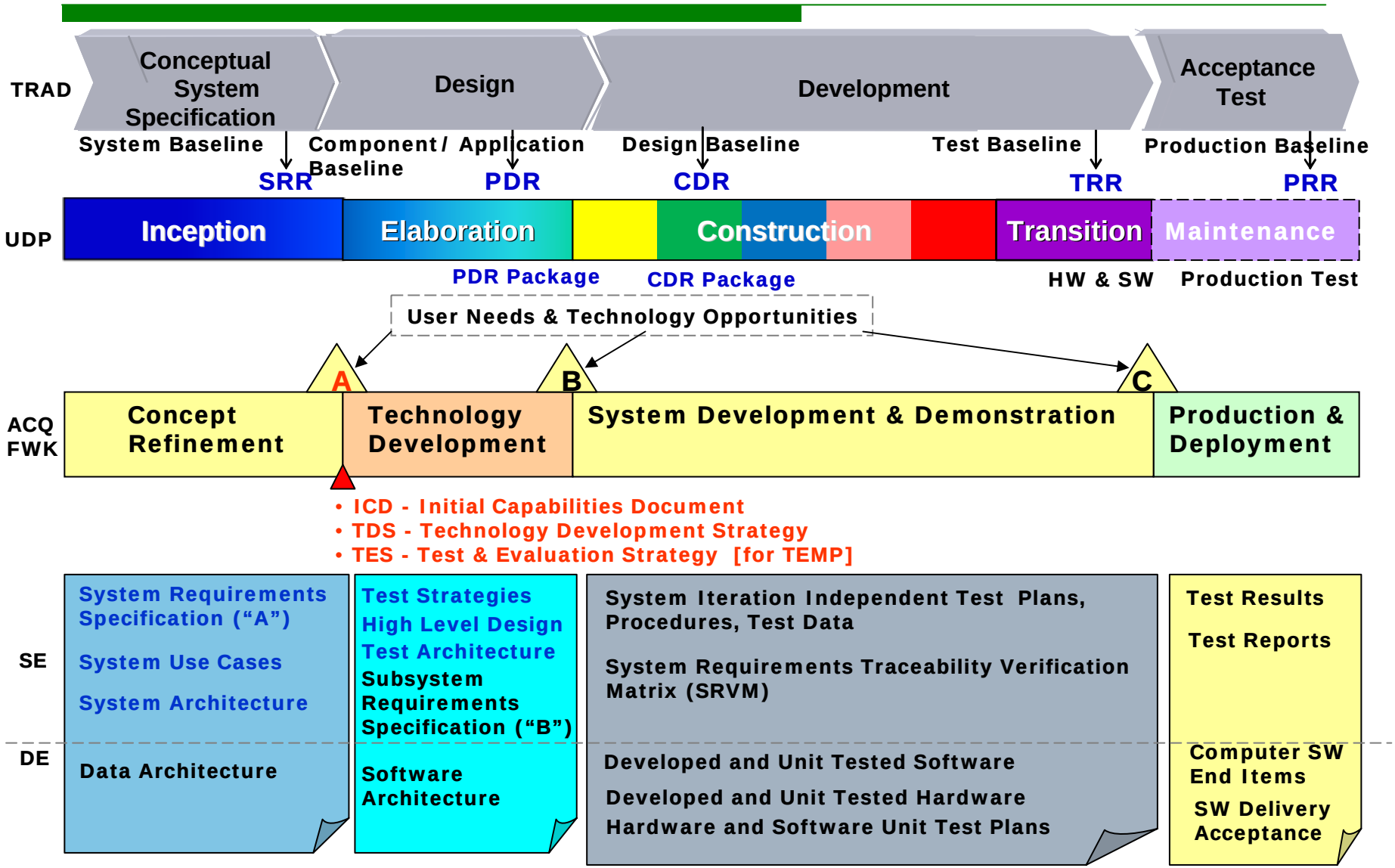

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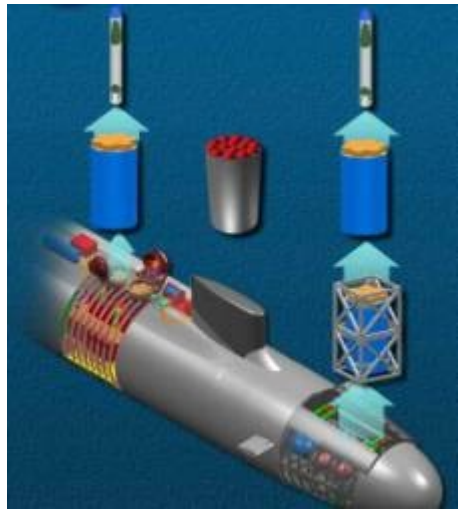
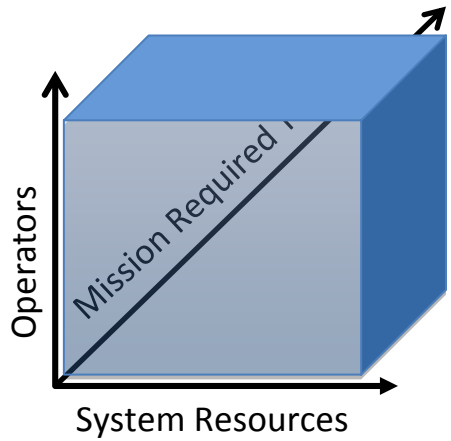
Two Current ASSETT Projects Address Operational Realism

- SBIR N05-149 Combat System of the Future
  - Non-Traditional View of the Submarine
    - Provide the Basis for Ship Design
      - HSI Impacts Manning Reduction that Drives Stores, Accommodations, and Supplies
      - Maximum Use of Technology that Drives Power, Cooling, Volume, and Footprint Requirements
    - Identify Changes in CONOPS and Training
      - Allow CONOPS to Change as a Function of Technology
      - Develop Confidence in New Analysis Tools and Automation
- ONR Capable Manpower Initiative
  - BAA 007-013 – Improved Manning and Optimized Personnel (IMOP)
    - Top-Down Approach to Estimating the Manning Requirements for a Platform
    - Searches for an Optimum Manning Solution Among Number of Operators, System Resource Requirements and Mission Tasking





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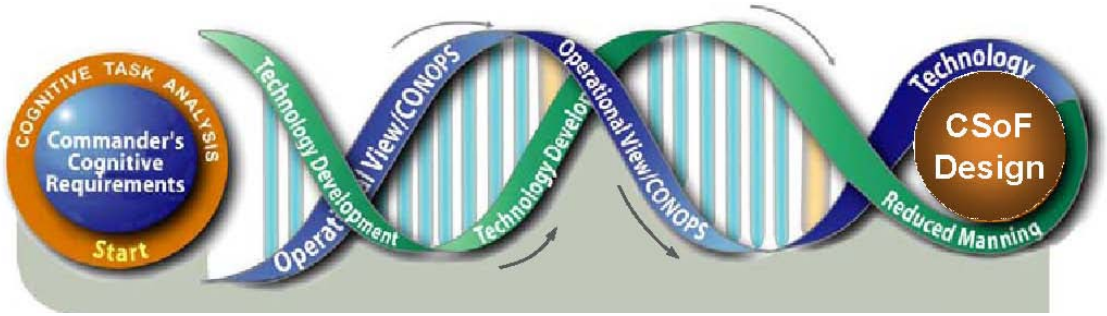
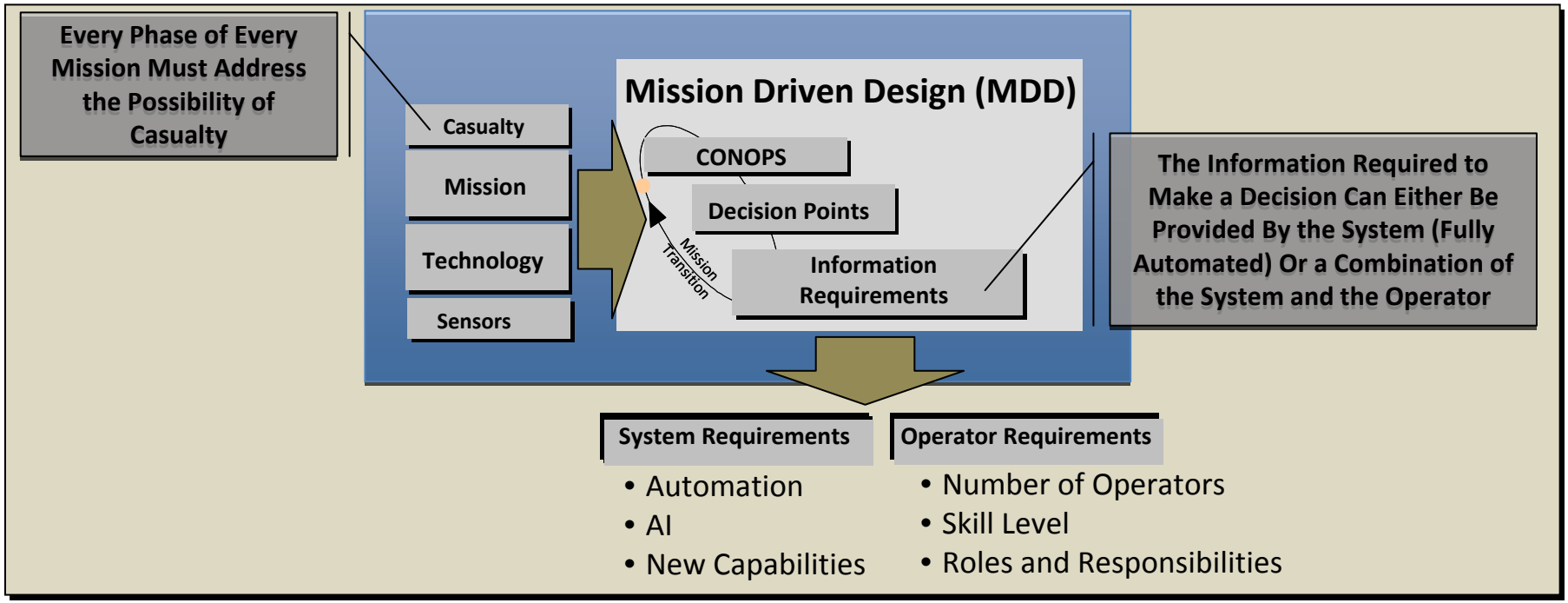
Our CSoF Methodology Incorporates Operational Concepts and Technology



Double Helix Approach Leveraged from the DARPA Command Post of the Future [CPoF])

- **Technology (Helix 1) and CONOPS (Helix 2 - Operator's View) Evolve and Over the Life Cycle of the System (Concept Through Disposal)**
  - **Understanding the Operator's View and What Is Needed for Effective Decision Making Is Necessary In Order to Apply New Technologies Effectively**
  - **Conversely, the Operator Needs to Be Made Aware of New Technologies and How They May Impact His Decision Making**
  - **The Blue Vertical Bars Represent Points in Time When an Exercise Is Run to Determine if Changes in Technology or CONOPS Would Enhance the Operator's Ability to Make Accurate Decisions. Typically this Exercise Is Via the Web or Video Conferencing**
  - **The Orange Vertical Bars Represent Point in Time When Actual Experiments Are Run to Analyze the Benefits of New Technology or Changes in CONOPS.**

Mission Driven Design



- Top Down Approach that Focuses On Ensuring Mission Success
  - Develop Mission Scenarios
  - Determine Alternatives for Presenting Information to Operator (s)
  - The ASSETT Team Executes Web Exercises, Interviews, & Team Experiments
    - SMEs Identify the Decision Points and the Information Required
  - System Engineers Determine Technologies and Capabilities Necessary to Provide the Required Information

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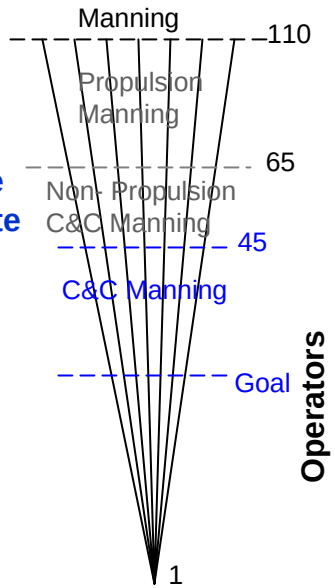
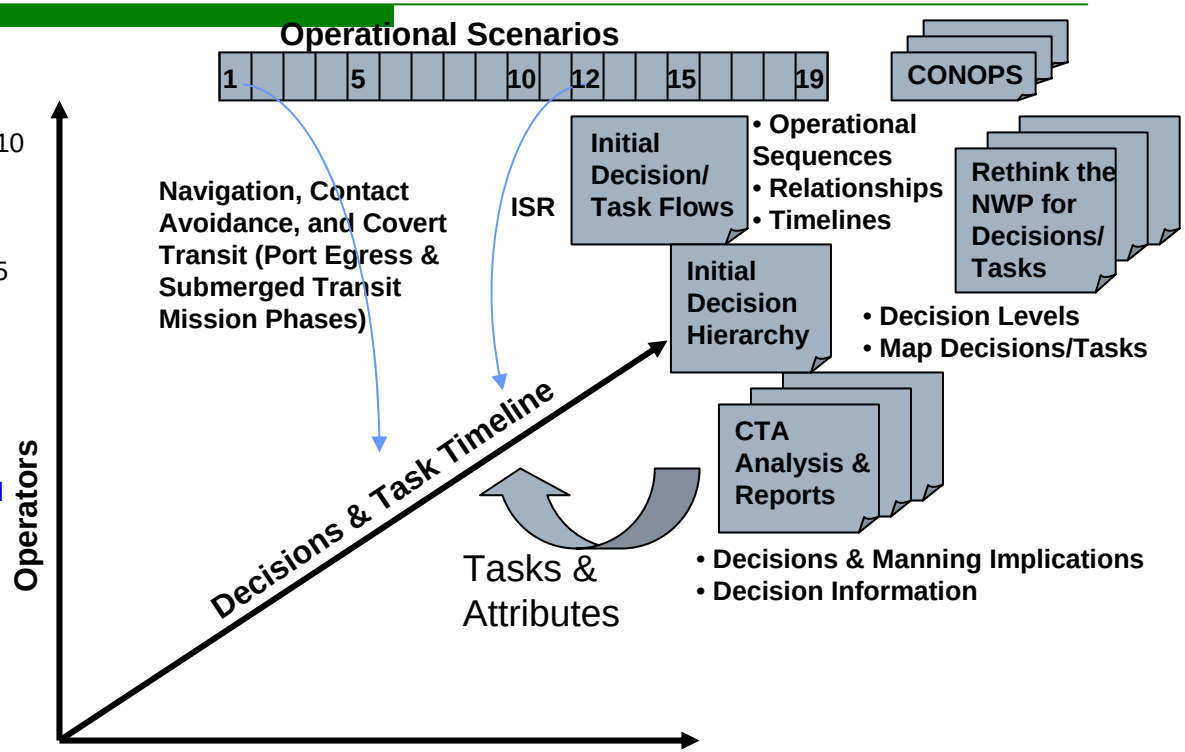
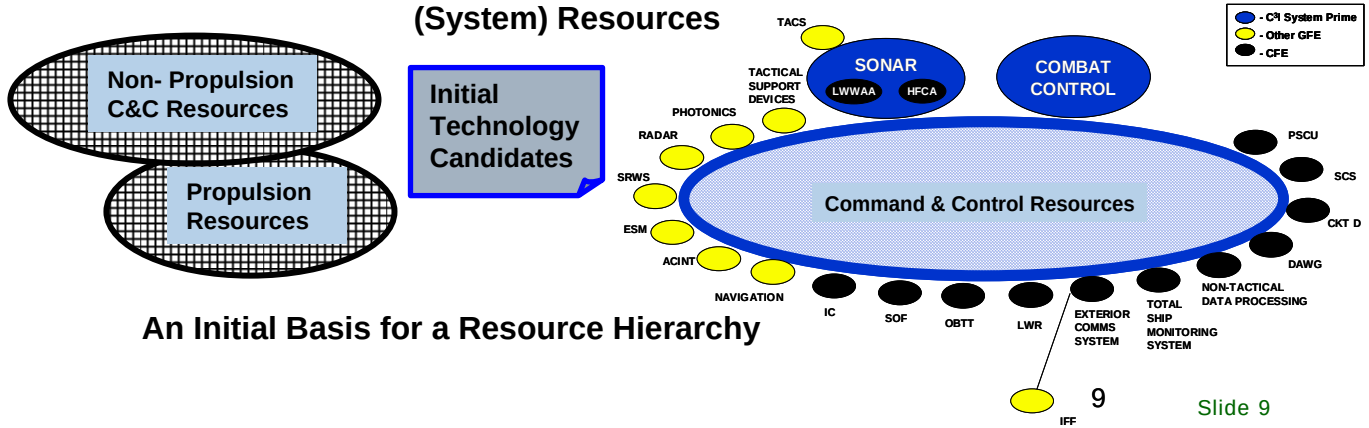
Operations & Technology Analyses Driven by Missions to Optimize Manning – Data Gathering

- **Personnel/ Roles of Current Submarines (CSoF)**
- **An initial CONOPS identifying Candidate Operators to Eliminate or Redefine**
- **Manning Goal of current crew size**
- **Zero-based double helix manning analysis (CSoF)**





Tasks are defined in the IMOP Manning Model with Trade-offs between Operators & Resources



An Initial Basis for a Resource Hierarchy

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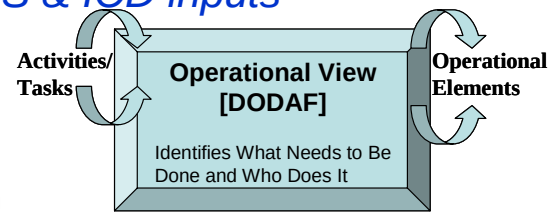
Building with the Combat System of the Future (CSoF) Process

Missions: (Representative mission phases from the CSoF Operational Scenarios: Port Egress, Submerged Transit, and Intelligence Surveillance and Reconnaissance (ISR))

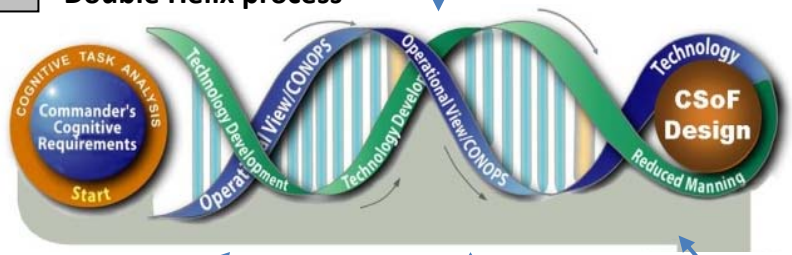
Decisions:
To support Missions

Objective: *Formulate data to define operational decisions & capture technology for TDS & ICD inputs*



- wDx
- SME Interviews

Double Helix process



Step 1

Decision Information Required/Task Timeline

CONOPS (Re-thought NWP for every activity for each mission)
Decision Hierarchies, Timelines

Multiple Iterations

Step 2

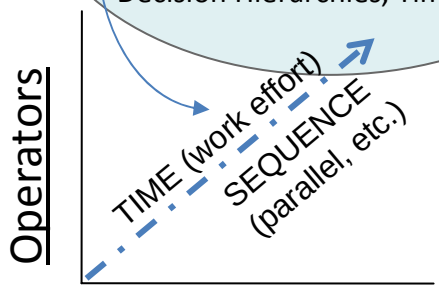
Technology

Technology Advancement

Step 3

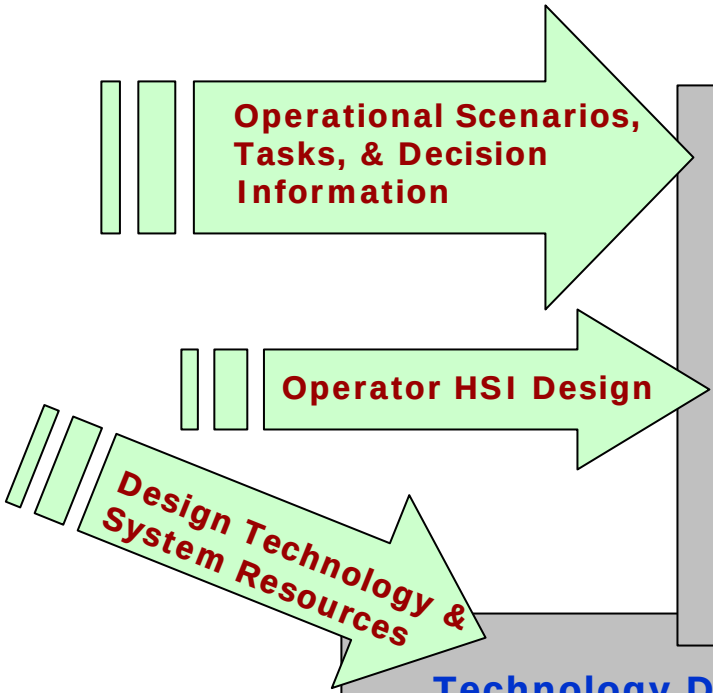
Systems
(Data, Technology)

Person
(User Role)



Proceeding Ahead:
Refocus Data Gathering to narrow search and expand data attributes for modeling

Our Process Would Drive Operational Needs Into the TES, ICD, and TDS



Test and Evaluation Strategy (TES) Objectives

(Defense Acquisition Guidebook – Section 9.3.1)

- **Verify SE Process**
- **Event driven T&E Strategy**
  - Assess technical progress against critical technical parameters (CTP)
  - Determine readiness of operational testing – an OT&E entrance criteria
  - Assess command, control, communications, and ISR to ensure interoperability will represent stressed OT&E scenarios
- **How stress system to at least the limits of the Operational Mode Summary / Mission Profile**

Technology Development Strategy (TDS) Objectives

(Defense Acquisition Guidebook – Section 2.2.1)

- **Focus is on the Technology Development Phase activities (TDP)**
- **Strategy to manage R&D**
- **Description of 1st technology demonstration**
- **Test Plan:**
  - How 1st technology spiral demo will be evaluated
  - Focus on evaluation of technologies being matured during TDP and signals end of Milestone A

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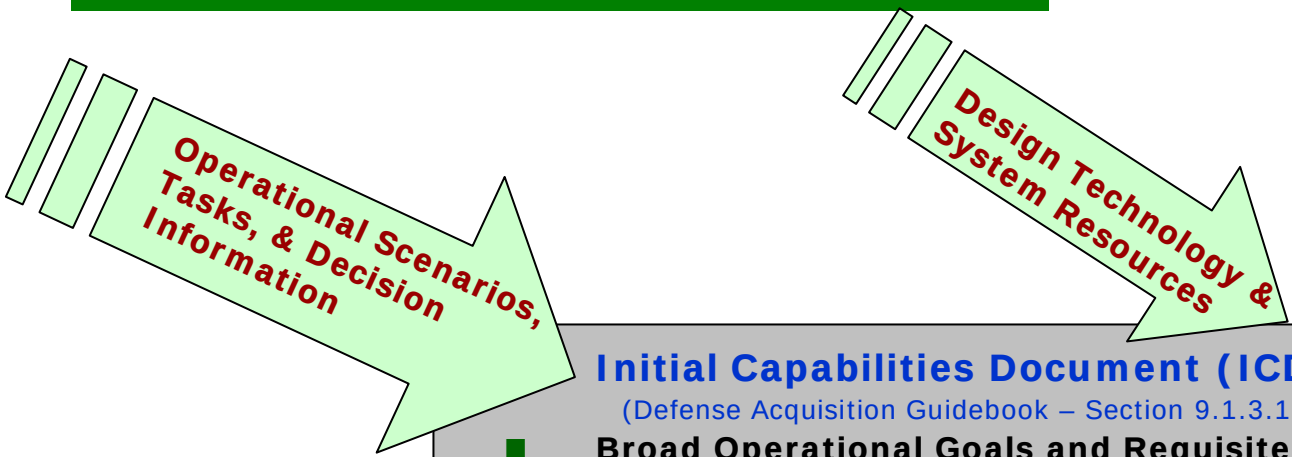
Our Process Would Drive Operational Needs Into the TES, ICD, and TDS



Initial Capabilities Document (ICD) Objectives

(Defense Acquisition Guidebook – Section 9.1.3.1 + Other Sources)

- **Broad Operational Goals and Requisite Mission Capabilities that drive the TES**
- **Addresses specific capability gaps in terms of**
  - **Functional areas**
  - **Range of Military Operations**
  - **Desired Effects and Time**
- **Description of 1st technology demonstration**
- **Describes materiel and non-material approach to satisfy capability gap**
- **Used for Milestone A decisions**

An important effort to define Initial Capabilities is to perform a demonstration of conceptual designs including Command & Control Display Concepts for operational scenarios – such as those done by the CPoF and CSoF projects.

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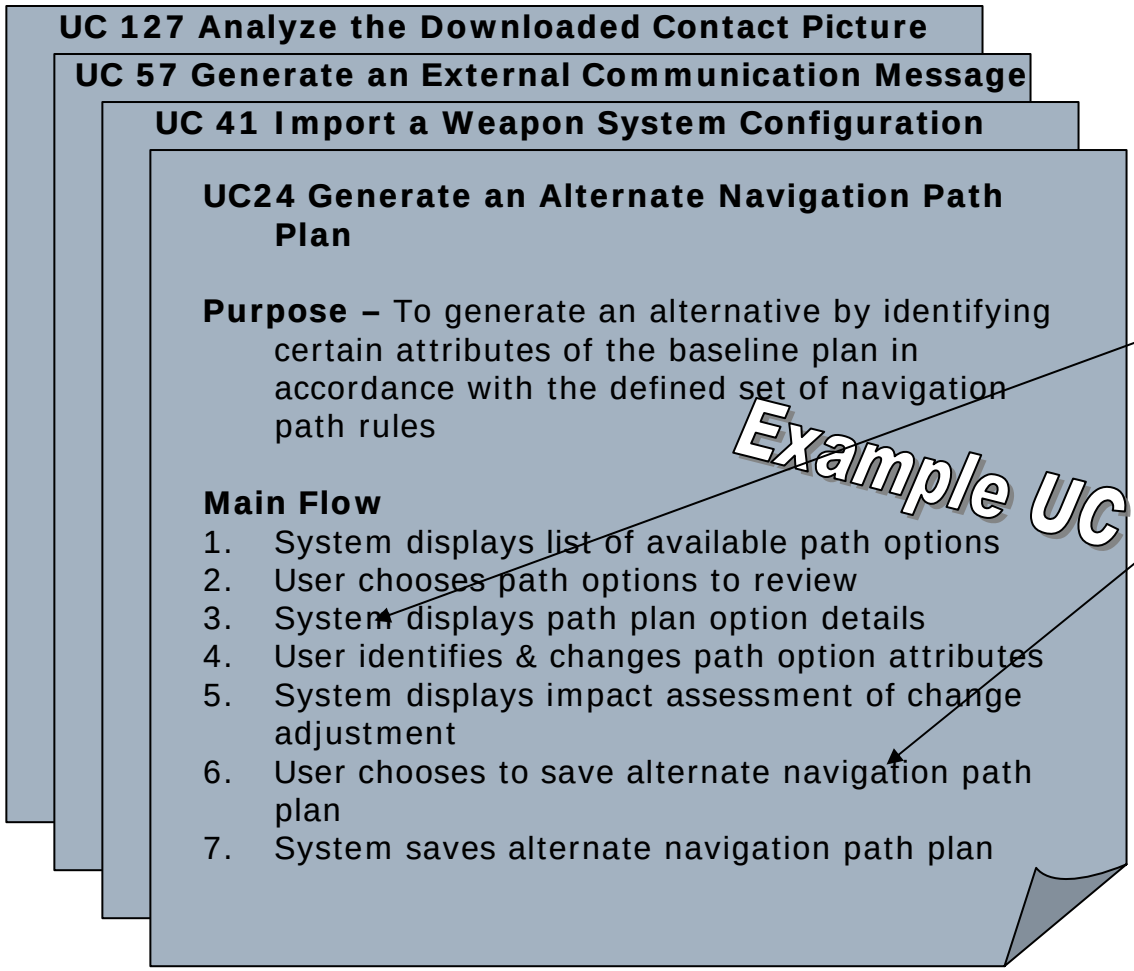
Use Cases provide a good Link to Operational Test Validations



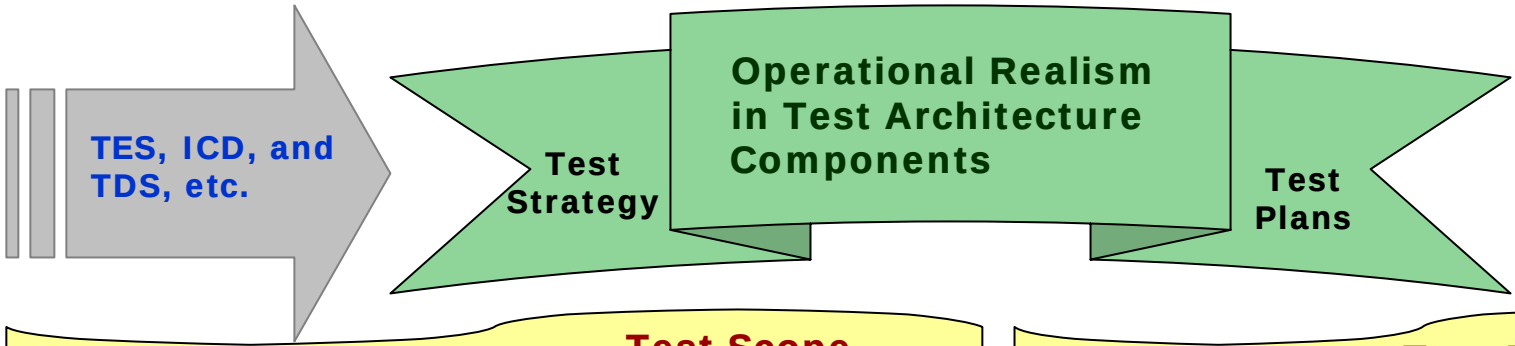
- **Use Case (UC) Definition:** *A use case is a single [operational] task, performed by the end user of a system, that has some useful outcome.*

- **Use cases (UC) are a popular way to express operational & system requirements**
- **A UC spans between the user needs and system functionality**
- **The UC directly states the user intention and system response of each step in a particular interaction.**

- **Mission Analyses result in defining tasks in an operational scenario that needs to be completed.**
- **These tasks become the basis for defining use cases**
- **A system design that satisfies a UC meets an operational need.**

A good Test Strategy includes a Test Plan that performs Test Cases involving Uses Cases for both DT&E and OT&E.

Test Architecture incorporates Methodology Outputs



Test Scope

- SOW emphasis on specific efforts to verify operational requirements

Test Objectives

- Clearly define overall project operational test objectives
- Define multiple levels of testing: Laboratory, Field, and Operational

Test Environments

- DT&E and OT&E environment HW/SW

Test Operations

- Planning and conducting DT& E (T&I) and OT&E
- Plans for incorporation of OT&E early in cycle
- Field testing and Customer site acceptance tests

Test Documentation

- Test Strategy, Plans, Procedures, & Reports for each level

Test Equipment

- Technology in test environments
- Transportability for operational field tests

Test Metrics

- Operational metrics
- Laboratory vs. Field metrics

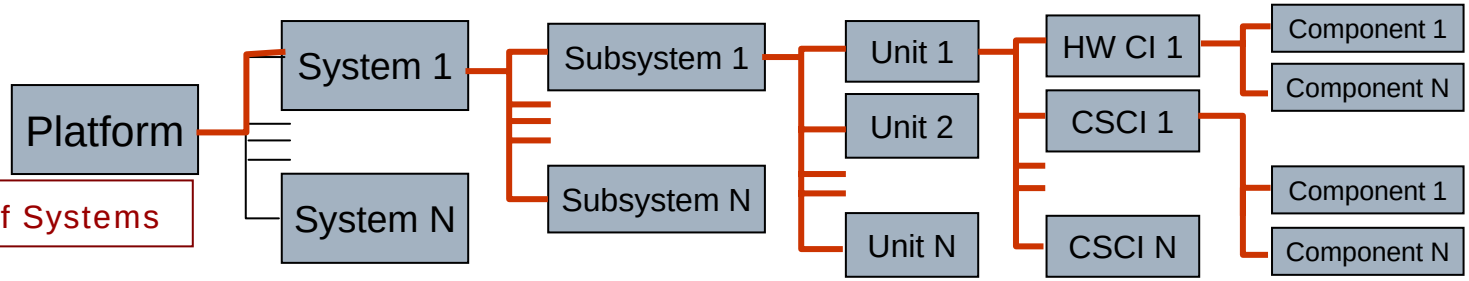
Test Management

- Test Manager & Test Director
- Customer Management for Field Testing

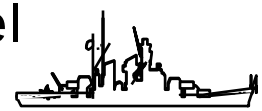
Plan Strategies for each Level of Testing

Integration Planning

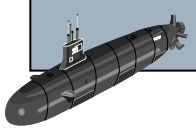
NCO => System of Systems



- The System Integration Planning Must Address All Levels of Test – Operational testing done at each level
  - Results in Multiple Test Plans
- Minimize risks of meeting Operational requirements



- **Integrating DT&E Events with early OT&E Events**
  - **DT&E is Laboratory level testing – little or no human environment**
  - **DT&E uses simulators for operating environment conditions**
  - **OT&E includes the human element in testing**
  - **OT&E has the real platforms and real operating environments**
  - **Early OT&E Alignment in DT&E environment can be done**
    - **Plan long duration operability demonstration tests with real system operators**
    - **Schedule regular test shifts for 3-6 months for real system operators**



Some Operational Realism Lessons Learned at ASSETT

- **Get testable operational requirements [e.g. use cases] defined early and agreed upon with the Customer**
- **Getting the users involved <u>early and often</u> results in you building what the operational users want, not what they asked for**
  - **Often when asked to clarify a requirements, the real need is uncovered…not the "design" they "required"**
  - **Results in fleet buy-in and more likely for operational acceptance**
- **The Navy ARCI project has CONOPS groups to address capabilities gaps currently not being supported now.**
  - **After group meets, then they meet with contractors**
  - **Initially a new capability could be requested and implemented without broad need. The group solves that.**
- **Often involving an operational crew in laboratory testing will identify design improvements and improve acceptance later**

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Summary & Conclusions

1. **Incorporating operational realism early will result in building something that be used and verified in DT&E and OT&E**

2. **A methodology exists and is being performed by contractors that addresses operational realism early in the design process**

3. **Conducting the operational modeling, designs, and technology trade-offs will result in requirements, strategies, and technology candidates for including in the TES, TDS, and ICD.**

Systems Engineering provides a structured approach to managing the technical solution over the full life cycle from concept to deployment to retirement…

…Test and Evaluation complements this approach with support for defining requirements and integration planning…and conducting many levels of integration tests with systems engineering support to achieve customer acceptance of a system…

Q&A

Abstract

Implementing a Methodology to Incorporate Operational Realism in CONOPS & Testing

Session: Test and Evaluation in Systems Engineering

Operational realism, a key piece of an Operational View in a System Architecture, is today being implemented as part of a Double Helix Methodology. The methodology, developed, tested, and validated by the DARPA Army Command Post of the Future is being used by ASSETT for a future Navy Combat System of the Future. The methodology incorporates iterations of CONOPS and Technology trade-offs using Subject Matter Experts (SME), web exercises, interviews, team experiments, and display simulations in developing and testing evolving conceptual system designs prior to a system acquisition. This presentation will identify how ASSETT Inc. has successfully implemented this approach within its system engineering process and how it will eventually lead to better acquisition development and test strategies.

The Double Helix Methodology and the CONOPS/Technology Trade-offs: In the 2008 NDIA DTE Committee Study Task Report, one of the key findings/recommendation was "to include operational realism in early phases of acquisition of a new system during generation of the CONOPS, ICD, TDS, and TES". Our Mission Driven Design process uses the Double Helix Methodology, beginning with a conceptual CONOPS and an eye for the future. New automated capabilities are envisioned based on a decision centered design approach to defining tasks, their sequence, and any associated time constraints. The CONOPS is synchronized iteratively with the technology team to address the CONOPS expectations for the future technologies & promising capabilities. From mission phases in operational scenarios, many different uses cases can be defined to test this new operational realism in DT&E and OT&E.

Outputs of the Approach Feed System Capabilities and Strategy Documents: The new capabilities, technologies, and mission driven conceptual designs will derive requirements to be captured in the acquisition development and testing documentation. This presentation will provide an insight into the methodology, the Decision Centered Design process that drives the operational and system architecture views, how the decisions are used in defining the tasks and events in each evolving CONOPS/Technical iteration, and how the Testing & Simulations of the HSI displays using operational personnel will focus the designs for a system to be acquired.

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Author Biography – Mr. Lyders is currently a Systems Engineering Manager and Lead Systems Engineer/Test Director for multiple projects at ASSETT, Inc. He has over 39 years of both systems engineering & project management experience in both federal software and commercial Information Technology (IT) development projects. He has significant complex system test and integration expertise, dockside, and at-sea testing experience developed through his federal work with multiple Sonar, Combat Control, and Submarine Combat Systems and multiple SBIR projects for the Navy. He was a Test Team Lead on large commercial projects for both domestic/international companies.