Systems Engineering Analysis
Littoral Undersea Warfare in 2025

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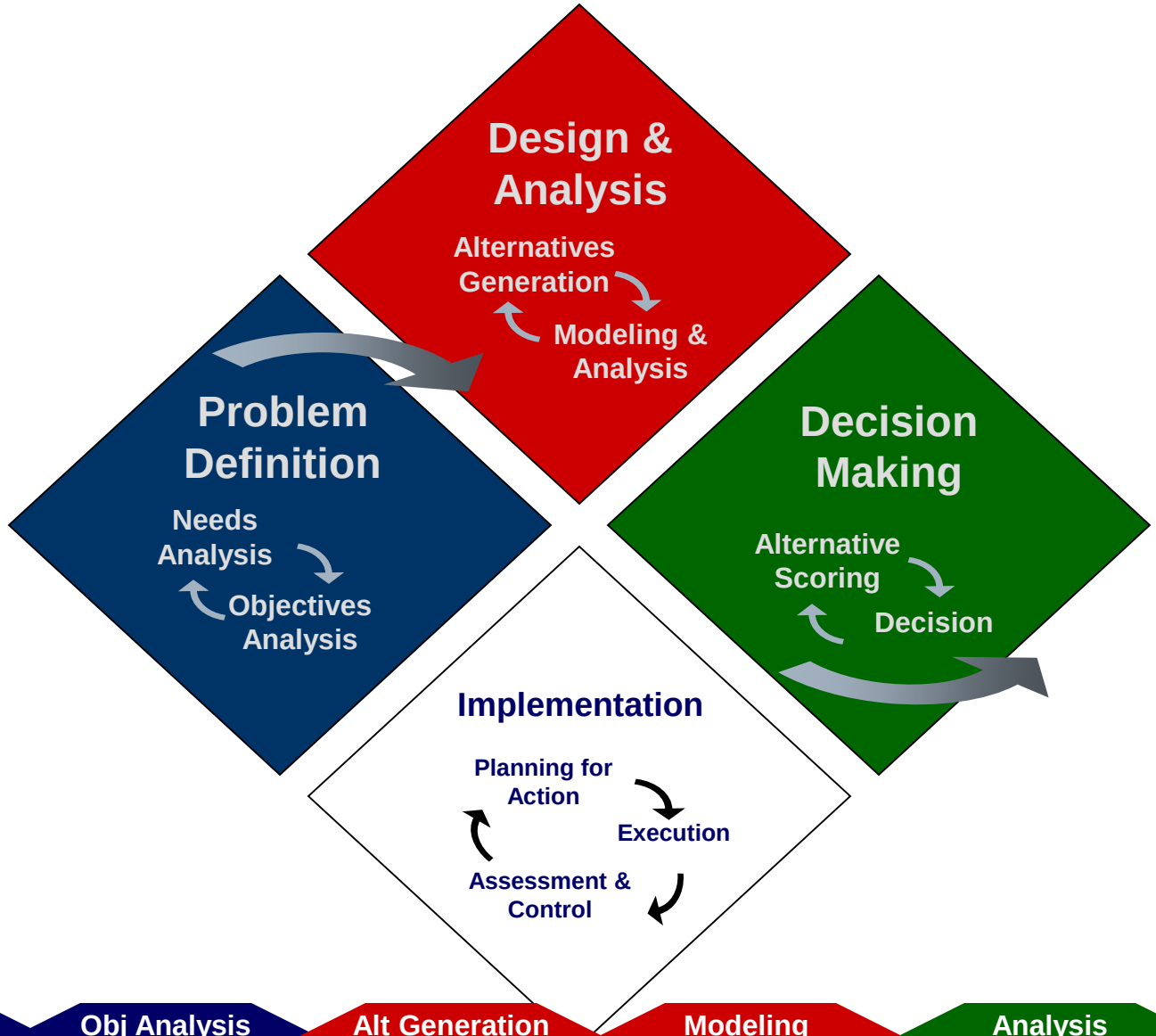
Systems Engineering Design Process



SEA-8 Problem Statement

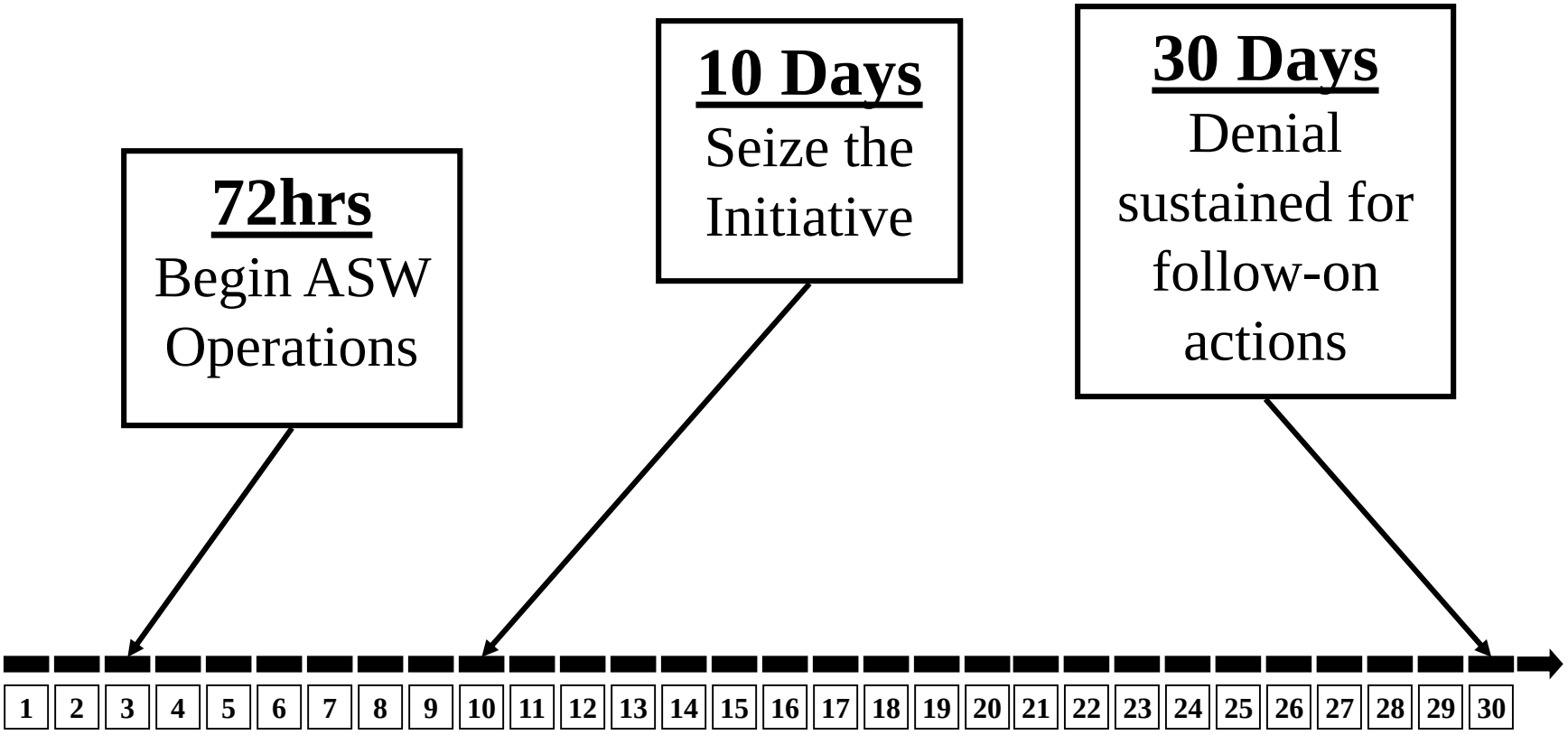
- **SEA-8**

  .. design a system that denies enemy undersea forces (submarine and UUV) effective employment against friendly forces within the littorals during the 2025 timeframe.

Problem Definition Phase

- Needs Analysis
  - Primitive Need
  - Stakeholder Acknowledgements
  - System Decomposition
  - Input-Output Modeling
  - Functional Analysis
  - Requirements Generation
  - Effective Need

ASW Timeline 3/10/30

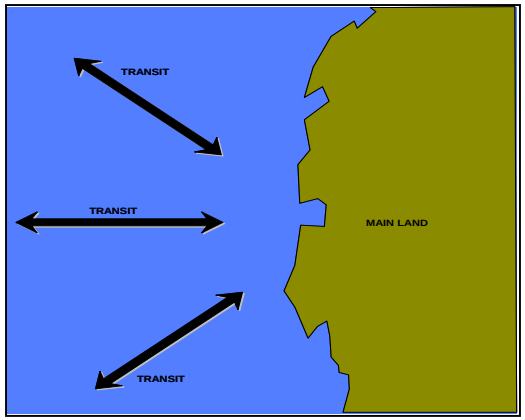


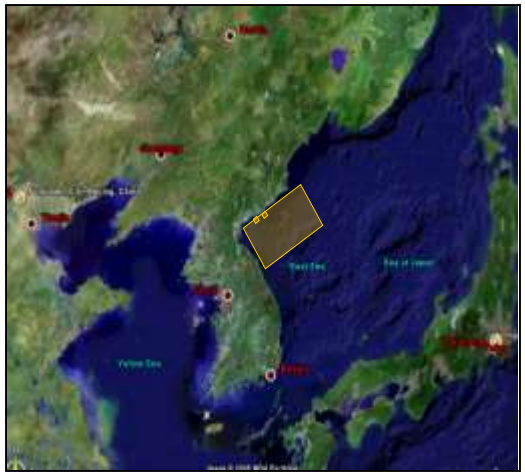
Objectives Analysis Phase

- Objectives Analysis
  - Functional Objectives
  - Measures of Effectiveness
  - Measures of Performance
  - Performance Goals

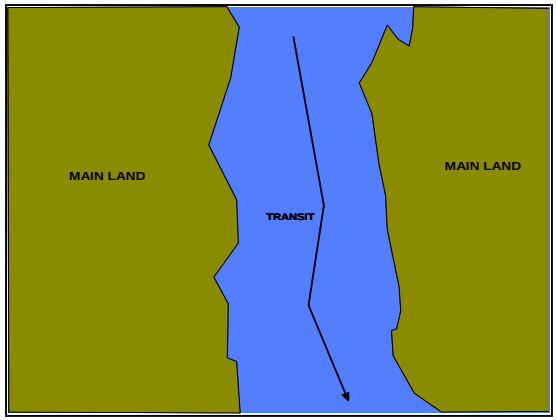
Scenario Building

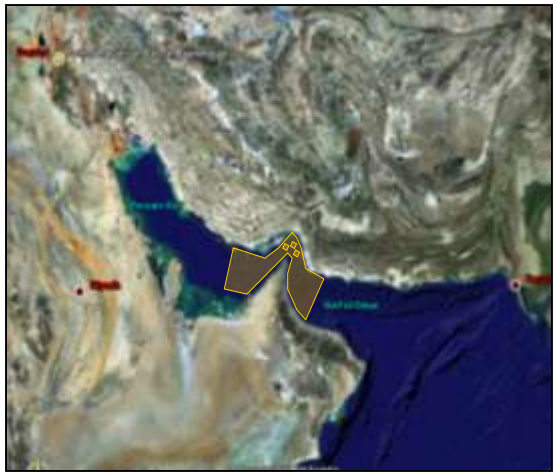
Coastal



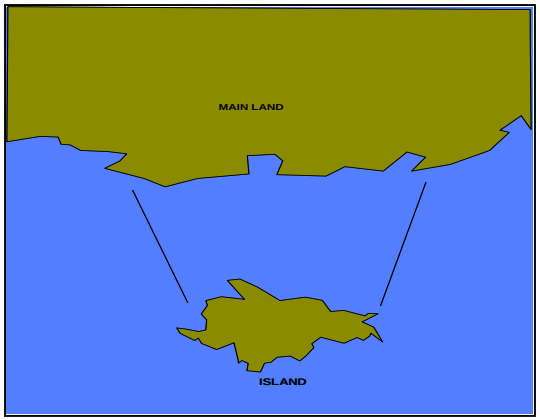


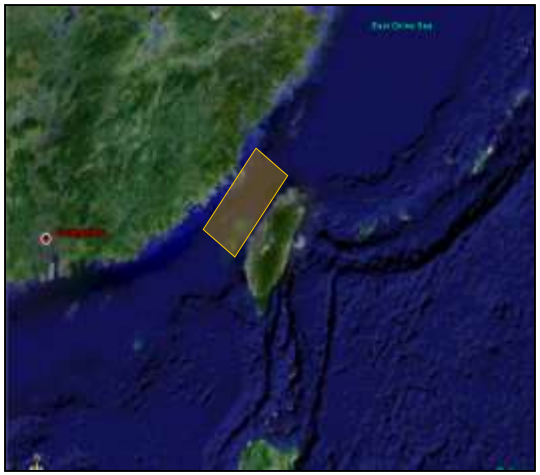
Choke Point Passage





Defense of Island Nation



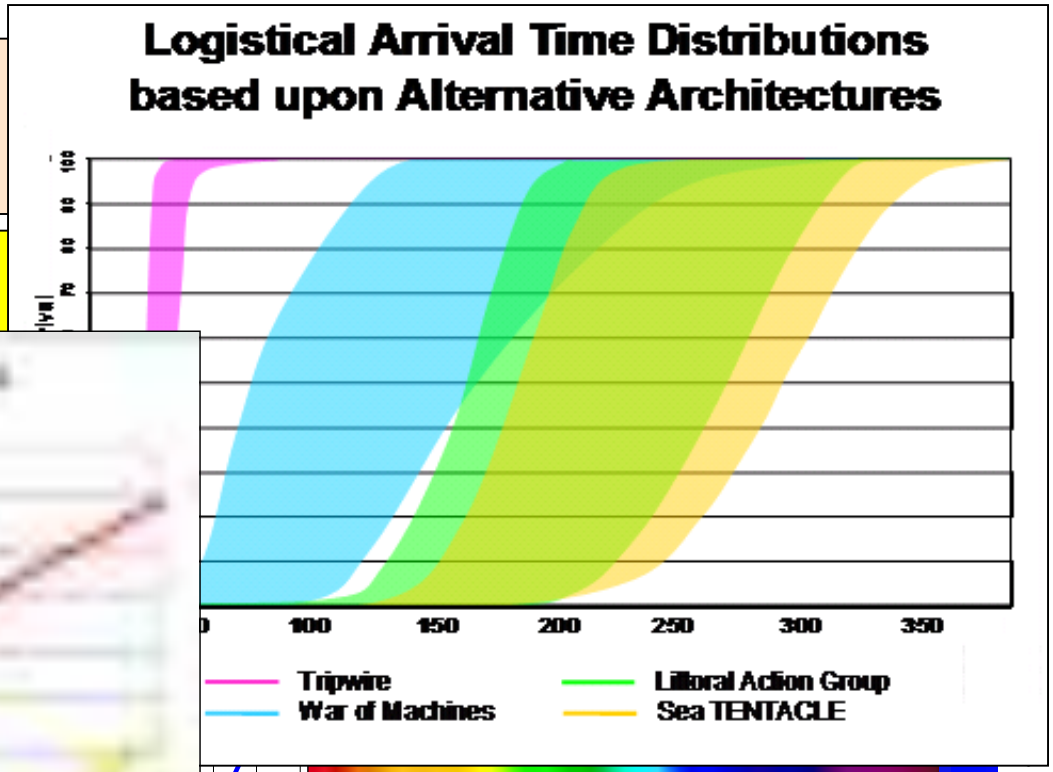


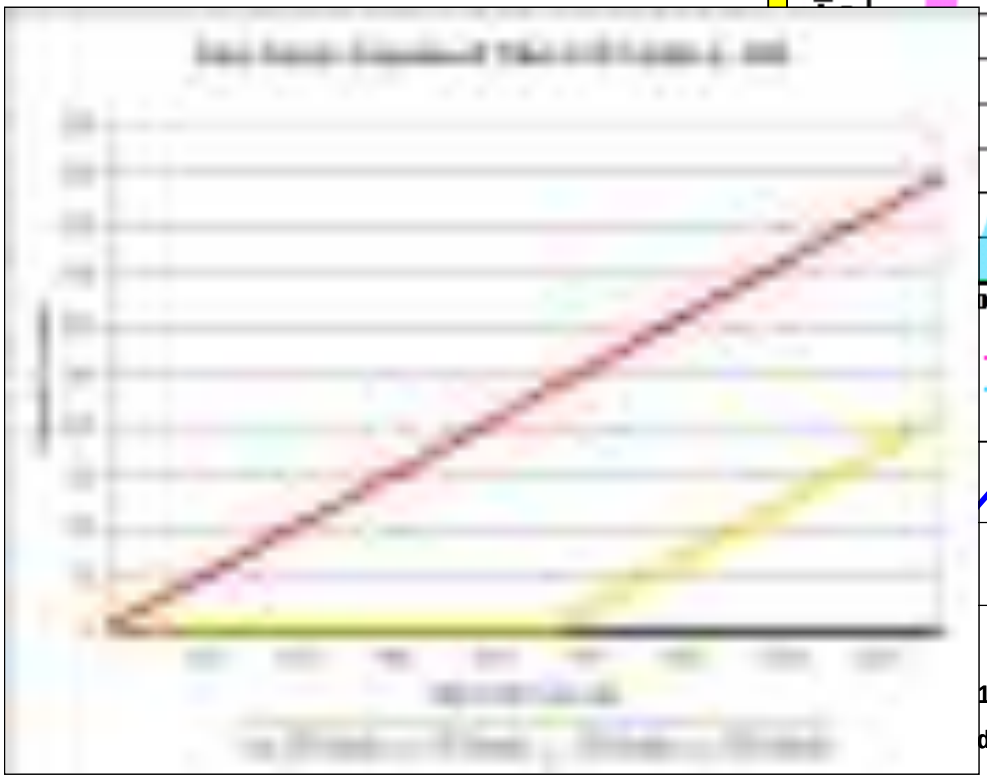
SEA-8 Defined Alternatives

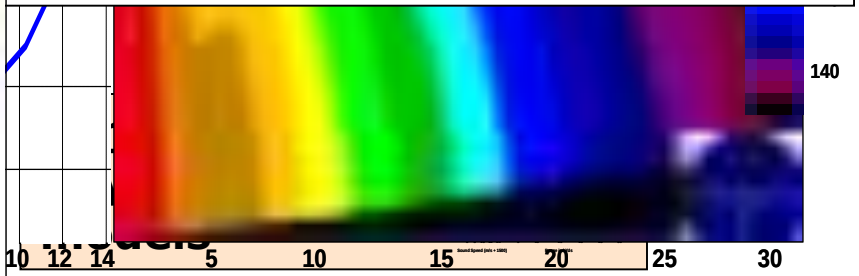
- **Littoral Action Group (LAG)**
  - DD(X), LCS, SSN, MH-60
- **Total Ship Systems Engineering (TSSE) – Sea TENTACLE**
  - Host ship, UUV, USV, UAV, Stationary Bottom Sensors
- **Tripwire**
  - UUV, Rapidly Deployable Stationary Bottom Sensors
- **War of Machines**
  - UUV, Recharging Stations
- **Floating Sensors**

High-level Model Development

Reliability
discrete event simulation models







ASW Results, Insights and Recommendations

NO PERFECT SYSTEM

- Scenario variables were the key factors
- Each alternative studied had weaknesses
- Differences between alternatives were significant
- “Best” solution might be a tailored mix

ASW Results, Insights and Recommendations

REACTION TIME

- Enemy submarines are vulnerable in restricted waterways
- Enemy timelines are unpredictable
- Quick reaction systems hedge uncertainty
- Strategic air least sensitive to enemy initiative

ASW Results, Insights and Recommendations

PRESENCE

- Pervasive persistence is the goal
- Traditional methods
- Non-traditional methods

ASW Results, Insights and Recommendations

KILL-CHAIN TIMELINE (KCT) TRADEOFFS

- Traditional methods require short KCTs
- Non-traditional methods afford longer KCTs
- Standoff weapons systems more easily used if longer KCT are allowed

ASW Results, Insights and Recommendations

UNDERSEA JOINT ENGAGEMENT ZONE (UJEZ)

- Cooperative mix of assets unlocks future ASW force capabilities
- Future ASW forces may require the establishment of the UJEZ
- Low false positive and low fratricide rates are required

ASW Results, Insights and Recommendations

RECOMMENDATIONS

- Research
  - Follow on study
- Development
  - UUVs
  - Rapidly deployable sensing grids
  - Common undersea picture
  - Autonomous recharge/replenishment systems

ASW Results, Insights and Recommendations

RECOMMENDATIONS

- Tactics
  - Strategic air
  - JSOW like systems to deliver ASW assets
- Doctrine
  - Evolution from waterspace management and PMI to UJEZ

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