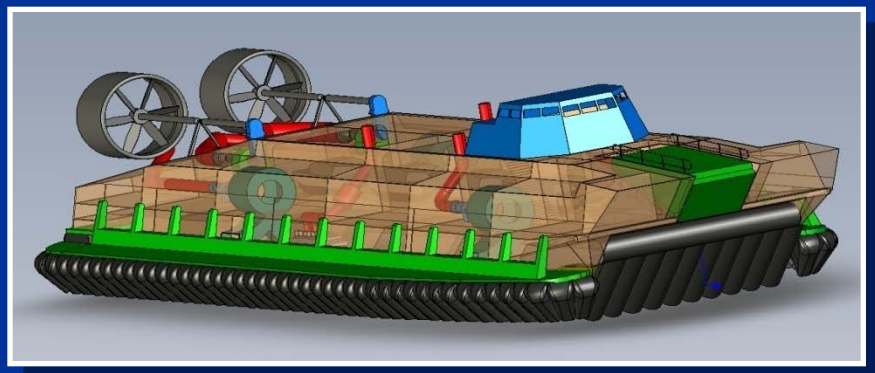
Naval Postgraduate School
Advanced Seabase Enabler Project:
A Systems Engineering Case Study



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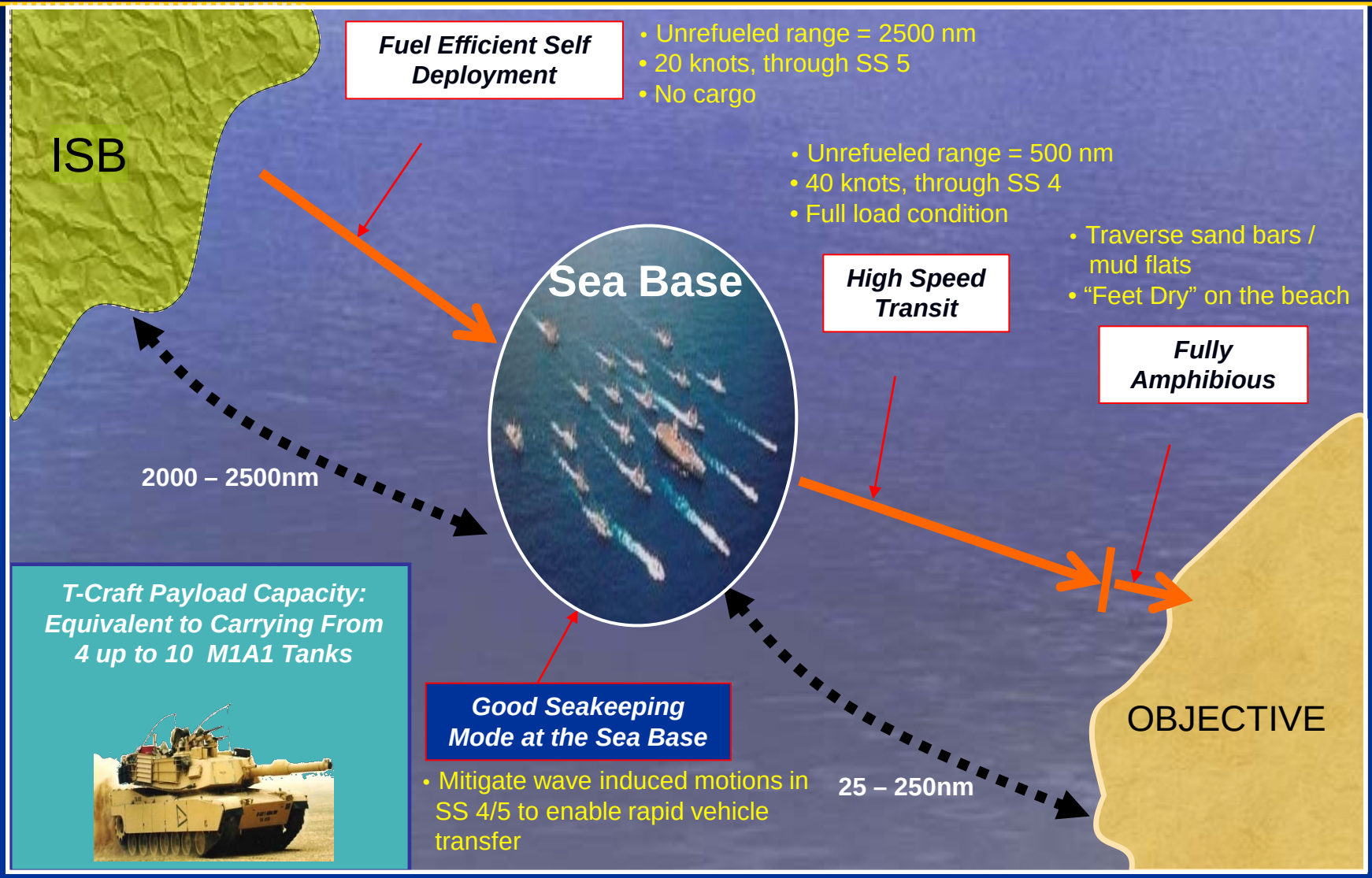
Project Overview

- This project describes a NPS capstone project as part of obtaining an MS in Systems Engineering.
- The project examined transporting cargo from a sea base to the desired destination and make recommendations regarding the best approaches for meeting those objectives. Key research goals were:
  - Determine required capabilities and functions for an ASE
  - Develop appropriate operational concept (OPCON)
  - Examine various ASE concepts, to include the Transformable Craft (T-Craft)
    - ✓ Conceptual platform under the design of the Office of Naval Research (ONR)
    - ✓ ONR sponsoring multi-year effort through NPS to assist in T-Craft system design and architecturing.

T-Craft Concept



ASE Project Stakeholders

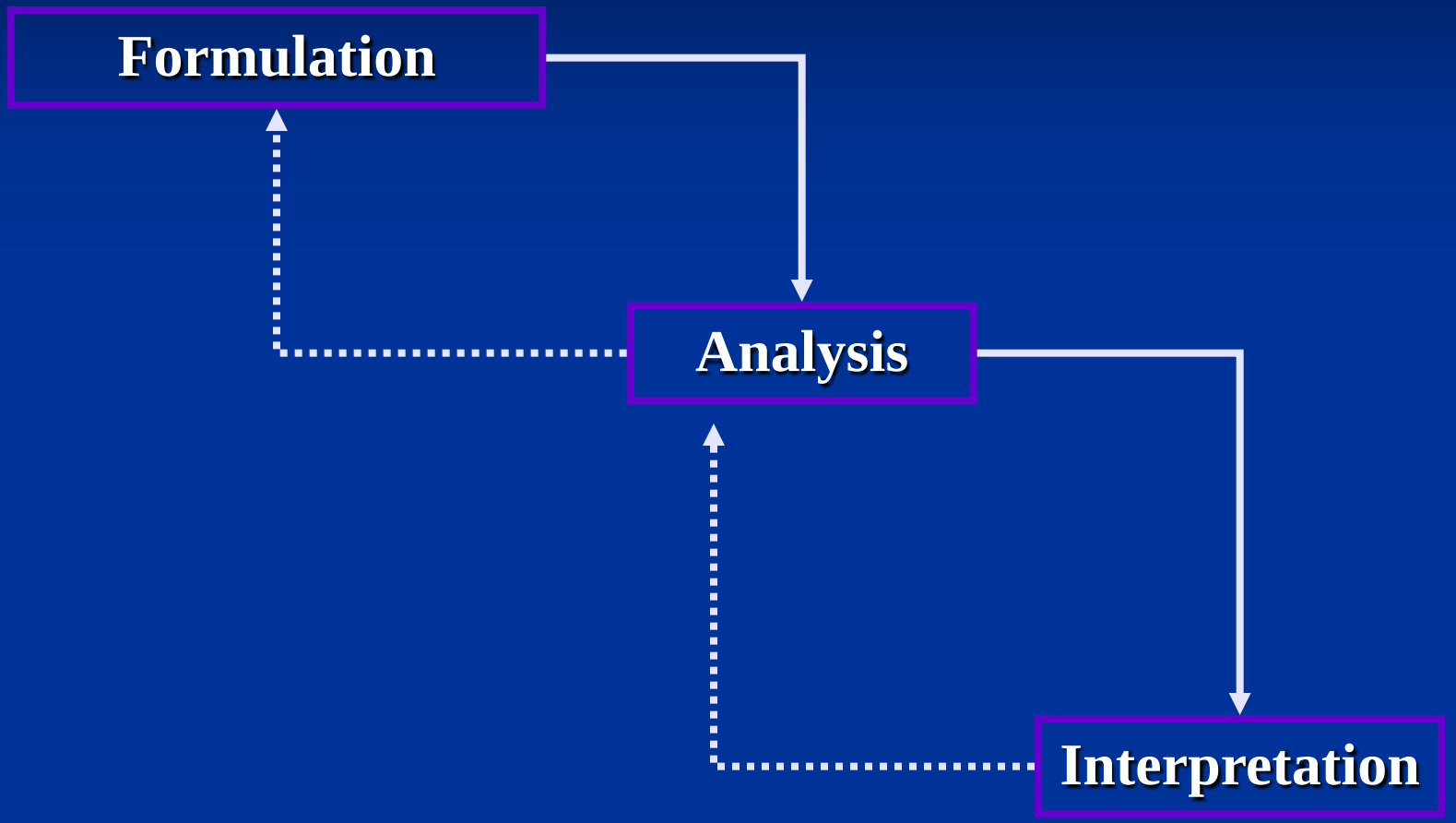
Major Stakeholders:

- Operational Commands
  - Navy
  - USMC
  - Army
  - SOCOM
  - JFCOM
  - TRANSCOM

Secondary Stakeholders:

- **NAVSEA**
- **Marine Corps Combat Development Command (MCCDC)**
- NAVSUP
- Marine Corps Logistics Command
- ONR
- TACOM
- Combined Arms Support Command (CASCOM)
- Military Sea Lift Command
- PDM Army Watercraft Systems (AWS)
- NATO
- Coast Guard

Systems Engineering Development Process



Final Problem Statement

"A capability is needed to fully enable the potential of the sea base. For a sea base to be truly beneficial a capability must exist that supports efficiently transporting needed materiel from the sea base to the desired debarkation point. The capability must support peace-time, non-combat operations' and war-time, combat operations' logistics and support needs. The solution must be cost effective and capable of operating under all environmental conditions, including sea states, under which necessary military operations are expected to take place and must support a transport rate sufficient to ensure materiel is delivered within operational time requirements."

Seabasing

Analysis of the Full Range of Military Requirements

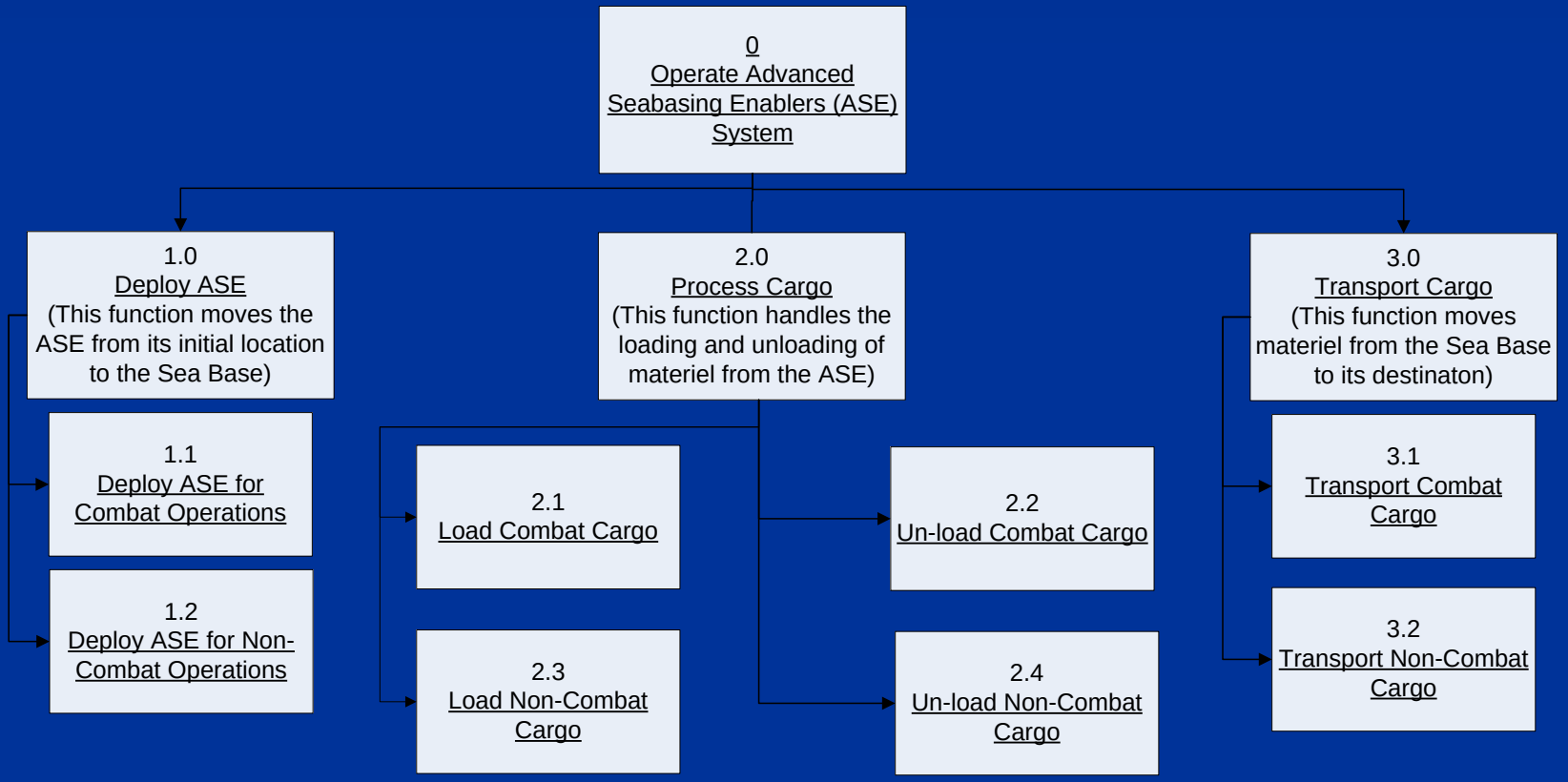
Missions

	High Threat Environment	Low Threat Environment
No Infrastructure	**Major Combat Operation** ■ Heavy Equipment ■ Time is essential ■ Forcible Entry Possible	**Natural Disaster Relief** ■ Cargo: food, medicine, personnel
Infrastructure Assumed	**Police Enforcement Operation** ■ Light Combat Equipment ■ May be time sensitive ■ AT/FP type threat, not major combat	**Humanitarian Aid** ■ Cargo: food, medicine, personnel

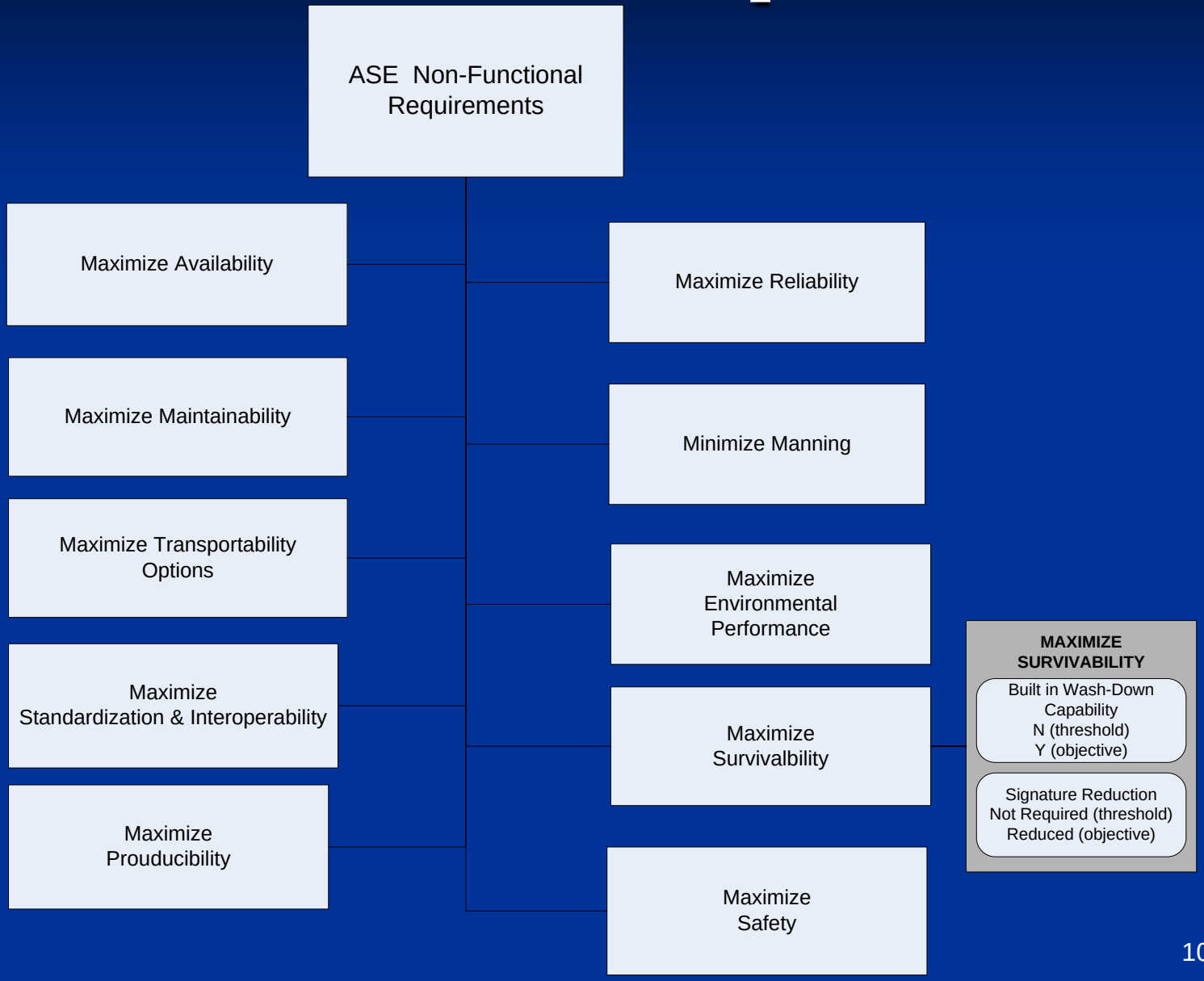
ASE Functional Decomposition

REVISED PROBLEM STATEMENT

For a sea base to be truly beneficial a capability must exist that supports efficiently transporting needed materiel from the sea base to the desired debarkation point. The capability must support peace-time, non-combat operations' and war-time, combat operations' logistics and support needs. The solution must be cost effective and capable of operating under all environmental conditions, including sea states, under which necessary military operations are expected to take place and must support a transport rate sufficient to ensure materiel is delivered within operational time requirements.



ASE Objectives Hierarchy
Non-Functional Requirements



Alternatives

- Researched several possible alternative solutions
  - LCAC (Landing Craft Air Cushion)
  - SSC (Ship to Shore Connector)
  - LSV (Logistics Support Vessel)
  - LCU (Landing Craft, Utility)
  - T-Craft (Transformable Craft)
  - JHSV (Joint High Speed Vessel)
  - Heavy Airlift
- All options already conceived. Information gathered from existing projects / programs.

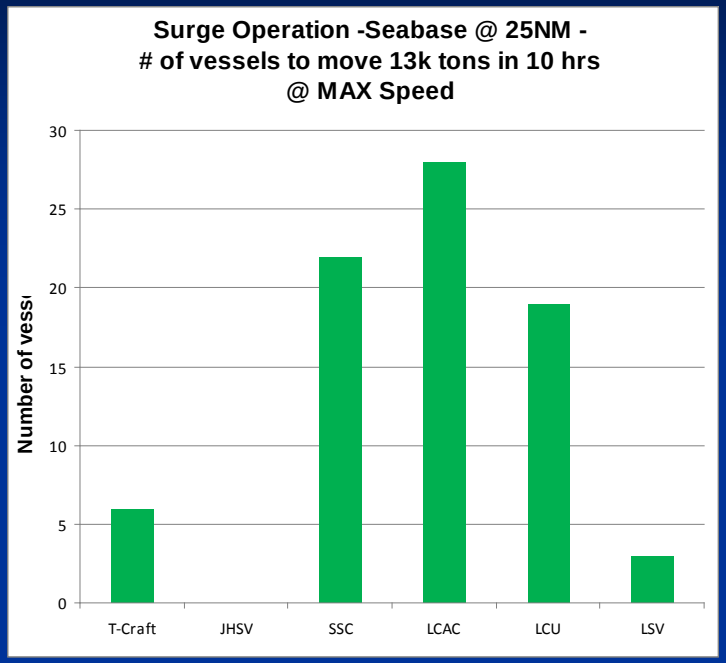
Systems Analysis

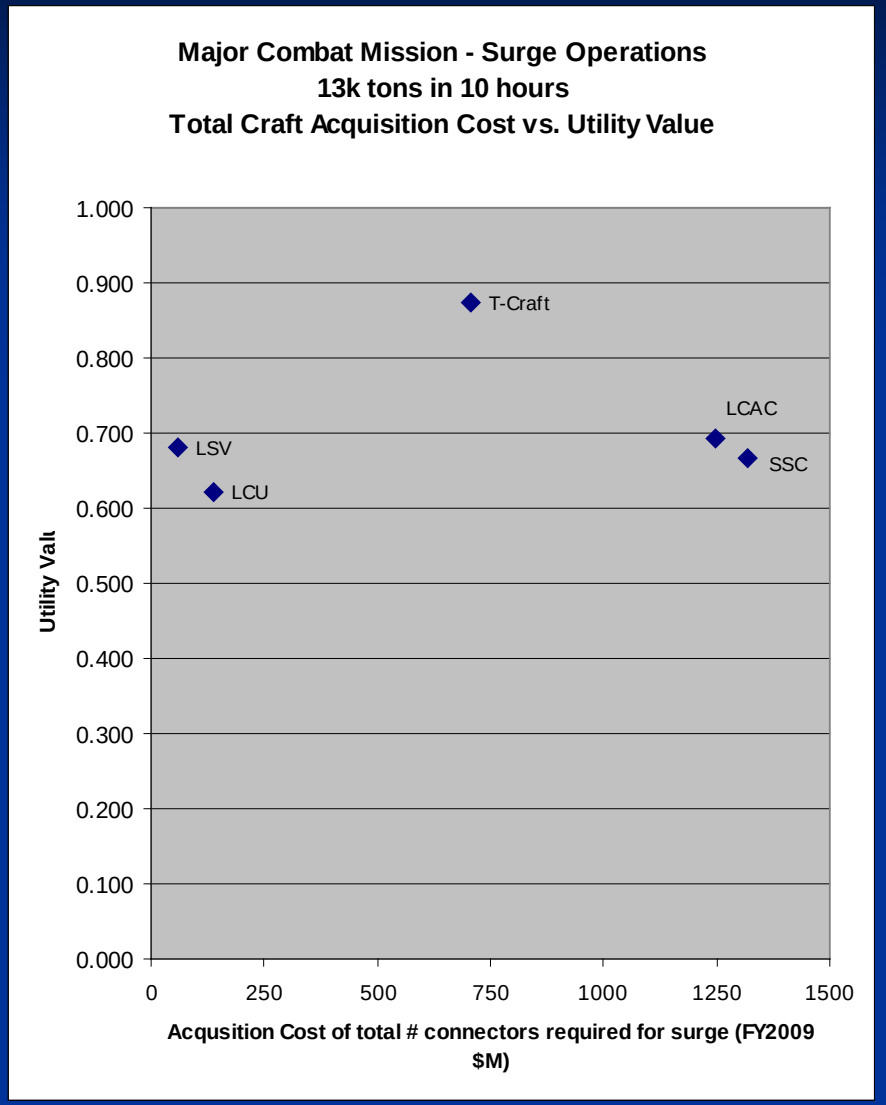
- Both static and dynamic systems analysis:
  - Using cargo capacity, speed, range of various alternatives, team members conducted comparison for both MCO and Humanitarian
  - Simulation analysis examined:
    - ✓ Extent of capability to complete the Load Cargo function, using Mean time required to assemble cargo/forces and load assembled cargo/forces.
    - ✓ Extent of capability to complete the Transport Cargo function, using mean time required to transport cargo/forces ashore.

Overall Results

- T-Craft has highest overall performance score by a large margin for combat mission
- JHSV has highest score for humanitarian mission followed by LSV and T-Craft

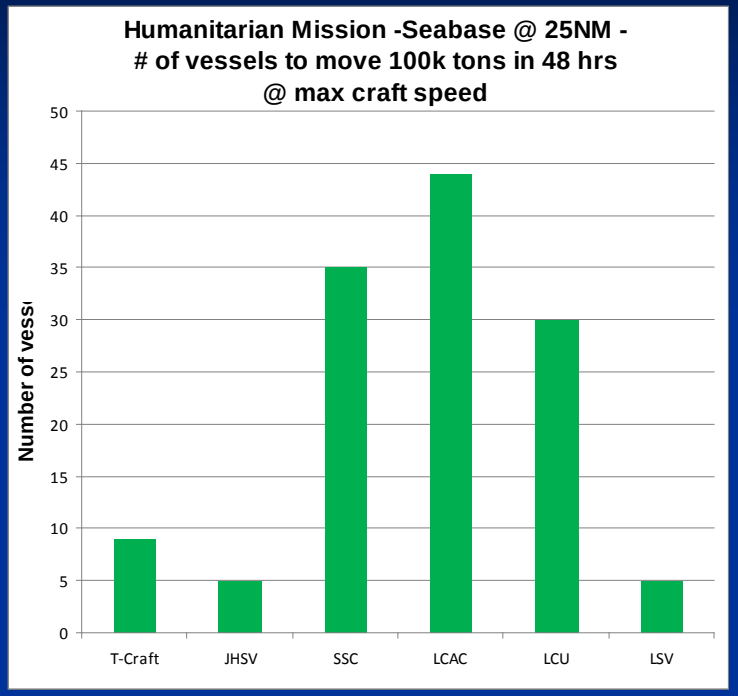
Cost vs Performance – Major Combat Operations

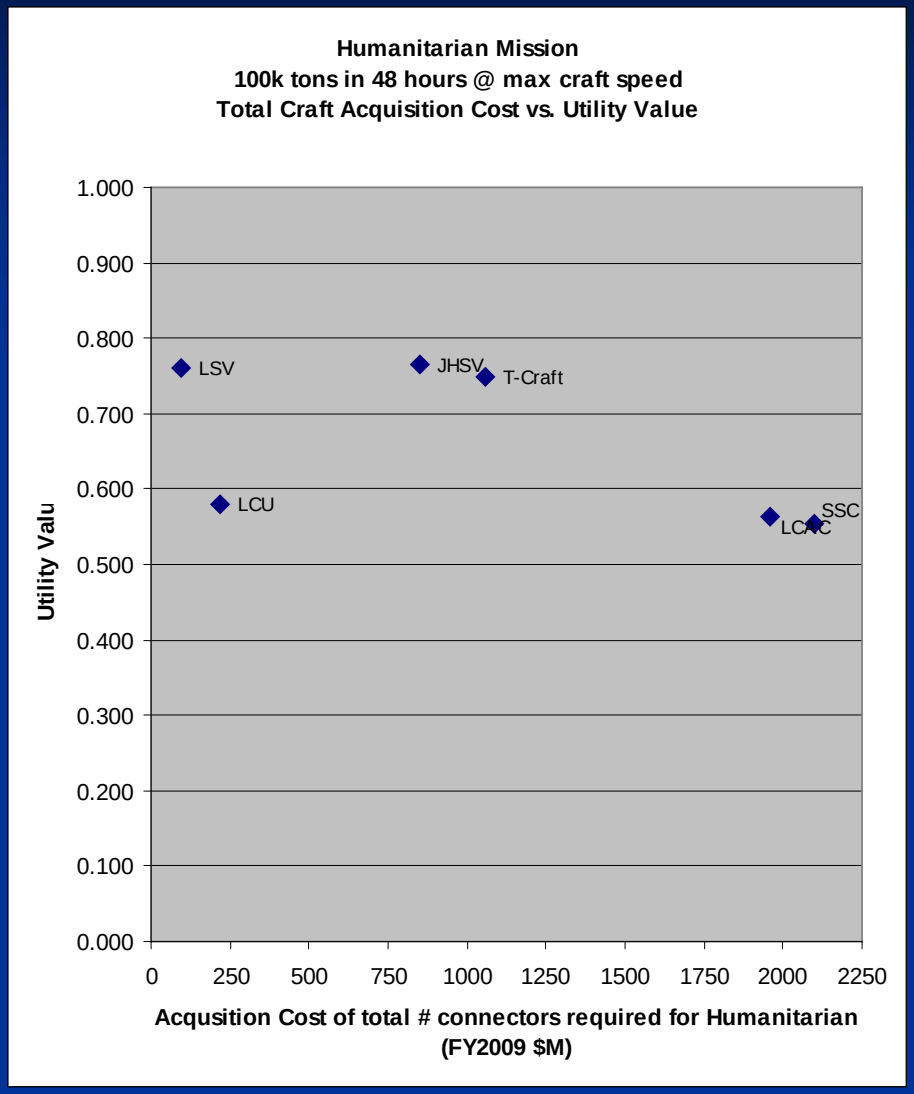




- T-Craft offers the highest utility with a moderate cost
- LSV and LCU provide moderate utility at comparatively low cost
- SSC and LCAC costs are the highest with the lower utility value due to their relatively small cargo capacity

Cost vs Performance – Humanitarian Mission





- JHSV offers the highest utility with a moderate comparative cost
- LCU and LSV again have the lowest cost with LSV having the lowest overall cost with a fairly high utility
- SSC and LCACs are obviously poor choices with high cost and low utility

FY 2010 (and Beyond) Proposed Research

- Conduct thorough systems analysis of T-Craft and Sea Base Enablers
- Examine more specific proposed T-Craft capabilities and their operational impact
- Examine other operational concepts and scenarios appropriate for T-Craft system.
- Develop a virtual representation of T-Craft for use in analysis and possibly training

Focus for FY 2010

In depth, formal evaluation of T-Craft performance, based on the systems engineering framework and operational concept developed as part of FY09 effort.

- This includes the evaluation of alternatives and decision analysis using simulation and experimental design.
- Researchers from Simulation and Efficient Experimental Design (SEED) Center at NPS support this effort
- Actively recruiting an NPS Operations Research student to address this topic for their thesis.

Focus for FY 2010

- Examine and determine the requirements for the broad simulation analysis efforts addressing T-Craft performance in a variety of operational concepts.
- Examine and determine the appropriateness of several simulation tools to meet these requirements regarding the evaluation of T-Craft performance in a variety of operational concepts.

Focus for FY 2010 (and beyond)

Create a prototypical virtual environment (VE) that can be used by designers of the T-CRAFT to inspect prospective designs.

- For example, inside the virtual environment, the designers will be able to simulate various operations in the craft to ensure that the design can support these operations.
- Additionally, the VE will be integrated into a Java-based discrete-event simulation package known as SimKit. This integration will provide a means to conduct very powerful simulation analysis in a virtual environment. At least one thorough test case of this integrated simulation will be developed and demonstrated.

Focus for FY 2010 (and beyond)

- Conduct a thorough life cycle cost analysis of the T-Craft. I have an OR student who is very interested in this as his thesis topic.
- Propose and develop a “fleet” architecture, examining different combinations of cargo platforms, to include T-Craft, that can best address transportation gaps identified by Army and USMC in specific detailed scenarios. This effort will build on our previous systems architectural development, which considered individual cargo platforms in competition with each other (LCAC, JHSV, T-Craft, etc). This portion of the project is being conducted as a graduate thesis by an NPS student in the Master of Science in Systems Engineering curriculum.

Contact Information

Questions?

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