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Systems and Cost Effectiveness Modeling of Unmanned Systems Product Lines for Acquisition

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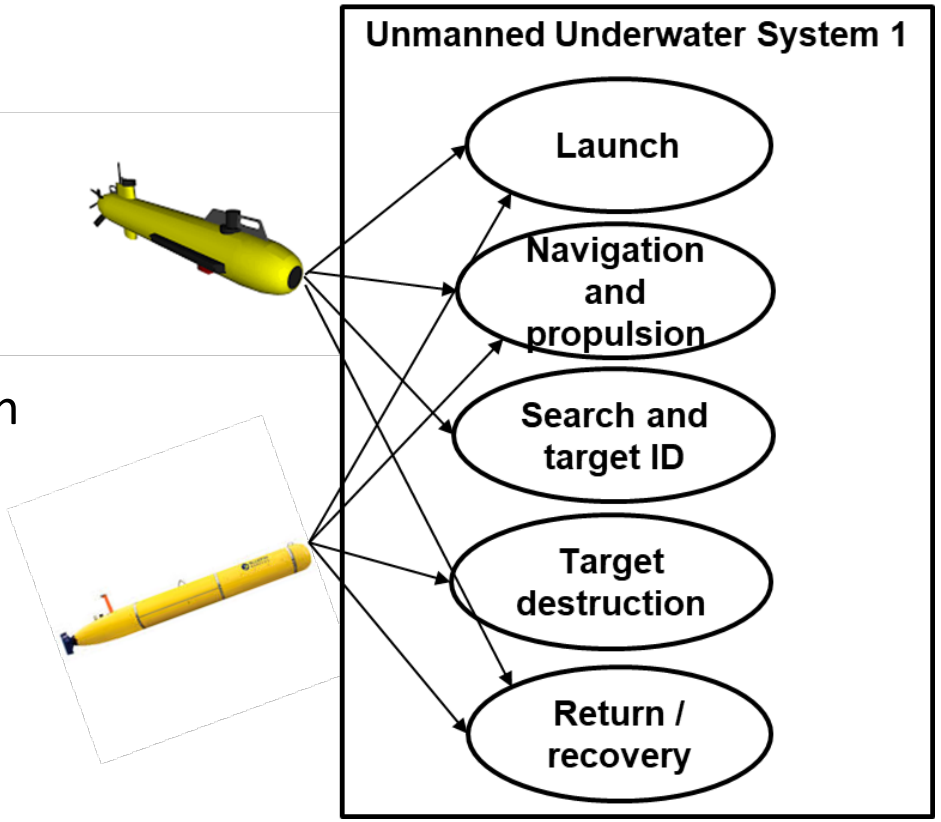
Overview

- This research has been investigating the systems and cost-effectiveness of unmanned system product lines with Model-Based Systems Engineering (MBSE) methods and parametric cost modeling.
- The modeling framework includes the Constructive Product Line Investment Model (COPLIMO) framework for product line cost estimation and investment analysis.
- A recent case study investigated the economics of a product line approach to UUVs for strategic missions demonstrating ROI of nearly 500% across the defined DoD missions.

UUV Mission Needs

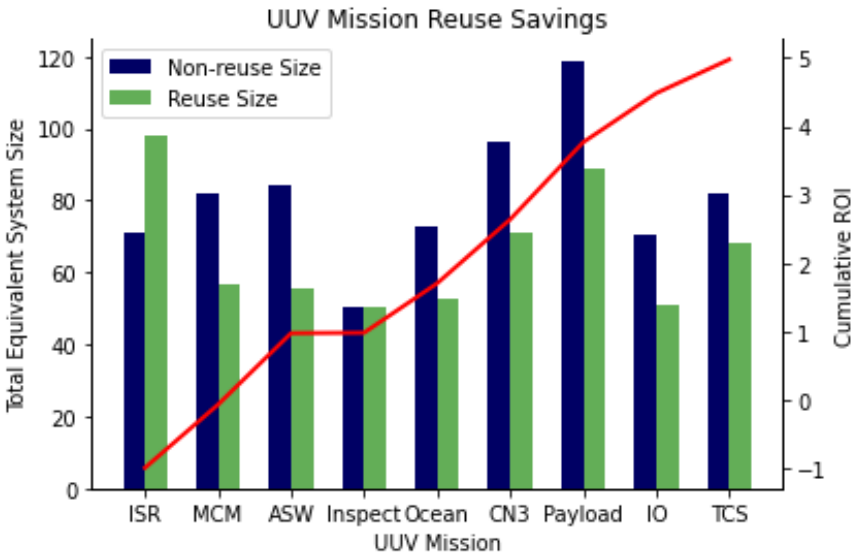
- The DON requires nine primary missions:
  - Intelligence, Surveillance, and Reconnaissance (ISR)
  - Mine Countermeasures (MCM)
  - Anti-Submarine Warfare (ASW)
  - Inspection and Identification (INID)
  - Oceanography (OO)
  - Communication or Navigation Network Node (CN3)
  - Payload Delivery (PD)
  - Information Operations (IO)
  - Time Critical Strike (TCS).



Research Questions

- What is the ROI of a product line approach for UUV systems?
- What is the reuse savings for individual UUV systems?
- What is the size and scope for the resultant systems being developed?
- How much work must be done over time?
- How should the system(s) be architected to best employ reuse?

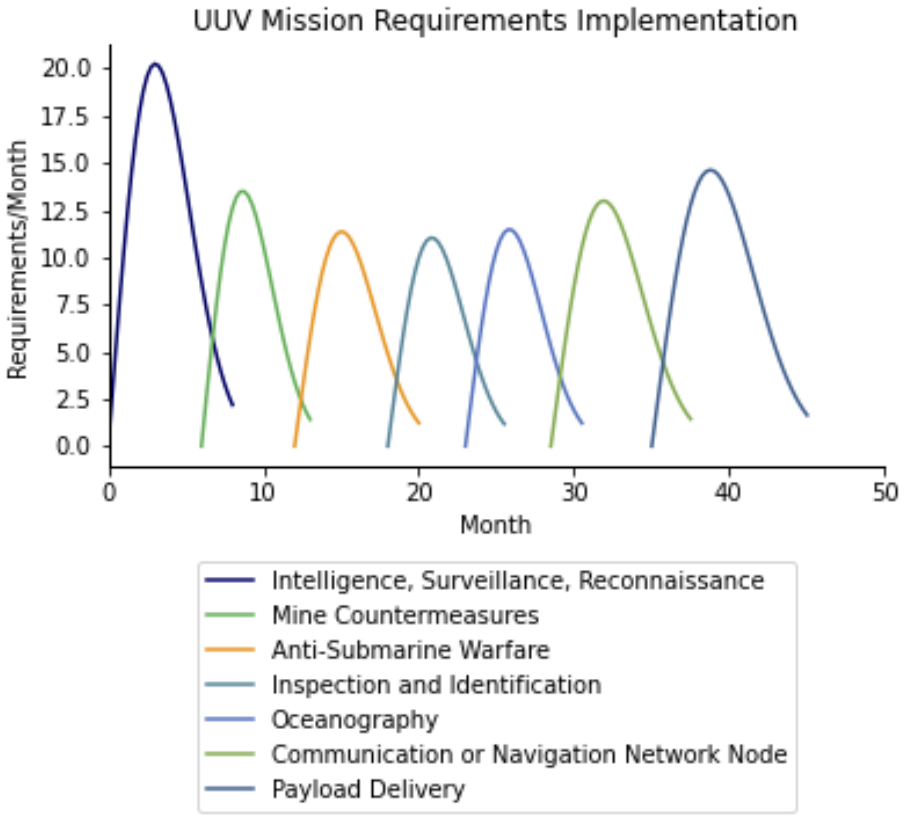
Reuse Savings and ROI



ISR: Intelligence, Surveillance, Reconnaissance
MCM: Mine Countermeasures
ASW: Anti-Submarine Warfare
Inspect: Inspection and Identification
Ocean: Oceanography
CN3: Communication or Navigation Network Node
Payload: Payload Delivery
IO: Information Operations
TCS: Time Critical Strike

- Requirements and interfaces from UUV MBSE models were enumerated and input into the COSYSMO cost model.
- This indicator displays the total equivalent system sizes and resultant ROI of a product line approach for UUV systems with overlapping mission capabilities
- The savings for subsequent missions are the differences between a traditional non-reuse approach and the product line reuse approach
- The cumulative ROI is the net savings over time divided by the investment cost based on the relative sizes
- The size is used as input to systems engineering cost models to quantify estimated costs
- The equivalent size difference represents a work savings, and added equivalent size represents the additional work investment to make the UUV baseline reusable

Planned Requirements Implementation



- Based on the high ROI, it is decided to implement the product line.
- This indicator displays the planned systems engineering requirements implementation over time for selected UUV mission systems.
- The phased implementation over time is derived from the COSYSMO effort and schedule model using requirements and other size elements directly measured in the model set as size inputs.

Conclusions

- System architectures for unmanned systems should focus on the product line, instead of mission specific systems. Plan for the reuse of system components over time.
- COPLIMO provides a trade space for determining initial investment and future return on investment (ROI) with respect to product line systems versus non-product line systems.
- Case study results indicate a strong ROI when using a product line approach for UUV systems.
- Applying the engineering product line methodology to system architecture design and development needs to happen at the earliest stage of design.

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Backup

System Product Line Investment Model