Systems Engineering Analysis of Unmanned Maritime Vehicles for USCG Mission Threads

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CRUSER Group
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Bottom-Line Upfront

• USCG is a unique stakeholder in the maritime domain (military, law enforcement, first responder, and regulator) and needs to strategically plan for new technologies, such as UMVs, to flexibly meet national needs.

• Benefits of USCG UMV
  – Augment current legacy fleet, combating obsolescence
  – Significant increase in CG MDA and persistence
    • ISR and CG mission specific capabilities
  – Potential human risk reduction and program cost savings

• Challenges
  – COLREGS implications (Coastal USV)
  – Technology and Integration immaturity
  – Organization resistance
  – Fiscally constrained (most likely implementation would augment existing cutters)

Preliminary Goal
Present and justify near-term (5-10 year) USCG UMV Roadmap
Research Questions

• How can the USCG utilize unmanned systems to enhance capabilities across multiple missions?

• *What USCG missions are best suited for unmanned technologies/platforms?*

• How does unmanned systems architecture correlate to existing asset system architectures in reference to suitability?

• Which system architectures (CONOPS) will best correlate to proposed unmanned systems?

• *What is the meaningful time line for USCG UMV system implementation?*
Unmanned Maritime Vehicles (UMV)
Phase: Conceptual Design

Mission X: Needs analysis

Problem/Need Definition

Capabilities Analysis

High Level Alternative analysis

Mission/Asset specific Vignette

Design Architectures

Implementation Timeline

Background Review

Capability Taxonomy

Design Reference Scenarios

Trade Spaces

Coverage of Assumptions

Mission X: Needs analysis
Maritime Threats and Vulnerabilities

DHS Missions
CG HS Missions
Illegal Drug Interdiction
Undocumented Migrant Interdiction
Other Law Enforcement
Ports, Waterways, and Coastal Security
Defense Readiness
U.S. Coast Guard Missions Overview

**DHS Missions**

**CG HS Missions**
- Illegal Drug Interdiction
- Undocumented Migrant Interdiction
- Other Law Enforcement
- Ports, Waterways, and Coastal Security
- Defense Readiness

**CG Non-HS Missions**
- Search and Rescue
- Marine Safety
- Ice Operations
- Marine Environmental Protection
- Living Marine Resources
### USCG UMV Mission Capability Analysis

<table>
<thead>
<tr>
<th>Relative Importance</th>
<th>Capability</th>
<th>Environmental Sampling</th>
<th>Marine Safety</th>
<th>SAR</th>
<th>Aids to Navigation</th>
<th>Maritime Security &amp; PWCS</th>
<th>USCG 25ft Defender Class Boat (Baseline)</th>
<th>Defender Specs</th>
<th>Notes/Comments</th>
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<tbody>
<tr>
<td>1</td>
<td>Persistance</td>
<td>4 N/A</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3150-175</td>
<td></td>
<td>Endurance, Durability, Survivability</td>
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<tr>
<td>2</td>
<td>Response Time</td>
<td>2 N/A</td>
<td>5</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>45kt</td>
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<td>Speed and Range, Launch and Recovery</td>
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<tr>
<td>3</td>
<td>Payload (Sensor)</td>
<td>3 N/A</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>2</td>
<td></td>
<td>Range, Fidelity, accuracy, size</td>
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<tr>
<td>4</td>
<td>Command and Control</td>
<td>2 N/A</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>2 (2 Crew)</td>
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<td>Autonomy, Useability</td>
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<tr>
<td>5</td>
<td>Seakeeping</td>
<td>2 N/A</td>
<td>4</td>
<td>3</td>
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<td>3</td>
<td></td>
<td>Fuel utilization, Classic seakeeping</td>
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<tr>
<td>6</td>
<td>Logistics/Suitability</td>
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<td>Transportability, RMA, HIS</td>
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<td></td>
<td>Commonality (Modularity)</td>
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<td>2</td>
<td>4</td>
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<td>Modularity, Interfaces, flexibility</td>
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<tr>
<td></td>
<td>Feasibility of Application</td>
<td>4 N/A</td>
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<td>3</td>
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<td>5</td>
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<td>TRL, Producability, Integration</td>
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<td></td>
<td>Affordability</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>180K Lower cost is positive</td>
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</tbody>
</table>

#### Relative Scale

- **1:** Less
- **3:** More
- **5:** More

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**WWW.NPS.EDU**
USCG Mission Thread Capability Analysis for Offshore Applications

- Logistics/Suitability
- Seakeeping
- Command and Control
- Response Time
- Payload (Sensor)
- Persistance

- Environmental Sampling
- Marine Safety
- SAR
- Aids to Navigation
- Maritime Security & PWCS
- ISR
What’s Next?

• Develop detailed CONOPS
• Perform Trade Space and Analysis of Alternatives
  – Utilize a modeling technique to gain insights about best suited UMV for most USCG missions/affordability
• Conduct Preliminary Feasibility Studies
• Draft Offshore Patrol Cutter (WMSM) Business Case
• “Magpie” Analogy
  – Primary focus on near-term operational capabilities and affordably augmenting assets instead of pursuing new capabilities

• Upcoming USCG UXV Operation in Arctic
  – Arctic Shield 2013 (UAV ↔ USV ↔ UUV)

• Other potential applications
  – “Bell-Ringer” type (monitoring historically significant gravesites – recent increase in underwater looting)
  – Deterrent
USCG Academy Engineering Dept.
2013 UMV Capstone Projects

Automated Pollution Rover (APR) USV: Collection Apparatus

“HullBug” Type UUV

APR Charging Station
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