Risk-Based Resource Allocation in Maritime Security and Maritime Domain Awareness

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**Risk-Based Resource Allocation in Maritime Security and Maritime Domain Awareness**

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Overview

- Problem Space
- RBDM Approach
- Levels/Applications
  - Acquisition
  - Planning & Execution
Problem Space

- EEZ Area: 3.36 million square nautical miles
- Over 7,000 vessels calling on U.S.
- Approximately 60,000 calls in U.S. ports
- Up to 6,600 containers on board a single container ship, each with at least one shipment
- Approximately 6 million container arrivals by sea per year
- Multiple agencies involved with non-interoperable/interconnected databases
- Limited resources to monitor, inspect, interdict
Problem Space: Geospatial View

- **Ports & Waterways**: At and inland from coast
- **Coastal Zone**: 0-12 nautical miles
- **Exclusive Econ. Zone**: 12-200 nautical miles
- **Open Ocean**: >200 nautical miles
- **Foreign Port**: In Departure Ports

(Please note that the text is not visible in the image, but the diagram elements are clearly labeled.)
Risk Based Decision Making

Decision Framework

Risk Assessment

Risk Management

Impact Assessment

Risk Communication
Levels/Applications

■ Planning and Execution
  ➢ Strategic
  ➢ Operational
  ➢ Tactical

■ Acquisition
Planning and Execution

- Support Resource Allocation
- Support Analysis and Replanning

Alternatives

- Assess risk for each vessel and plan accordingly (man to man)
- Assess risk geospatially and plan accordingly (zone)
Stages

- Decision Framework
  - How best allocate finite resources to manage risk
  - Assume for example that only concerned about security risk and resource removal

- Risk Assessment
  - Draw upon regional risk assessment to develop risk profile
    - IPOE
    - MSRAM
    - Other
### Planning and Execution: High Level Risk Assessment

<table>
<thead>
<tr>
<th>Goal: Enforcement of Laws and Treaties</th>
<th>Concern: Vessel as Resource Removal *</th>
<th>Location(s) of Concern</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Vessel being used to extract and/or remove U.S. resources such as groundfish, minerals, etc.)</td>
<td>Ports and Waterways: Unlikely given limited resources, likelihood of interdiction</td>
<td>Coastal Zone*</td>
</tr>
</tbody>
</table>

* Requires complicit crew

<table>
<thead>
<tr>
<th>Goal: Security</th>
<th>Concern: Vessel as Transport</th>
<th>Location(s) of Concern</th>
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</thead>
<tbody>
<tr>
<td>(Vessel being used to transport personnel, weapons, equipment or funds for terrorist-related activities.)</td>
<td>Ports and Waterways</td>
<td></td>
</tr>
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<td>Coastal Zone*</td>
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<td></td>
</tr>
<tr>
<td>EEZ &amp; Beyond*: unlikely given difficulties of transfer.</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Goal: Security</th>
<th>Concern: Vessel as Weapon</th>
<th>Location(s) of Concern</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Kinetic or chemical energy of vessel used by agents on board as either improvised weapon of mass destruction or weapon targeting critical infrastructure.)</td>
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<tr>
<th>Goal: Security</th>
<th>Concern: Vessel as Target</th>
<th>Location(s) of Concern</th>
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<tr>
<td>(Vessel targeted externally as mass-casualty inducting target, either due to the number of people on board {e.g., ferry, cruise ship}, or due to the hazardous nature of the cargo {e.g., using the vessel as an improvised weapon of mass destruction}.)</td>
<td>Ports and Waterways</td>
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<td></td>
</tr>
<tr>
<td>EEZ &amp; Beyond: unlikely given difficulties of targeting, lesser consequences</td>
<td></td>
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</table>

### Existing Resources:
- IPOE
- MSRAM
- CMT
- NCRA
- TSSRA

* Requires complicit crew
## Planning and Execution:
### High Level Risk Management

<table>
<thead>
<tr>
<th><strong>Goal:</strong></th>
<th><strong>Concern:</strong></th>
<th><strong>Location(s) of Concern</strong></th>
<th><strong>Risk Management</strong></th>
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<tr>
<td><strong>Security</strong></td>
<td><strong>Vessel as Transport</strong></td>
<td>Ports and Waterways</td>
<td>Hold, Monitor, <strong>Board</strong>, Deny Entry</td>
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<td>EEZ &amp; Beyond*: unlikely given difficulties of transfer.</td>
<td><strong>Monitor</strong>, Mitigate additional EEZ risk by monitoring for rendezvous</td>
</tr>
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<td><strong>Vessel as Weapon</strong></td>
<td></td>
<td>Ports and Waterways</td>
<td>Hold, Monitor, Board, Deny Entry, <strong>Escort, Sea Marshal</strong></td>
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<td><strong>Vessel as Resource Removal</strong></td>
<td>Ports and Waterways: Unlikely given limited resources, likelihood of interdiction</td>
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Impact Assessment

- Assessment
  - Cited as challenge throughout Navy, Coast Guard, particularly at operational level

- Use model to:
  - Determine where results less than expected
  - Evaluate potential changes to planning and execution
“Man to Man”: Decision Support System

- HUMINT
  - Law Enforcement Data
  - Manifest
- SIGINT
  - Vessel Records
  - 96 Hour ANOA
- IMINT
  - Operator Records
  - AIS
- MASINT
  - Support Requests
  - Other Sensors
  - Market Rates
  - Vessel Movements

Risk-Based Fusion and Analysis

- Hold
- Monitor
- Escort
- Deny Entry
Acquisition

- Similar to Planning and Execution
  - More detailed, less subjective given time available, resources involved

- Overarching Approach
  - Cost-Benefit/Cost-Effectiveness Analysis
    - Maximize $Net \text{ Benefits} = Social \text{ Benefits} - Social \text{ Costs}$
    - Such that $Benefit_i / Cost_i > \eta_i$, for all individuals/groups $i$
      - where $\eta_i$ is some acceptable threshold for equity
    - And other constraints specific to the situation
Illustrative Threat Scenarios

Ports & Waterways
- Cruise Missile
- Transfer of Illicit Cargo/Persons
- Improvised WMD
- Vessel as Target

Coastal Zone
- Cruise Missile
- Transfer from Mother Ship
- Vessel as Facility
- Vessel as Target

Exclusive Econ. Zone
- Cruise Missile
- Transfer from Mother Ship
- Vessel as Facility

Open Ocean
- Cruise Missile

Foreign Port

ABS Proprietary
Illustrative Data Sources

Ports & Waterways
- Patrons (Group, MSST)
- VTS
- AIS
- HUMINT
- Law Enforcement
- Commercial Sources
- Radar
- EO/IR
- EPIRB
- Ship Security Alert

Coastal Zone
- Patrons
- VTS
- AIS
- Commercial Sources
- AMVER
- VHF/DSC
- Port Service Requests
- SIGINT
- Radar
- GMDSS
- EPIRB

Exclusive Econ. Zone
- Patrons (cutters, USN, aircraft)
- Acoustic
- AIS
- SIGINT
- IMINT
- MASINT
- RADAR
- EO/IR
- AMVER
- VHF/DSC
- Port Services
- GMDSS
- EPIRB

Open Ocean
- Patrons (cutters, USN)
- ACINT
- SIGINT
- IMINT
- MASINT
- 96 hour ANOA/SANS
- AIS Remote
- AMVER
- GMDSS
- EPIRB
- Ship Security Alert

Foreign Port
- ACS
- HUMINT
- SIGINT
- IMINT
- MASINT
- Law Enforcement
- OSINT

Other Databases
- MISLE
- Lloyd’s
- Freight Information
- Transaction Information

ABS Proprietary
Risk Based Decision Making

- Decision Framework
- Risk Assessment
- Risk Management
- Impact Assessment

Risk Communication
Overarching Approach: Risk Assessment
**Terminology**

- **Threat**: Probability that an attack scenario is selected given that an attack is to be undertaken. This includes the deterrent effect of existing and forthcoming countermeasures.

- **Vulnerability**: Probability that attack reaches the intended target, given that a particular scenario is planned. This includes all preparatory efforts once the scenario is selected up to and including the breach of applicable defensive systems to allow interaction of the attack with the target.

- **Consequence**: Outcome of interaction of the attack with the target, to include target hardness relative to that attack, and broader systemic effects as mitigated by response, redundancy and recovery.
Model


- P[Attack] a function of intent and capability
- P[Scenario | Attack] a function of specific scenario-related capability and intent
- P[Attack Intersects Target | Scenario]
- Consequence

<Reasonable Minimum, Best Estimate, Reasonable Maximum>

- Use Best Estimate for primary analysis, use Reasonable Minimum, Reasonable Maximum for uncertainty analysis, sensitivity analysis

\[
R = \sum_{i=1}^{m} \sum_{j} \sum_{k} P[i \text{ Attacks in Time } t] * P[Scenario_{jk} | i \text{ Attacks}] * P[l \text{ Successes } i \text{ Attacks}] * P[Defensive Systems Breached | Scenario_{jk}, Attack] * E[Consequences | Defensive Systems Breached, Scenario_{jk}, i \text{ Attacks, l Successes}]
\]
Vulnerability

- Probability that attack intersects target given scenario

Consider

- Inherent Difficulty
- National Defenses and Mitigation
- State and Local Defenses and Mitigation
- Target Defenses and Mitigation
Consequences

- Life Safety
- Primary Economic
- Post-Primary Economic
- Psychological
- Mission
Risk Management

- Identify Investments
  - Enhance detection
  - Enhance analysis
  - Improve interdiction
  - Combinations

- Evaluate Investments
  - Life cycle cost
  - Effectiveness
  - Cost-effectiveness

- Decide and Design
  - Determine optimal investment
Management Strategies

- **Ports & Waterways**
  - Monitor
  - Inspect
  - Hold
  - Escort
  - Control

- **Coastal Zone**
  - Monitor
  - Inspect
  - Hold
  - Deny Entry

- **Exclusive Econ. Zone**
  - Monitor
  - Inspect
  - Deny Entry

- **Open Ocean**
  - Monitor
  - Inspect

- **Foreign Port**
  - Tag
  - Inspect
Assets: Existing & Planned

Ports & Waterways
- USCG Cutters
- USCG Boats
- USCG Fixed, Rotary Wing Aircraft
- State/Local LE Patrols
- CBP Inspectors
- Waterway Sensor Systems

Coastal Zone
- USN Vessels
- USN MPA
- USCG Cutters
- USCG Fixed, Rotary Wing Aircraft
- USCG UAV
- National Assets
- Coastal Sensor Systems
- IUSS

Exclusive Econ. Zone
- USN Vessels
- USN MPA
- USCG Cutters
- USCG Fixed Wing Aircraft
- USCG UAV
- National Assets
- IUSS

Open Ocean
- USN Vessels
- USCG Cutters
- National Assets
- IUSS

Foreign Port
- CBP Inspectors
- USCG Inspectors
- HumInt

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## MDA Functional Support

<table>
<thead>
<tr>
<th>Goal:</th>
<th>Concern:</th>
<th>Alertment Basis:</th>
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<tbody>
<tr>
<td></td>
<td><strong>Security</strong></td>
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</table>
|       | Vessel as Transport | • Detection of anomaly in cargo.  
|       | (Vessel being used to transport personnel,  
|       | weapons, equipment or funds for terrorist-  
|       | related activities.) | • Detection of anomaly in crew.  
|       | | • Detection of anomaly in passengers.  
|       | | • Detection of anomalous behavior by vessel.  
|       | | • Detection of anomalous behavior in vicinity of vessel.  
|       | Vessel as Facility | • Detection of anomalous behavior in vicinity of vessel.  
|       | (Vessel being used for manufacturing,  
|       | training, logistics, etc.) | • Detection of anomalous behavior in vicinity of vessel.  
|       | Vessel as Weapon | • Detection of anomaly in crew.  
|       | (Kinetic or chemical energy of vessel used by agents on board as either improvised weapon of mass destruction or weapon targeting critical infrastructure.) | • Detection of anomaly in passengers.  
|       | | • Detection of anomalous behavior in vicinity of vessel.  
|       | | • Detection of threatening behavior in vicinity of vessel.  
|       | Vessel as Target | • Detection of anomalous behavior in vicinity of vessel.  
|       | (Vessel targeted externally as mass-casualty inducing target, either due to the number of people on board [e.g., ferry, cruise ship], or due to the hazardous nature of the cargo [e.g., using the vessel as an improvised weapon of mass destruction].) | • Detection of threatening behavior in vicinity of vessel.  
|       | Vessel as Response Asset | • Identification of vessels in vicinity.  
|       | (Vessel as resource to prevent and/or mitigate/respond to mishap.) |                  |
|       | **Enforcement of Laws and Treaties** |                  |
|       | Vessel as Transport | • Detection of anomaly in cargo.  
|       | (Vessel being used for smuggling activities such as illegal immigration, drug trafficking, etc.) | • Detection of anomaly in crew.  
|       | | • Detection of anomaly in passengers.  
|       | | • Detection of anomalous behavior by vessel.  
|       | | • Detection of anomalous behavior in vicinity of vessel.  
|       | Vessel as Resource Removal | • Detection of anomalous behavior by vessel.  
|       | (Vessel being used to extract and/or remove U.S. resources such as groundfish, minerals, etc.) | • Detection of illegal behavior by vessel.  
|       | **Safety** |                  |
|       | Vessel in Danger | • Identify unsafe operations.  
|       | | • Identify delayed/missing vessels.  
|       | Vessel as Response | • Identification of vessels in vicinity  
|       | (Vessel as resource to prevent and/or mitigate/respond to mishap.) |                  |
|       | **Environmental Protection** |                  |
|       | Vessel as Pollution Source | • Identify operations of concern.  
|       | (Vessel as source of oil, hazardous material, non-indigenous species, etc.) | • Support forensic evaluation.  
|       | Vessel as Response | • Identification of vessels in vicinity  
|       | (Vessel as resource to prevent and/or mitigate/respond to mishap.) |                  |
|       | **Mobility** |                  |
|       | Vessel Traffic Management | • Support real-time operational management.  
|       | | • Support planning and analyses (e.g., Port Access Routes Studies)  

---

*ABS Consulting*
Identify Interventions

Waterside attack on Vessel Scenario

Legend:

1. Suspect Vessel Boarding
2. Specialized Use of Force
3. End Game Prosecution
4. Escort Vessel
5. Intervene After Attack - Response
Waterside attack on Vessel Scenario Risk Calculation

<table>
<thead>
<tr>
<th>Threat</th>
<th>Vulnerability</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Escort Vessel</td>
<td>Intervene After Attack - Response</td>
<td></td>
</tr>
</tbody>
</table>

**Raw Risk**

- **700 RIN**
- **99%**
- **95%**
- **90%**
- **80%**
- **90%**

**Line of Assurance Failure Probabilities**

- **1** Suspect Vessel Boarding
- **2** Specialized Use of Force
- **3** End Game Prosecution
- **4** Escort Vessel
- **5** Attack - Response

**Residual Risk**

- **427 RIN**
- **700 - 427 = 273 RIN**
- **34% Risk Reduction**

**Targets directly protected by activities**

- **Raw Risk** **700 RIN**
- **300 RIN**
- **99%**
- **95%**
- **90%**
- **90%**

**Line of Assurance Failure Probabilities**

- **1** Suspect Vessel Boarding
- **2** Specialized Use of Force
- **3** End Game Prosecution
- **5** Attack - Response

**Residual Risk**

- **229 RIN**
- **300 - 229 = 71 RIN**

*Lines of Assurance dependent on external detection activities (e.g., MDA)*
Impact Assessment

Look for and use opportunities to refine assessment, re-evaluate risk management

- Drills
- Exercises
- Experiments
- Actual Events (security and otherwise)
Conclusion

- Complexity of maritime problem space and limited assets demands strong analytics
- Risk-based approaches provide structured methods for analyses that acknowledge uncertainties