NPS MDP Study
Outbrief Schedule, 1 JUN 2005

0800-0815 Introductions

0815-0915 Background/Results

0930-1015 Cargo Inspection System (Land)

1030-1130 Cargo Inspection System (Sea)

1130-1230 LUNCH

1230-1330 Sensor System

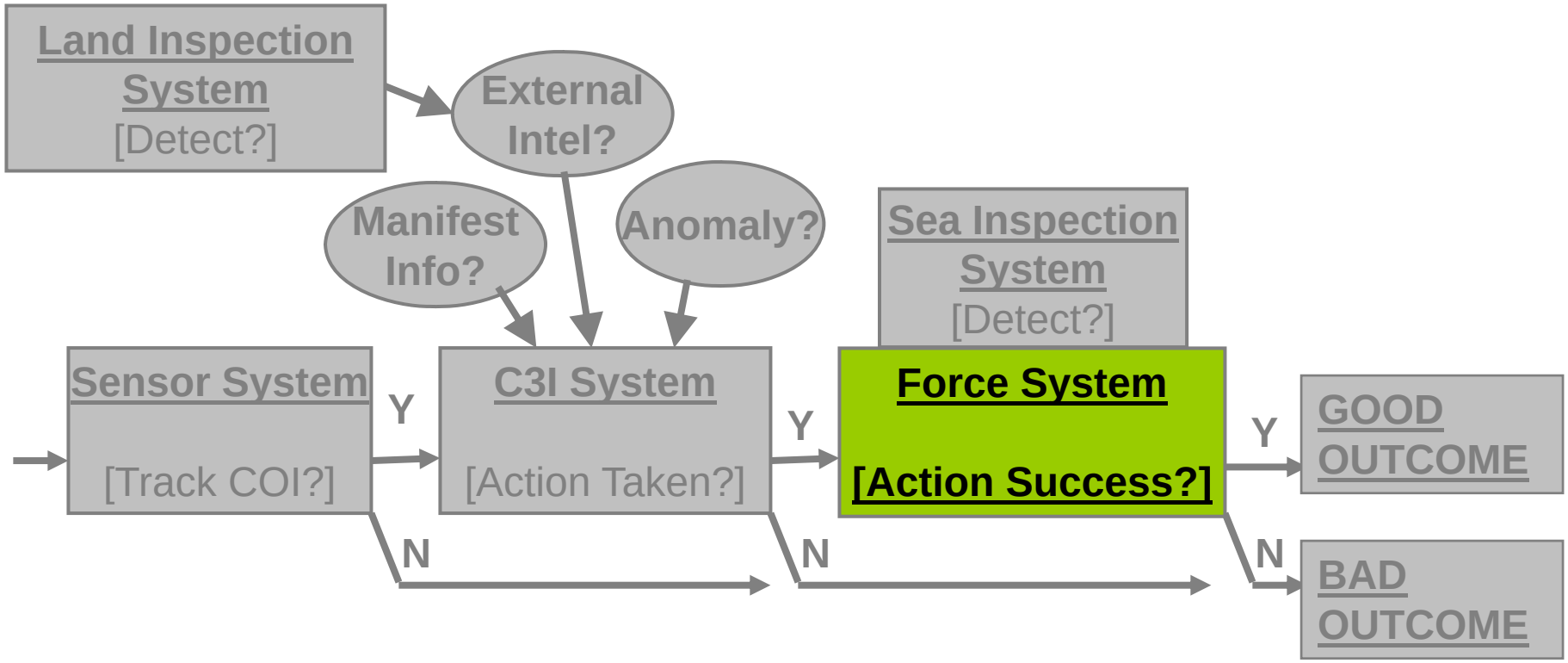
1345-1445 C3I System

1450-1600 Response Force System

Force System

LT David Walton, USN

Force Group


Land Inspection System
[Detect?]
External Intel?
Manifest Info?
Anomaly?
Sea Inspection System
[Detect?]
Sensor System
[Track COI?]
Y
C3I System
[Action Taken?]
Y
Force System
[Action Success?]
Y
GOOD OUTCOME
N
N
N
BAD OUTCOME

Force Agenda

- Big Picture
- Functional Decomposition
- Requirements
- Alternatives Generation Matrix
- Parameters/Variables
- Model Overview
- Results
- Conclusions/Insights

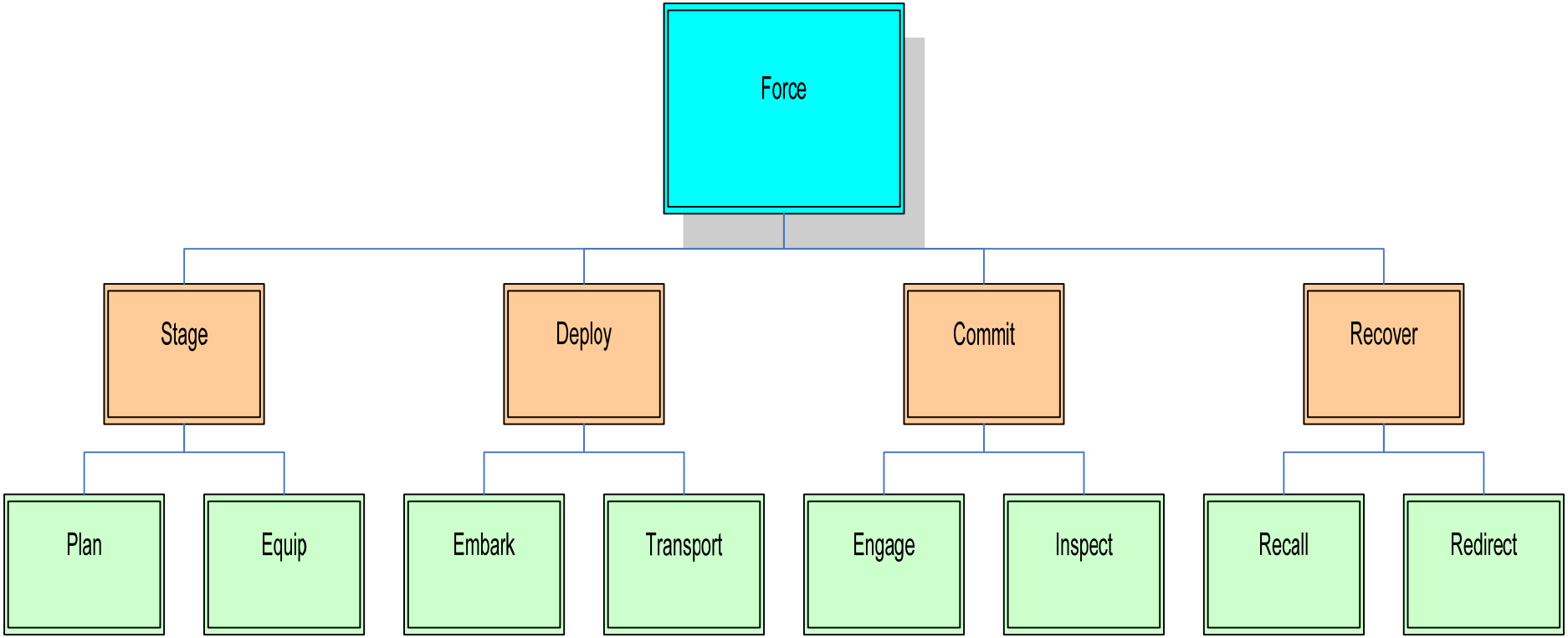
Force System Objectives

- Engage and defeat physical threats to shipping in the Straits of Malacca
- Identify methods to improve transiting vessel security
- Develop model for force system.
- Recommend system alternatives to improve force performance.

Force Requirements

Small Boat Attack	Keep Small Boat Attack >35m from HVU
	Engage and Defeat 80% of SBA threats
	Maintain responsive capabilities up to Sea State 3
Ship As Weapon	Keep SAW >250m from pier
	Engage SAW by 2,000m from pier
	Engage and Defeat 90% of SAW
WMD	Transport and utilize inspection gear
	Provide security for Inspection Teams during Inspection

Force Functional Decomposition



“As-Is” Force System

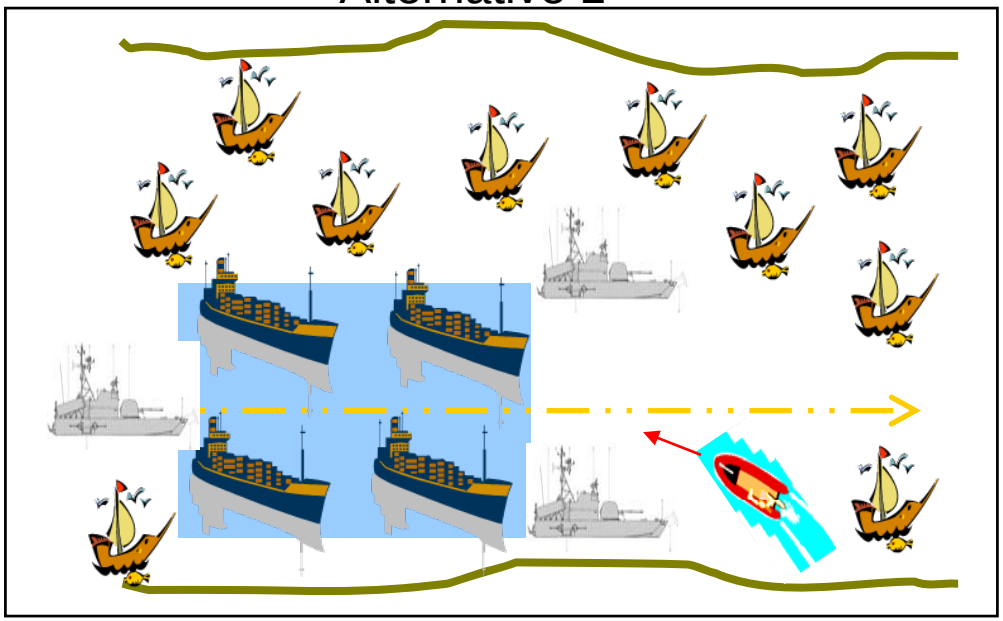
- SBA
  - No persistent regulated force in place
- SAW
  - 3 Man Sea Marshal teams onboard all HVUs entering Singapore ports
- WMD
  - No system in place to inspect incoming vessels at sea

Force Alternatives Generation

DESIGN NAME	SBA		SAW		WMD	
	Platform	**Force**	**Platform**	**Force**	**Platform**	**Force**
As-Is	None	None	Harbor Pilot Boat	Singapore Navy Sea Marshals (3)	None	None
Patrolling	Weapons Transport	Transport Crew	Weapons Transport	Singapore Navy Sea Marshals (3) And Weapons Transport Crew	Helicopter	Inspection Team
Sea Marshal	HVU	Sea Marshals (5)	Helicopter	Singapore Navy STAR Team (12)	Weapons Transport	Inspection Team

Force SBA Scenario Alternatives

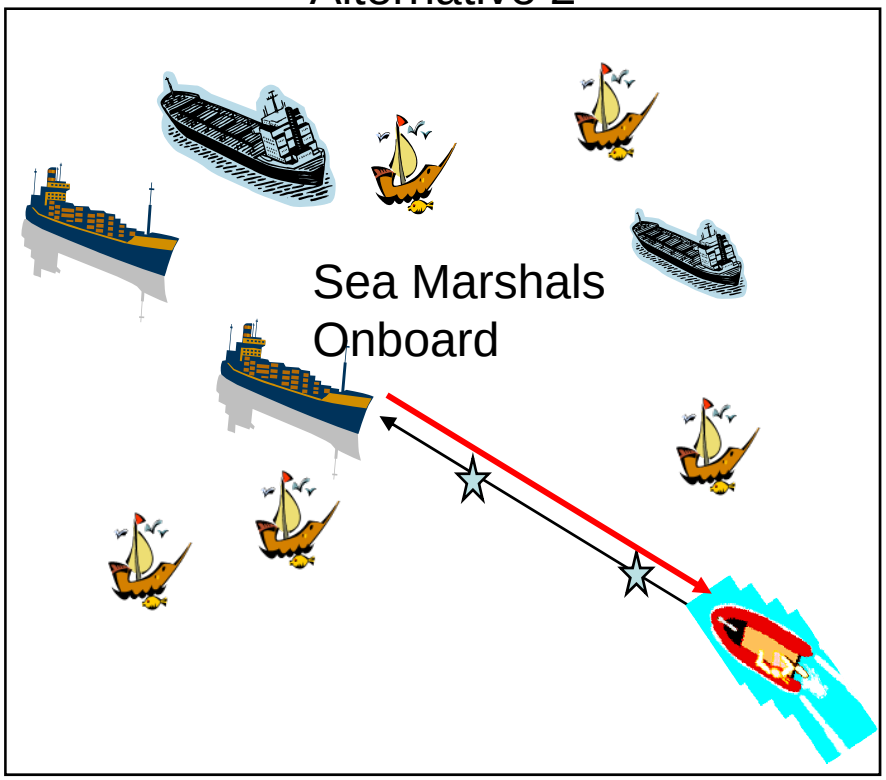
Alternative 1



•Patrol/Escort of HVUs through AOR

•3 Escorts per 150nm operational area

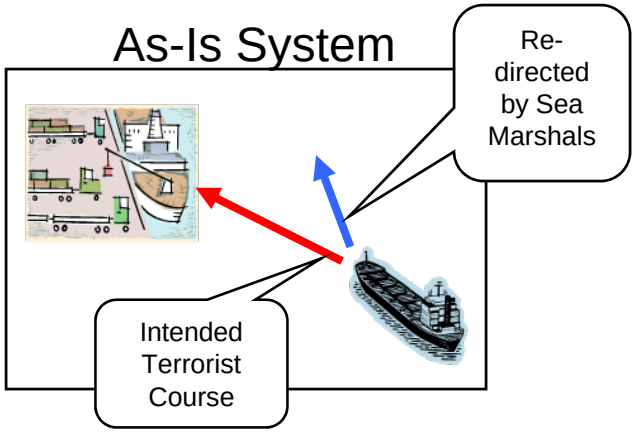
Alternative 2

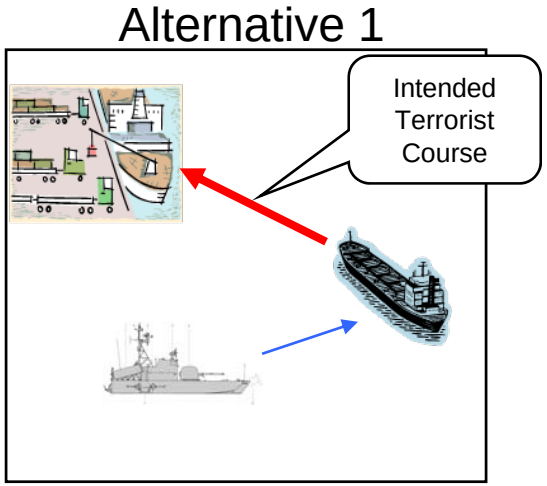


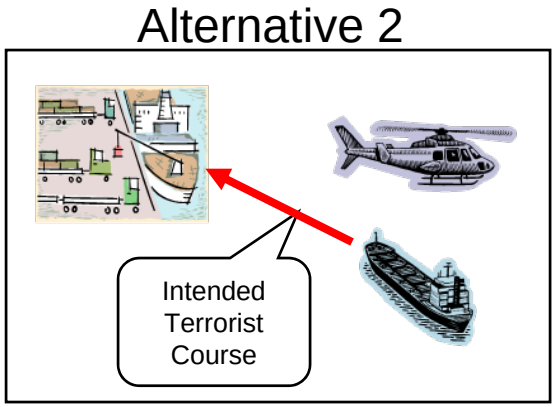
•Onboard Sea Marshal Teams

•5 Man Teams (2 crew-served weapons)

Force SAW Scenario Alternatives







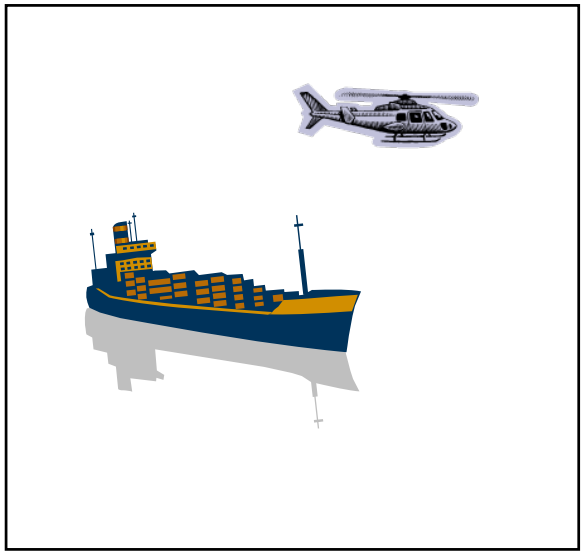
- 3 Man Sea Marshal Team

- 3 Man Sea Marshal Team
- Sparviero Patrol Craft

- 3 Man Sea Marshal Team
- 12 Man Helo Transported Re-Take Team

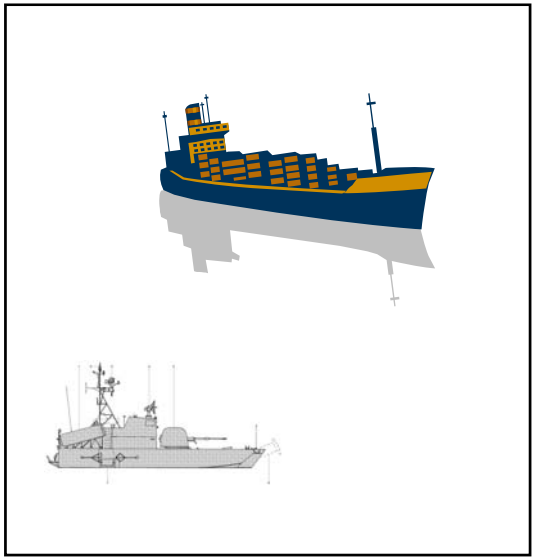
Force WMD Scenario Alternatives

Alternative 1



- Helicopter Transports 12 Man Inspection Team from Singapore

Alternative 2



- Sparviero Patrol Craft Transports 12 Man Inspection Team

Weapons Track TDSI

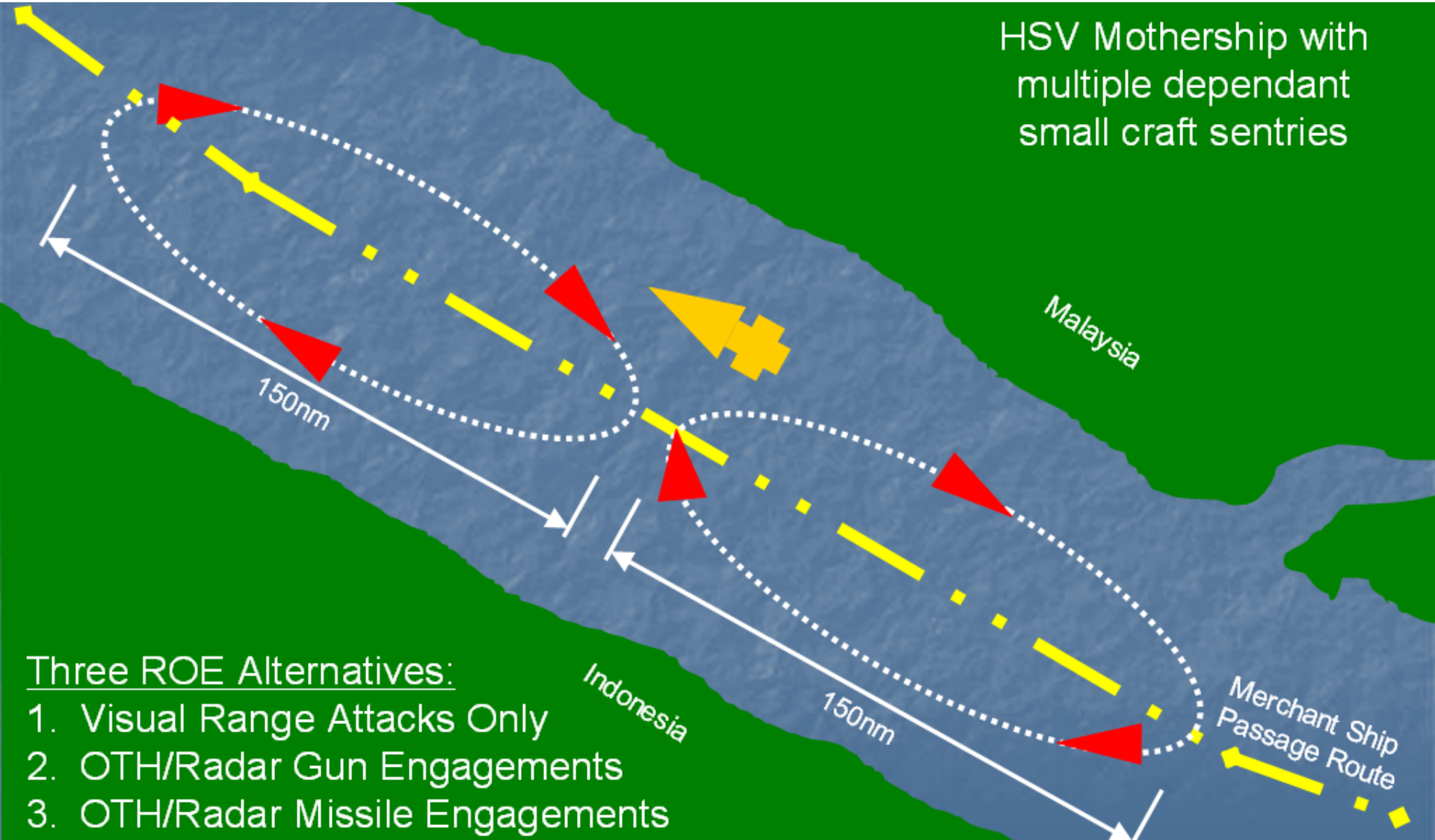
Presented by: LT John Lukacs

Weapons Track Focus

- Small Boat Attack
  - Minimal Response Time (2nm → 4 min.)
  - Maximum Precision Required (high traffic density)
  - High Durability Required (continuous operations)

- Ship As a Weapon / WMD Threat
  - Long Lead Time (Speed)
  - Moderate Durability Requirement (Range)
  - Transport WMD Inspection Team to target vessel

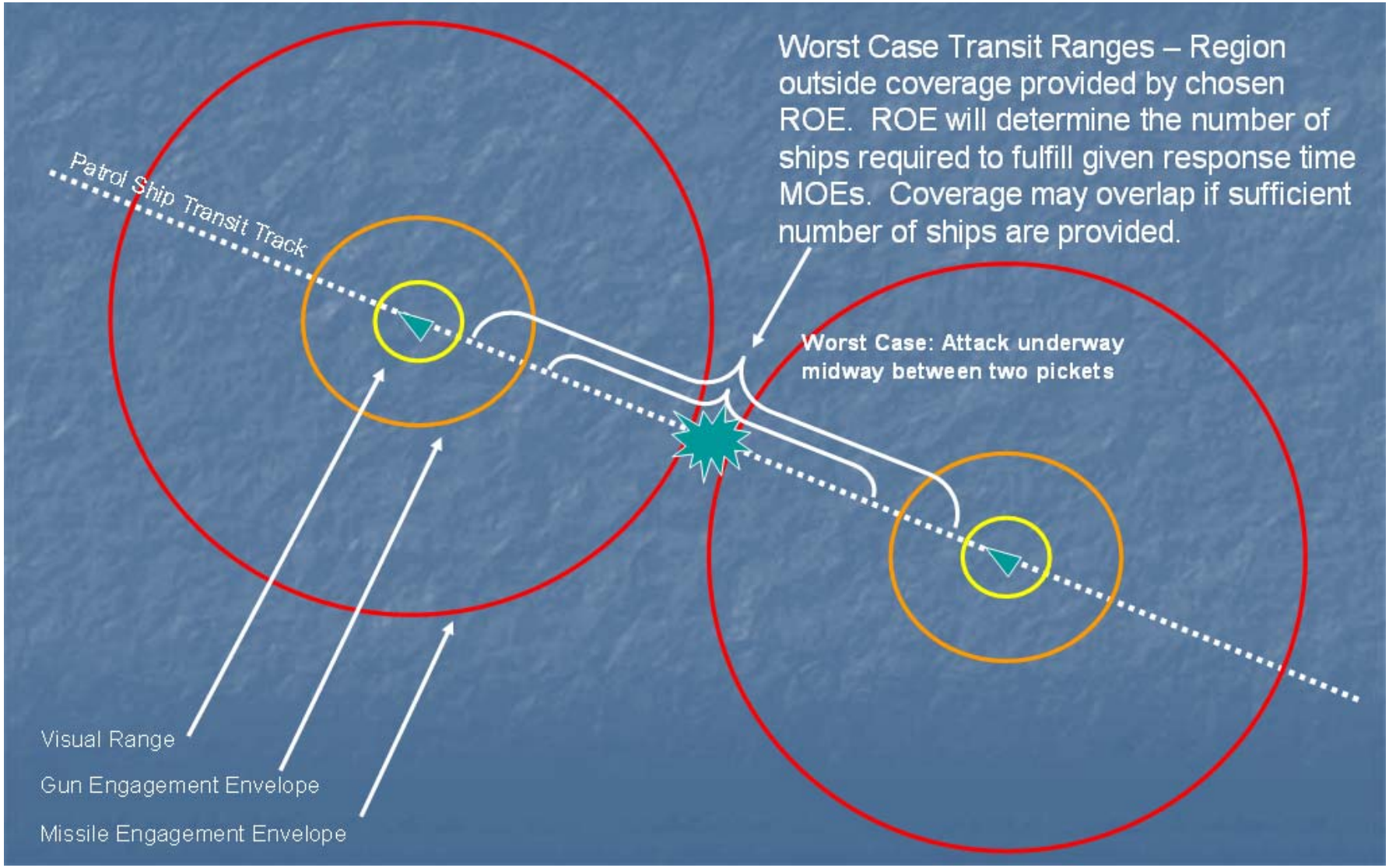
Planned Operations



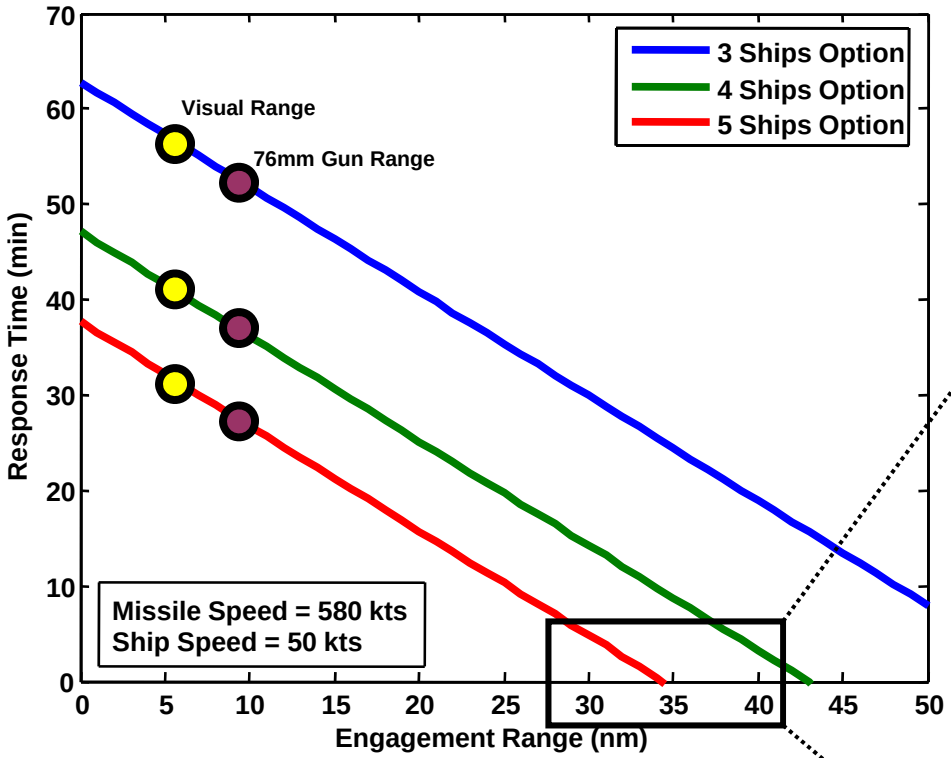
Three ROE Alternatives:

1. Visual Range Attacks Only
2. OTH/Radar Gun Engagements
3. OTH/Radar Missile Engagements

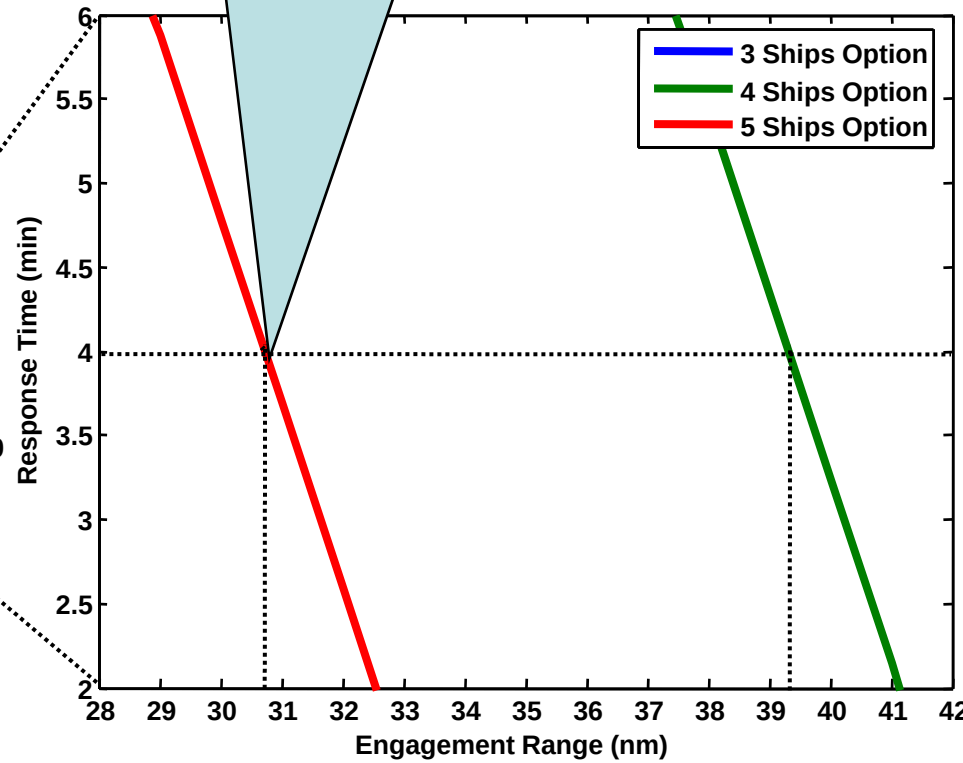
Weapon Range Evaluation



Numerical Requirements



Need 31nm Missile for Engagement Times < 4 minutes with 5 ship patrol

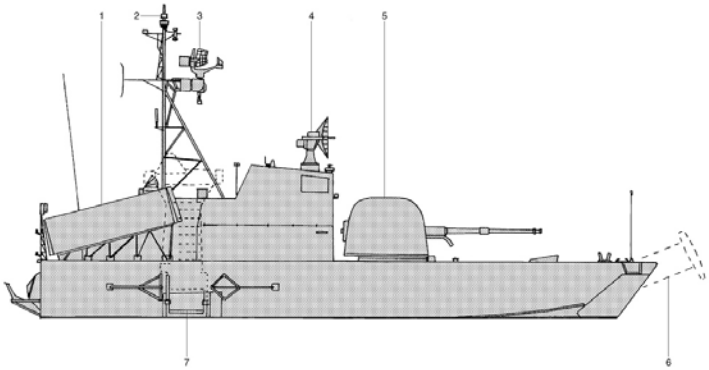


Proposed Ships

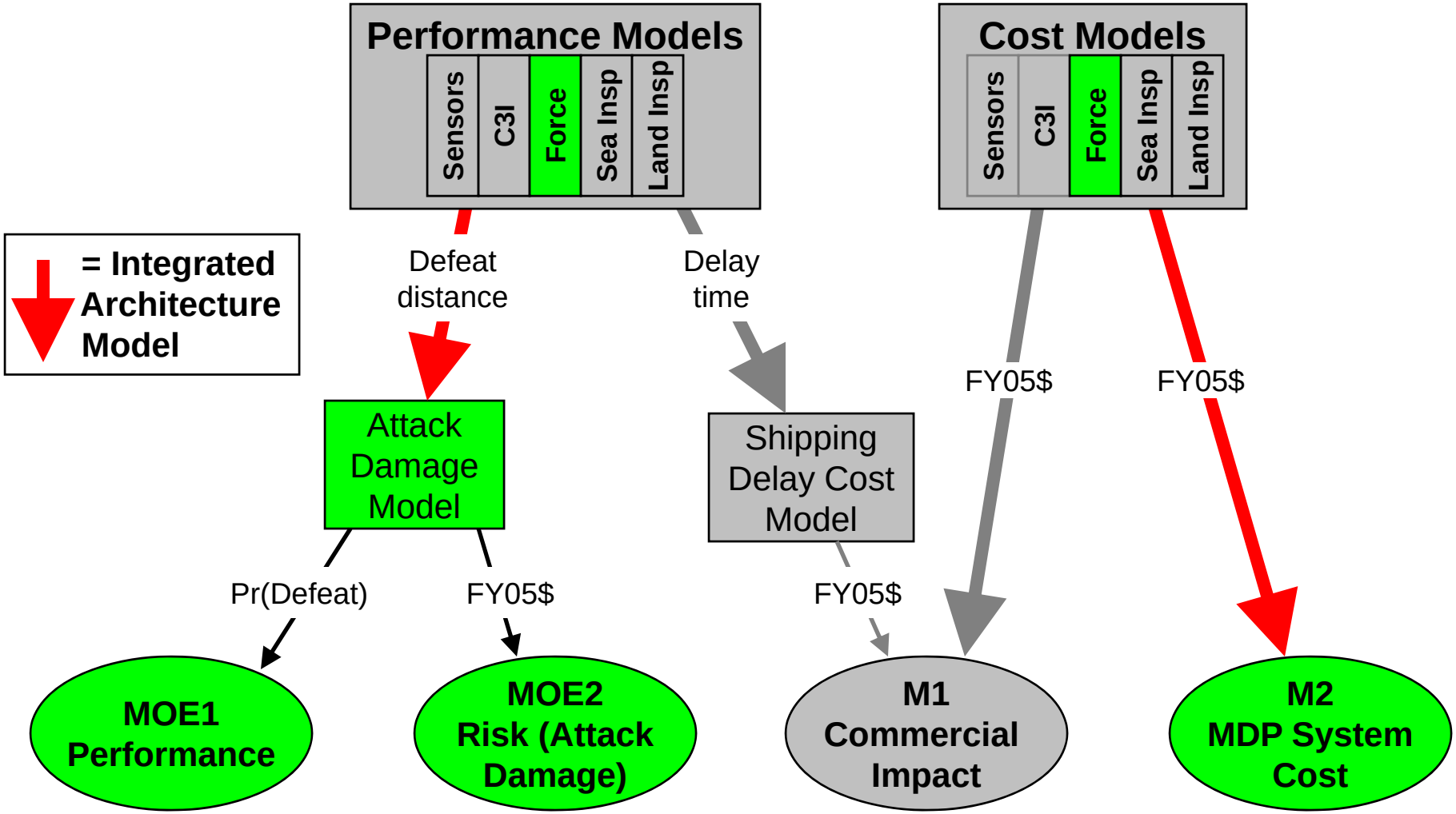
	Tenix Fast Attack Craft	Hayabusa Class	Skjold Class	Sparviero Class
Build	Monohull	Monohull	Catamaran	Hydrofoil
Length by Beam, ft	151 by 28	164 by 28	155 by 44	71.5 by 23
Speed, knots	34	44	45	46
Range, nm	2000 at 15 knots	Estimated 800	800	1200 at 8 knots
Displacement, tons	205	200	270	50
Compliment	37	21	15	11

Selected Ship Type

- Sparviero Hydrofoil (Japan, Italy)
  - Range: 1200 nm
  - Speed: 46 kts
  - Displacement: 50 LT
  - Crew: 11 standard
  - Weapons:
    - 76mm deck gun
    - Otomat Mk 2 SSM
    - Interchangeable
  - Cost: $2.3 Million (est.)



Force Modeling Plan



3 Force Models Used: Optimized by Scenario

- SBA
  - Map Aware Non-uniform Automata (MANA)
  - A multiagent-based simulation of notional combat
  - Patterned after mobile cellular automata rules
- SAW
  - EXTEND
- WMD
  - Microsoft EXCEL (Transport time only)

OR Track TDSI

Presented by: Mr. Victor Ang

Map-Aware Non-uniform Automata (MANA)

- Why MANA?
  - An entity based model
  - Designed to allow for the testing of robustness of observations across modeling platforms
  - Distillation model
    - Transparency
    - Speed
    - Little training needed
    - Ease of configurability
  - Light-weight model: permit examination of very wide range of possibilities and outcomes

Data Analysis

- Design Model
  - Full factorial design of experiment
- Software Tool
  - Microsoft Excel
  - JMP Statistical Discovery software package
    - friendly graphical user interfaces
    - superb power to handle up to hundreds of thousands data points

Patrol Scenario: Snap Shots of MANA Simulation

a) Initial Patrol Scenario

- 1 Small Boat, 7 HVUs, 3 TDSI Patrols and 68 Fishing Boats.

Force Factors Considered

- Scenario Geography
- Engagement Range
- Weather
- Blue Force Starting Position
- Red Force Starting Position
- Pk
- # of Hostiles
- Transportation Speed
- Engagement rates
- Blue Force #s

RED : Factors varied

Force Modeling Assumptions

- Sea Marshals are onboard before SBA attack commences
- One small boat only per SBA (No “Wolf pack” tactics)
- No P_{fa} (Hostile intent is known with certainty)
- Max SAW Engagement Range will be defined by Singapore Port Limits
- Sea Marshals are conducting compliant boardings only
- All targets designated will be within range of response force sensors
- Effect of sea state is not modeled
- RAM data constant

Force Performance Model Overview

Input Variables

- Engagement range
- Blue Force Start Position
- Red Force Start Position
- P_k
- Force Engagement Rate
- # of Blue Force Agents
- # of Hostile Agents

→ **Force Performance Models** →

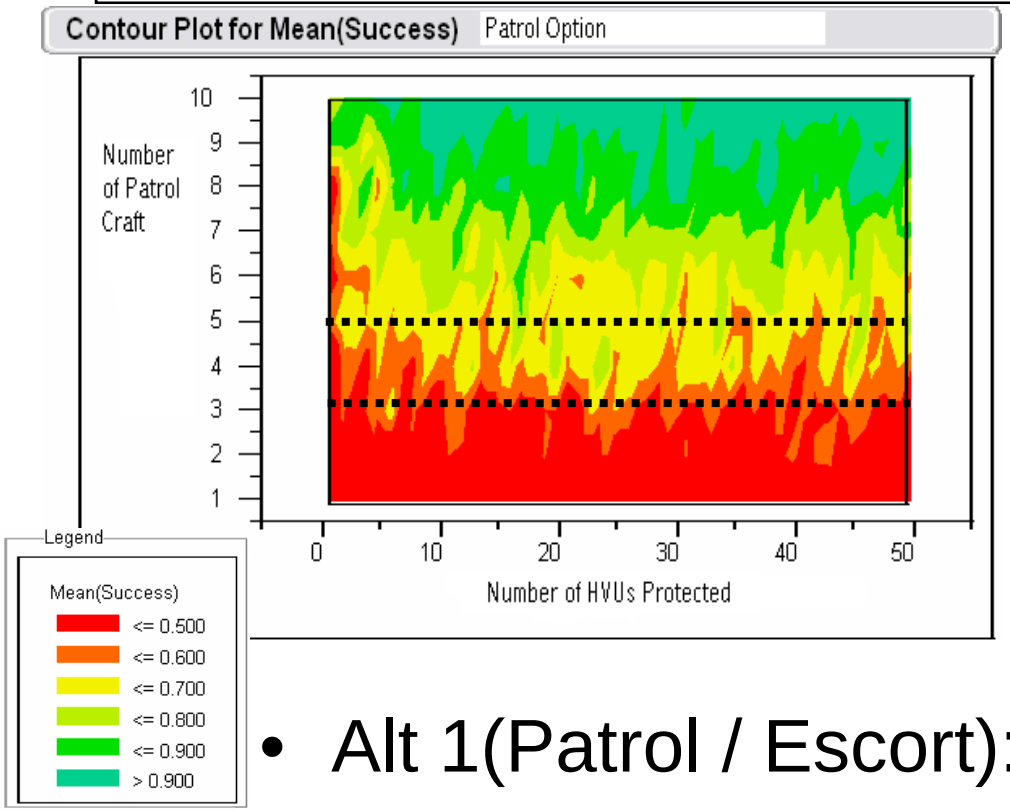
Outputs

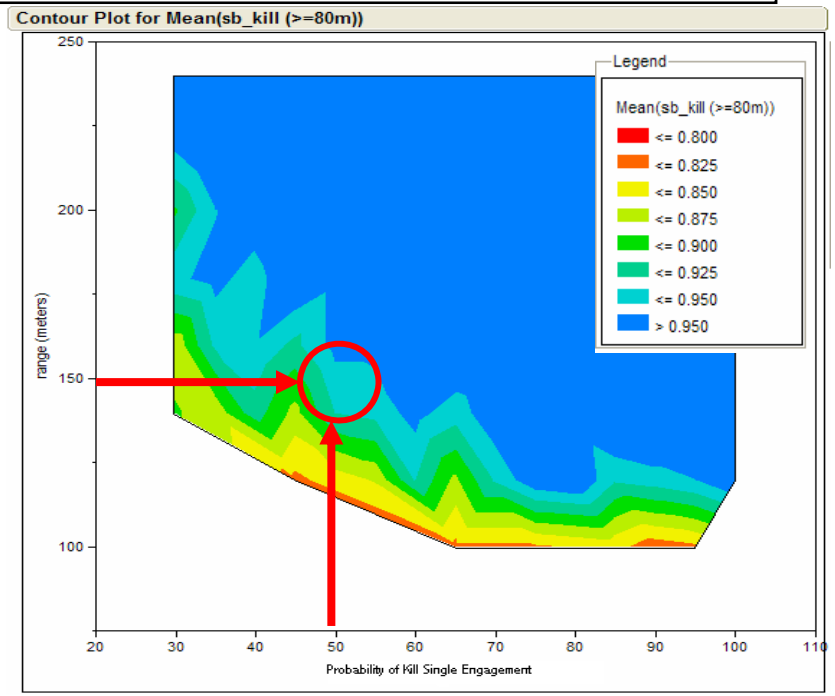
- P_{DEF}
- Transport Time

Force Factor Parameters

Scenario	Factor	As-Is	Alternative 1	Alternative 2
SBA	Engagement Range	0 Meters	9 nm	150 Meters
	P_k	0	80%	50%
SAW	Engagement Range	0-5nm	0-5nm	0-5nm
	Force Engagement Rate	2.2	2.2	2.2
	P_k	0	5-50% by Range	50-95% by Range

Force SBA Model Results





- Alt 1(Patrol / Escort):
  - SBA defeated 60% with 3 Patrol Craft (70% with 5)
  - SBA defeated >90% with 3 Escort Craft protecting Convoy of HVUs
- Alt 2 (Sea Marshal):
  - SBA Defeated >92.5% with P_{KSE} 50% if engaged at 150m
  - SBA Defeated >95% with P_{KSE} 35% if engaged at 200m

Force SAW Model Results

- As-Is (Sea Marshal):
  - 83% ± 2% Retake rate using Sea Marshals
- Alternative 1 (Patrol):
  - 91% ± 1% Retake rate using Sea Marshals and Patrol Craft with 2.5nm or more notification
  - Outside 2.5nm notification = no change in performance
- Alternative 2 (Helo):
  - 83% ± 2% Retake rate using Sea Marshals and Helicopter team (Helo ineffective inside 7nm notification)
  - Expected to be more effective when Helo has time to intercept

Force WMD Model Results

- As-Is System
  - No response capability
- Alternative 1 (Helo)
  - 1.5 hours to lift inspection team to 250nm from Singapore
- Alternative 2 (Ship)
  - 1.5 hours to transport inspection team from forward land bases

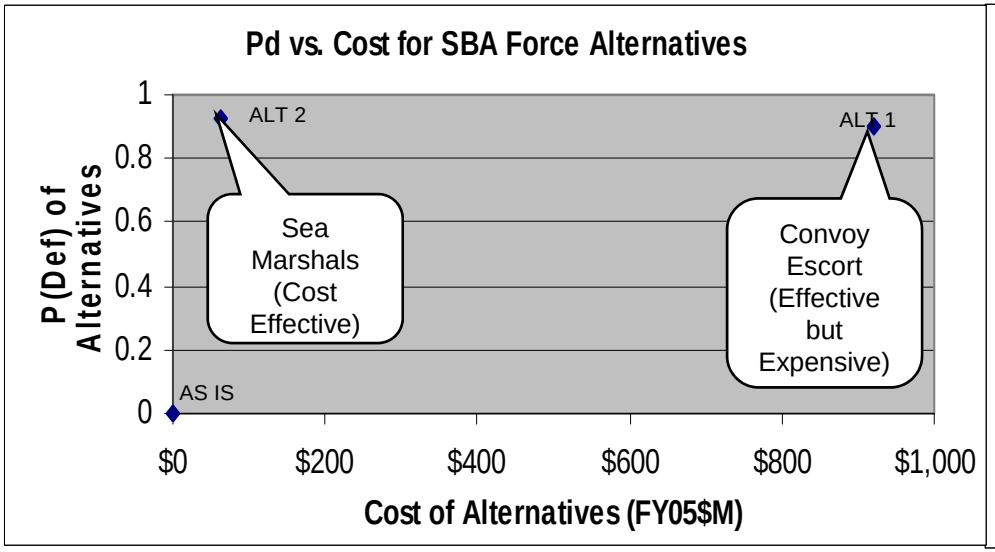
Force Modeling Factors

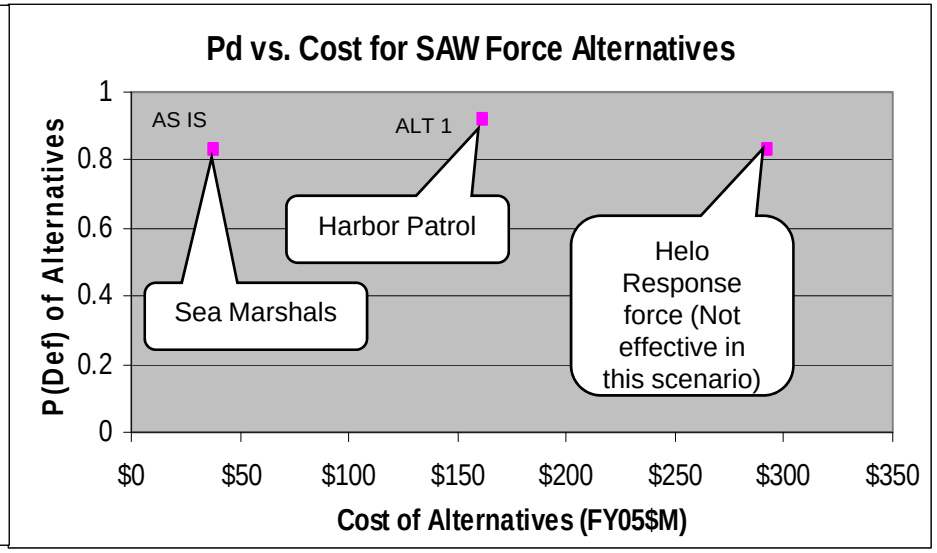
		Values Chosen		
Treatment	**Values Evaluated**	**As-Is**	**Alt 1**	**Alt 2**
SBA P_{KSE}	0.3 - 1.0	0	0.8	0.5
SBA Engage Range	100m - 50nm	0	50nm or 9nm	150m
SAW Sea Marshal FER	1.5, 2.0, 2.2, 2.5	2.2	2.2	2.2
SAW Engage Range	.5nm - 5nm	5	5	5
SAW Engage P_k	.5-.05	0	.25-.5	.5-.95
WMD Inspection Team Transport Speed	150kts , 46kts	0	150kts	46kts

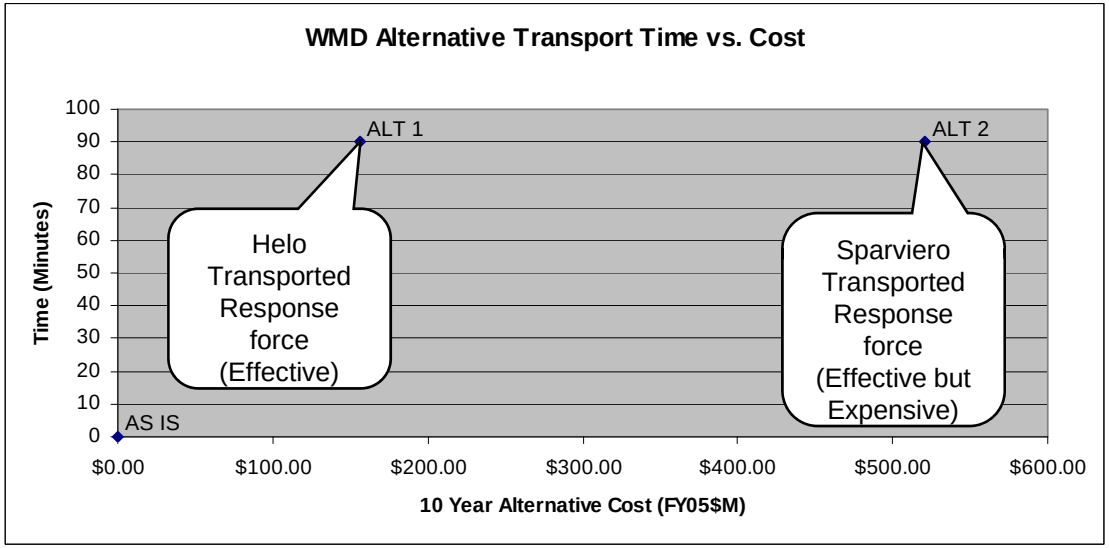
Force System Results

MOE's	'As-Is'	ALT 1	ALT 2
P(Defeat) SBA	0%	90%	95%
P(Defeat) SAW	83%	92%	83%
Time To Transport WMD	0	1.5 Hr	1.5 Hr
System Cost for SBA (FY05$M)	$0	$921	$63
System Cost for SAW (FY05$M)	$38	$292	$162
System Cost for WMD (FY05$M)	$0	$157	$521

Force Cost vs. Performance Results







Force Conclusions/Insights

SBA

- Best countered by onboard Sea Marshals with crew served weapons
- Escort of HVU Convoy produced marked improvements over patrolling

SAW

- Inport threat best countered by combination Sea Marshal / Patrol Craft
- Helicopter response force (STAR-like) shows promise if attack is detected early

WMD

- Transport inspection team by helicopter from Singapore

Questions?

- Force Group
  - LT DJ Walton, USN
  - LT Enrique Garcia, MxN
  - ENS Cory MacCumbee, USN
- Operations Analysis Track TDSI Group
  - Mr. Han Hiong Ang, SGP
  - Mr. Lawrence Liang, SGP
- Weapons Tack TDSI Group
  - Mr. Kim Hua Er, SGP
  - LT John Lukacs, USN
  - Mr. Chin Khoon Quek, SGP
  - Mr. Dinesh Raghavan, SGP
  - Mr. Yew Seng How, SGP

Backup Slides

Numerical Requirements

Number of Ships	Visual Range				76mm (9nm) - Flight Time at 960 kts = 0.25			
	Worst Case Range (nm)	Response Time at 30kts (min)	Response Time at 40kts (min)	Response Time at 50kts (min)	Worst Case Range (nm)	Response Time at 30kts (min)	Response Time at 40kts (min)	Response Time at 50kts (min)
3	47.10	94.21	70.66	56.52	43.33	86.92	65.25	52.25
4	34.02	68.04	51.03	40.82	30.25	60.75	45.63	36.55
5	26.17	52.34	39.26	31.40	22.40	45.05	33.85	27.13
13	6.85	13.69	10.27	8.22	3.08	6.40	4.87	3.94
14	5.98	11.97	8.98	7.18	2.21	4.68	3.57	2.91
15	5.24	10.47	7.86	6.28	1.47	3.18	2.45	2.01
16	4.58	9.17	6.87	5.50	0.81	1.88	1.47	1.23
17	4.01	8.01	6.01	4.81	0.24	0.72	0.60	0.53
18	3.49	6.98	5.24	4.19				
19	3.03	6.07	4.55	3.64				
20	2.62	5.24	3.93	3.14				
21	2.25	4.49	3.37	2.70				
22	1.91	3.81	2.86	2.29				
23	1.60	3.19	2.39	1.92				
24	1.31	2.62	1.97	1.57				
25	1.05	2.10	1.58	1.26				

Number of Ships	Missile (30nm) - Flight Time at 580kts = 3.1				Missile (50nm) - Flight Time at 580kts = 5.2			
	Worst Case Range (nm)	Response Time at 30kts (min)	Response Time at 40kts (min)	Response Time at 50kts (min)	Worst Case Range (nm)	Response Time at 30kts (min)	Response Time at 40kts (min)	Response Time at 50kts (min)
3	22.33	44.67	33.50	26.80	2.33	4.67	3.50	2.80
4	9.25	18.50	13.88	11.10				
5	1.40	2.80	2.10	1.68				

Project Albert

- Developed by U.S.M.C. Warfighting Laboratory
- R&D effort to develop the process and capabilities of Data Farming
- A suite of entity based models
- Designed to allow for the testing of robustness of observations across modeling platforms
- Includes MANA, Socrates, and Pythagoras models

ISAAC/EINSTein

- A multiagent-based simulation of notional combat whose dynamics is patterned after mobile cellular automata rules
- Designed for identifying, exploring, and possibly exploiting emergent collective patterns of behavior on the battlefield.

MANA Model Assumptions

- Sea Marshals are onboard before SBA attack commences
- One small boat only per SBA (No “Wolf pack” tactics)
- No P_{fa} (SBA intent is known with certainty)
- All targets designated will be within sensor range
- Over the Horizon Missile use will be allowed for TDSI Alternative
- RAM data constant
- Effect of sea state is not modeled

EXTEND Model Assumptions

- No P_{fa}
- Sea Marshals are conducting compliant boardings only
- Max Engagement Range will be defined by Singapore Port Limits
- All targets designated will be within range of response force sensors
- RAM data constant