State of the Art Observations: Maritime Information Systems

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Where are we strong...

And where are we weak?

“existence”

“context”

“reason”

“Foundation for Command”

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“Maritime activity is intentionally opaque and convoluted” ...

“Internal”
Flag
Owner
Cargo owner
Master
Crew
Agent
Insurer
Indemnity Club
Declared destination
Brief stops
Ship characteristics
...

“External”
Weather
Price of commodities
Port costs
Exchange rates
Restricted areas
High-risk passages
...

“Maritime activity is intentionally opaque and convoluted” ...
“WHY” is Complicated

Cause and Effect
“WHY” is Complicated
“WHY” is Complicated

Conceptually:

\[ F(x,y,z,...) \]

Can you solve this knowing only “x”?

* A Pooled Information Environment is absolutely
“WHY” is Complicated

Is it $F(x, y, z)$ ?

... or is it $F(x, y, z \ and \ w)$ ?

Modeling Maritime Activity is absolutely
“WHY” is Complicated

Vessels, Cargo, People, Infrastructure are not enough.

External drivers include everything that determines Profit or Loss

Commercial sector Knowledge is absolutely
How are we doing?
Existence Data - availability

• Military Systems:

Global reach and local, generally classified
Defense oriented
How are we doing?
Existence Data - availability

• Civil Systems

Shore-based, internationally *interdependent* Safety and Security oriented
How are we doing?
Existence Data - availability

• Commercial Systems

Global reach, internationally *independent*
Profit oriented
Commercial Space – A Sea Change

Shore-based AIS

Space-based AIS
How are we doing?
Existence Data – AIS and Radar

• Coastal AIS and radar

Shore-based, limited Over the Horizon capability

Courtesy of Volpe Center
How are we doing?
Existence Data – AIS and Radar

• Ships’ AIS and Radar Contact Reporting

Extends reach of shore-based systems
Engages commercial sector
How are we doing?
Existence Data – AIS and Radar

• Space-based AIS and Synthetic Aperture Radar

Global reach
Wide area, useful for search and law enforcement

Courtesy of JRC
Commercial Space
A Tool for Governance

Space-based SAR

Space-based AIS and SAR

Courtesy of TerraSAR

Sicily

Courtesy of MDA
New types of Existence Data
Wide area / High resolution optical imagery

Courtesy of DigitalGlobe
New types of Existence Data
RFID for Small Vessel Tracking

CONOPS illustration – RFID vessel info

MFK displays track data
MFK autpopulates screen with vessel info
Track data
Sensor data
Website data

SVT-RTT

RFID reader
MFK N5
LE Vessel

RFID Reader
To RFID Tag
Wireless link

Security Zone (SZ)
Homeland Security

CG-4100 Vessel info stored on RFID tag
How are we doing?
Existence Data

What’s the question? ...

which vessels should we know about?

? – undetected - ?

17% 52% 30%
How are we doing?

Information

• **Current Focus:**
  Multi-source track fusion

• **Future Understanding:**
  Associated Information, Behavior, and Network Relationships
How are we doing?
Track Fusion
SeaLink Advanced Analytics

• Authoritative global maritime ship tracking

Courtesy of ONI
How are we doing?

Associated Information

Dynamic Enterprise Integration Platform

Scale: Centralized storage and computing

Subject Matter Expertise: Centralized R&D
How are we doing?

Associated Information

Information Integration Pilot

Scale: Distributed Storage and Computing

Subject Matter Expertise: Modular Analytics
How are we doing?

Behavior

Predictive Analysis for Naval Deployment Activities

Scale: Tens of thousands of ships

Subject Matter Expertise: Learned from identified tracks
Key Enabling Technologies

Cloud storage promotes:
• Information sharing
• Huge span of available information

Cloud computing promotes:
• High volume, high speed analysis
• Machine-to-machine interagency sharing

Widget technology promotes:
• modeling with increments of knowledge
• wide engagement for developing algorithms

Attribute-based Access Control promotes:
• sharing with responsible data stewardship
How are we doing?

Knowledge

Computer Assisted Maritime Threat Evaluation System

Rules-based threat Assessment
How are we doing?

Knowledge

Government Research: Using context to update normal behavior or explain reasons for deviations: “Context-based Prioritization”

Academic Research: for example: “The complex network of global cargo ship movements”
Summary

• DATA: we’re doing well with cooperative vessels, getting better at non-cooperative vessels and related information

• INFORMATION: we’re doing well at track fusion and correlating related data with vessels

• KNOWLEDGE: we’re just beginning to develop high-speed, high-volume algorithms for sense-making
Summary

WHAT WE NEED:

• More Types of Data in a Pooled Information Environment

• Models for Maritime Activity and a Knowledge Framework

• Commercial Partners’ Knowledge
Discussion