

GLOBAL MARITIME FORUM WORKSHOP

**Maritime Data Acquisition and Sharing Technologies
International Opportunities to Enhance
Maritime Domain Awareness**

REPORT ON THE WORKSHOP

**Italian Naval Staff College
Venice, Italy
21-22 May 2014**

Maritime Data Acquisition and Sharing Technologies International Opportunities to Enhance Maritime Domain Awareness



Report on the workshop jointly sponsored by

**The National Maritime
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and

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This report summarizes the presentations of the GMF workshop as interpreted by Dr. Paul Shapiro, Chief Science and Technology Advisor, National Maritime Intelligence-Integration Office, with support from the staff of Delex Systems, Inc.

The conference adheres to a variation of the Chatham House Rules. Accordingly, beyond the points expressed in the presentations, no attributions have been included in this conference report.

EXECUTIVE SUMMARY

The Global Maritime Forum (GMF) evolved from a multi-national initiative that began in 2005, the Global Futures Forum. In May 2012, National Maritime Intelligence-Integration Office (NMIO) supported Singapore's Centre of Excellence for National Security workshop on "The Geostrategic Implications of Cyberspace" in Singapore. In September 2012, in Rome, NMIO co-sponsored, with the Italian Navy and Centro Alti Studi per la Difesa, another Global Futures Forum on the theme of "The Role of Maritime in WMD Transportation and Global Supply Chain Security." The GMF workshop continues NMIO's cooperation with Italian partners, and was coordinated with the Italian Security and Intelligence Department and Joint Intelligence Center.

This GMF workshop sought to discover opportunities to enhance Maritime Domain Awareness (MDA) through emerging technologies, in order to improve data acquisition, sharing, and analysis, while also providing strategies and recommendations to improve the Global Maritime Community of Interest (GMCOI).

The workshop attendees were encouraged to consider the linkages between data collection, data integration, and analysis to achieve a future vision of holistic or comprehensive MDA. Dedicated collaboration sessions capitalized on attendees' diversity of expertise, and formulated recommendations to integrate or advance the various emerging technologies and efforts.

The two-day analytic exchange brought together 60 participants, with presentations from government, military, academic, and business leaders from ten countries: Canada, France, Germany, Ireland, Italy, Japan, Portugal, Romania, United Kingdom, and the United States. Each day had a unique substantive focus:

Day One:

Highlighted challenges to effective MDA and available and emerging technologies for observing the maritime environment, and

Day Two:

Focused on sharing information to achieve a holistic view of the maritime domain and understanding how to access and benefit from the many sources of available data.

The workshop was organized into six panel sessions, each with associated questions:

I. Emerging National Space-based Maritime Observation Phenomenology: Capabilities and Access

What are the emerging technologies for ship detection, and how far away is real-time global coverage?

II. Emerging Commercial Space-based Maritime Observation Phenomenology: Capabilities and Access

What new capabilities are emerging from the Automatic Identification System (AIS) tracking of ship identities and other commercial efforts to provide MDA?

III. Terrestrial Maritime Data Acquisition: Terrestrial Maritime Data Acquisition and Emerging Ocean-Deployed Sensing, Detecting, Characterizing, and Reporting Capabilities

What are the new challenges regarding maritime operations and interdiction, and what are the opportunities for current and emerging ocean-deployed sensing? What is the role of crowd-sourced collection?

IV. Data Integration Technologies: Format and Timing Challenges, Geo-registration, Selective Access

What data integration efforts are underway and what gaps exist?

V. Data Analytics: Analyst Tools, Automated Correlation, and Collection Tasking

What are the latest advances in MDA analytics to fully realize the potential of data being collected, and how will these techniques scale to make sense of the increasing volume and diversity of data?

VI. Overcoming Proprietary, Political, Strategic, Legal, Language, and Interagency Barriers to Information Sharing

What are the best ways to share ship-, cargo-, and people-tracking information and to develop global collaboration across maritime centers and commercial shipping interests?

GMF workshop collaboration sessions made recommendations at the end of each day. Six groups were established, each with eight or nine members with diverse backgrounds in subject matter expertise, organizational types (government, commercial or academic), and country representation. Additionally, a group facilitator documented the discussions. These six groups generated a number of challenges, opportunities, and recommendations.

Day One Recommendations:

The working groups identified short-term and long-term gaps, recommending the following areas for focus:

- Acquire persistent and historical data to obtain patterns of life and overcome the cost-prohibitive nature of data acquisition and the difficulties of sharing due to legal concerns.
- Establish algorithms to more efficiently address “lower end” threats or predictable behaviours. Assume higher end threats will adapt to enforcement techniques.
- Emphasize the need for more dedicated space-based assets addressing maritime surveillance requirements; maritime does not currently have a dedicated “seat at the table.”
- Evaluate current practices and models to encourage reuse, lower costs, and reduce duplicative collection.
 - Make a common historical data set available to all stakeholders, including academia, to establish standard analytic techniques and findings for MDA.
 - Establish a cost-benefit model to determine “what a pound of MDA is worth.”
- Establish an MDA concept of operations for working in and sharing data layers.
- Focus on small vessels through technology and policy to better identify vessels of interest. Investigate possible deployment of small-vessel transponders with associated policy and enforcement.
- Engage end users to better develop new technologies that can become operational; overcome the “acquisition valley of death.”
- Leverage non-traditional partners for big data analytics, foster public private partnerships and determine systematic approaches to equitable information and cost sharing.

Day Two Recommendations:

The working groups followed the collaboration framework detailed by Dr. Dino Lorenzini during his keynote address identifying a top objective and steps to achieve that objective. All groups arrived at a general consensus to focus on data standardization and sharing as the most important objectives.

- Share data and work with industry to automate.
- Create a lexicon for MDA with automated routines.
- Establish a public repository of data.
- Increase data sharing with standardized formats using a technical working group to formulate those standards.

The key outcomes of the workshop include the successful sharing of technical information and activities among a diverse international set of governmental, commercial, and academic stakeholders—a set of actionable recommendations to smartly plan efforts to enhance MDA, and strong workshop content that can be shared beyond the workshop participants.

WELCOME REMARKS



Left to Right –Rear Admiral Train, Dr. Shapiro, Vice Admiral Ruzittu, Major General Caravelli

Remarks by Vice Admiral Salvatore Ruzittu, Commandant of the Italian Naval Staff College, opened the workshop. He said Venice, with its strong maritime history, capability to control the sea, and MDA, is a pivotal site for the Italian Navy, the Naval Staff College, and now this GMF workshop. Admiral Ruzittu was pleased the workshop would address future challenges, where surveillance will be improved by new technologies affecting data acquisition, analysis processing, and information sharing, and welcomed participants to enjoy Venice and its facilities.

Major General Giovanni Caravelli of the Italian Military Intelligence Department emphasized the need to enhance security by bringing people from different countries together to face the new challenges in the complex, globalized environment. He said about 80 percent of the total volume of global trade is carried by sea, with half of the world's trade value and 90 percent of the general cargo now traveling by container. Logistic supply chains have become critical to modern manufacturing and service industries. Consequently, a threat to the stability of global markets can arise from transportation of dangerous materials, opportunities for terrorist attacks, illegal immigration and human trafficking, and piracy. A flexible, agile, and comprehensive approach is needed in response, requiring intelligence with deep knowledge of the maritime environment. Major General Caravelli described the development and deployment of innovative and capable technologies to include space-based Synthetic Aperture Radar (SAR) and AIS along with software to track and discover anomalies. He said globalization makes it almost impossible for governments to deal with domestic as well as international challenges in a fast-paced world facing constant asymmetric threats. He commented that this maritime workshop was critical to the exchange of information, sharing of ideas, and generation of new

visions to deal with our new security challenges, and that he hoped the GMF would produce new interest in areas where maritime data acquisition and military intelligence come together.

Rear Admiral Elizabeth Train, Director of the U.S. NMIO, and Commander of the U.S. Office of Naval Intelligence (ONI), provided some context to the GMF and prior fora that have taken place and detailed the creation of NMIO. As tasked by the Director of National Intelligence, James Clapper, NMIO strives to develop and expand the GMCOI; improve information and intelligence sharing; and engage with governmental, academic, nongovernmental, commercial and foreign partners to understand the implications of emerging technologies. Rear Admiral Train challenged participants to “not just think about the here and now” but consider what future technologies could create—or mitigate—threats to our mutual maritime security 10 to 25 years from now. Using climate change as an example, the Admiral highlighted NMIO's successful hosting of the National Maritime Interagency Advisory Group (NIAG) to explore Arctic issues. This forum was attended by more than 90 representatives from Arctic nations and nations with interests in the Arctic, and by representatives from U.S. Federal agencies, military services, and private industry. She also emphasized the threat that maritime crime poses in various regions of the world such as the Gulf of Guinea and the Strait of Malacca including piracy; armed robbery against ships; kidnapping; oil theft; migrant smuggling; illegal, unreported and unregulated fishing; illicit dumping and severe environmental damage; and trafficking in humans, narcotics and arms. Lastly, Rear Admiral Train invited everyone to actively participate in the panel discussions and the sessions that followed.

SESSION 1: Emerging National Space-Based Maritime Observation Phenomenology: Capabilities and Access

Dr. John Mittleman, U.S. Naval Research Laboratory, chaired the first session, “Emerging National Space-Based Maritime Observation Phenomenology: Capabilities and Access”. He opened by asking, “How much do we really know about ships at sea?” Dr. Mittleman provided the results of studies comparing emissions-based detections and SAR detections. The study of the Mediterranean Sea demonstrated a common detection of 52 percent, with 17 percent unique to emissions-based detection and 30 percent unique to SAR detection. In Southern California, 60 percent detection was common, with 38 percent unique to emissions-based detection and only 2 percent unique to SAR. Lastly, in the South China Sea only 29 percent of detection was common, with 16 percent unique to emissions-based detection and 55 percent unique to SAR. Dr. Mittleman concluded that “without imagery we do not know enough about ships at sea.”

Dr. Gordon Campbell of the European Space Agency (ESA) discussed space-based maritime awareness and its possibilities. The number of SAR platforms is increasing, but all are in more or less the same orbit. Space-Based (SB-AIS) is increasingly performant, but data fusion remains non-systematic. A combination of different sensors based on elaborating “best fit” track and basic integrated surveillance is progressively operational in specific geographic regions. Dr. Campbell provided examples of key technical challenges including persistent tracking and the fusing of data at different time points. In the short term, technical satellite developments will have SAR and AIS on the same platform, high-resolution wide-swath SAR, new vessel detection mechanisms, image correlations, and new data collection and processing opportunities. In the longer term, even more vessel detection approaches will be available along with new satellite technologies such as high resolution thermal infrared (IR), high frequency SAR (Ka/Ku Band), data

relay, Electro-Optical (EO) imaging, dedicated SB-AIS channels and faster data access over remote areas. Dr. Campbell concluded that many ongoing satellite developments will ensure new maritime surveillance capabilities, but cautioned that there is a strong risk these capabilities will not be effectively integrated into an operational surveillance concept because:

- We are still not sufficiently clear on what we are offering,
- We are still unwilling to explore maximum flexibility within our space and ground segments to fully respond to user requirements, and
- We still consider what to use on an ad-hoc basis.

Colonel Andre Dupuis, the Canadian Department of National Defence and the Canadian Armed Forces, discussed the current Polar Epsilon architecture and follow-on initiatives. The Polar Epsilon architecture allows for the processing of radar images, automatic detection of ships, and the generation of tracks on the recognized maritime picture in six to eight minutes. The process is almost completely automated, with an operator confirming ship detections, which in general only takes a few seconds. This is the “magic” of the Polar Epsilon system: essentially turning space-based radar into radar with the same functionality as shore-based radar, but with global coverage. Radarsat Constellation Mission (RCM) will provide near-real time coverage, with a very high probability of detection of vessels at least 25 meters in length approaching Canada, at least once every 24 hours. In the north Atlantic, this will give approximately 6,000 tracks to be monitored and assessed. This is the information needed, but it remains a challenge to analyze and assess. The information from the Radarsats will be transmitted to the ground where the ship detection reports will populate the Recognized Maritime Picture at the maritime security operations center. In addition to the Radarsat-2 contribution to



*Left to Right –
Dr. Campbell,
Dr. Mittleman,
Dr. Lehner,
Colonel Dupuis*



Left to Right - Rear Admiral Train, Major General Caravelli, Rear Admiral Simoncini, Vice Admiral Canova

MDA, every day SB-AIS is providing 4.5 million position reports of 100,000 unique ships globally. A data stream of SB-AIS ship-position information is being fed directly to the maritime server in Halifax. An example of the significant capabilities and advancements made in global MDA, Canada will have five satellites, (one SB-Radar/Radarsat-2, and four SB-AIS) contributing daily two-thirds of all ship positions from all sensors both classified and unclassified fed to the maritime Common Operating Picture (COP) Halifax server. A web-based user interface via an Internet portal permits multiple agency and maritime government departments access to all unclassified and sharable data, in addition to the maritime COP.

Dr. Susanne Lehner, Remote Sensing Technology Institute, German Aerospace Center (DLR), presented work done by the maritime research labs in Bremen and Neustrelitz, on research and development of algorithms and services enabling maritime information products. The development of near-real-time processing systems has enabled systems engineering, operational use of research findings, processing of different sensors and modes, operational data fusion of different data source like EO data and terrestrial or SB-AIS, and dissemination systems that are based on user requirements. Dr. Lehner provided examples of X-band high-resolution SAR, TerraSAR-X, and TanDEM-X, able to deal with factors such as wind, sea state, oil, ships, bathymetry, breaking waves, land-water line, surface currents, and ice and icebergs. She also highlighted the difficulties of organizing Joint Information Systems among the United States, Canada, and Europe with competitive data providers charging for services; no joint U.S., Canadian, European funding schemes; work on maritime European Union (EU) Projects sometimes becoming subject to competition between large companies; and possible improvement of communication and data sharing between national government agencies with European institutions.

After the speakers' presentations, discussion focused on the question of whether cooperative security is enhanced by encouraging economic soundness as an important component of stability. The specific challenge the NATO/EU coalition faces is how to achieve closure in Somalia now that the level of piracy is lower than in 2006. How do you restore confidence and convince Somalia that it is a fishing area without an Exclusive Economic Zone (EEZ)?

The need for surveillance and capacity building often is an issue of cost. Nations need to build up their own resources to enhance the capacity of the state to protect itself. For example, enhancing awareness through an investment in Liberia for fisheries' transponders and fusing SAR detection with other systems would enhance MDA. It was noted that the World Bank has international programs for grants to nations emerging from conflict, and regional programs to see how all aspects of resources can be put into place.

Remote sensing alone is not enough in many cases. Governments need to know not just that illegal activity is occurring, but who is doing it. This requires a whole-of-government approach, which is what has been happening in Somalia, and remote sensing can be the baseline.

The Joint Research Center of the EU is trying to start a one-year project of surveillance off the coast of East Africa to develop ship trafficking patterns to give to Kenya and the Seychelles. It hopes to use SB-AIS data and enhance it with satellite imagery to find non-reporting ships. The frequency of satellite imagery is currently insufficient. The EU can tell Somalia what it knows is happening in Somalia's waters, but Somalia still would not have the full picture.

Another question posed during the session focused on distinguishing between cooperative and non-cooperative vessels. Recommendations included creating a multi-level architecture for MDA and understanding how to draw in the greatest number of sources, and the need to identify the small vessels first with polarimetric data. This question highlighted the need for an integrated approach of how to divide the water space. It was noted that MDA does not equate to knowing where every ship in every class is all the time. Certain kinds of targets need to be targeted by certain types of aircraft. People need to tailor requirements to capabilities, and "don't task radar satellite imagery for something it can't see."

SESSION II: Emerging Commercial Space-Based Maritime Observation Phenomenology: Capabilities and Access



Dr. Charles Holland, Office of Naval Research-Global, stationed in the Czech Republic, chaired the second session, “Emerging Commercial Space-Based Maritime Observation Phenomenology: Capabilities and Access”. Session II focused on new capabilities emerging from the AIS tracking of ship identities and other commercial efforts to provide maritime domain awareness.

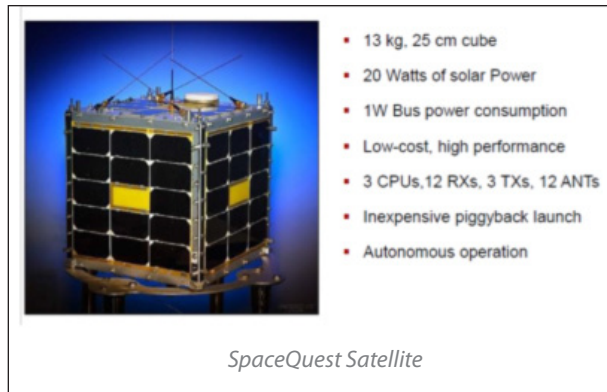
Mr. Simon Chesworth, exactEarth Ltd, presented “Deriving Intelligence from Satellite AIS for the Complete Maritime Picture.” ExactEarth’s core focus is Satellite AIS (SAT-AIS) data services for global maritime surveillance community. Operational since 2010, exactEarth provides more than 80 percent of the commercial SAT-AIS data used by navies, intelligence services, fisheries organizations, and maritime safety agencies on five continents. Mr. Chesworth discussed the additional information and intelligence that can be inferred from analyzing base AIS messages and other data sources, including:

- Data quality checks, such as verifying position and latitude and longitude;
- Events and behavior analysis, such as ship drifting, ship rendezvous, ship fishing, wave height exceeds five meters, or a ship entering an area;
- Ship identification issues, such as an invalid IMO number or changing MMSI number; and
- Message occurrence, e.g. message 14 received.

Lastly, Mr. Chesworth identified the challenges of current AIS Class B detection from space: that it is insufficient for large scale vessel numbers, and that large numbers of these devices will overwhelm the current AIS channels.

Dr. Oliver Lang, Airbus Defence and Space, presented the Airbus DS space fleet pursuit of near-real-time satellite coverage at a global scale. The company’s goal of an integrated concept of operations for earth observation and surveillance includes infrastructure integrity (oil, gas, minerals extraction facilities, pipelines, iceroads, bridges, and landslide and fire risk), maritime safety and security (off-shore operations, ship detection, ship routing, and ice charting), environmental safety (environmental assessments and planning, regulatory compliance, and local stakeholder requirements), and search and rescue support (maritime and terrestrial situational awareness, and airborne and space-borne observation assets). Dr. Lang presented the challenges for SAR: near-real-time receiving capabilities in area-of-interest and multi-mission operation facilities; the need for existing and future capabilities to be improved and integrated into the Common Information Sharing Environment (CISE); and integrating CONOPS, including Unmanned Aerial Vehicles (UAVs) and ground-based sensor technology and forces.

Dr. Dino Lorenzini, SpaceQuest Ltd, presented the operations and capabilities of SpaceQuest’s microsatellite technologies. Founded in 1994 and based in Fairfax, Virginia, SpaceQuest with 10 full-time employees has built and launched 6 AIS satellites, as well as delivered components to Canadian Space Agency (CSA), NASA, Air Force, Navy, universities and foreign customers. Each microsatellite has a 7- to 10-year mission life that is low cost and high performance with autonomous operation, store-and-forward data collection, and global AIS receivers. The satellites rely on inexpensive piggyback launches available through a



relationship with a Russian launch provider. There have been eight successful launches on Dnepr rockets, using a standard launch adapter provided by Kosmotras.

Dr. Lorenzini said likely consumers of AIS data include law enforcement agencies, intelligence services, navies, coast guards, government ministries and agencies, commercial shippers, major oil companies, and commodity traders. The maritime challenges highlighted include: smuggling, piracy, oil theft, terrorism, coastal security, trade disruption, search and rescue, fisheries violations, illegal dumping, illegal immigration, human smuggling, drug trafficking, transnational organized crime, vessel traffic monitoring, and environmental zone monitoring.

The subsequent discussion focused on the challenges of detecting small vessels and the associated technologies being considered.



It was noted that the detection of small vessels, such as dhows and canoes, is of interest in African waters. Cellphone-sized battery-operated transponders are needed because these small vessels often do not have power sources. It was questioned whether these devices would be detectable from space. In response, a few class-B devices on the market were described. Power is an issue for the VHF transmitter, but it will work with

a solar panel. Tests have shown 33cm devices can last at least five days on battery power. These devices are suited for vessels that go beyond the 12nm boundary. ORBCOMM is working with the Malaysian government to produce credit card-sized devices. The problem is that AIS requires an active, voluntary broadcast. Illicit operators are unlikely to comply.

Speakers were asked about Argos transponders, which can be used for tracking animals. Issues discussed included the need for new channels to monitor all the signals, and the prohibitive cost. Argos costs \$2,000, but if they can be produced in quantities of 1,000 or more, the cost drops to about \$1,000 each. Of note, the success of the technology solutions proposed relies on countries enforcing their use, and on persistent coverage to detect anomalies.

SESSION III: Terrestrial Maritime Data Acquisition and Emerging Ocean-Deployed Sensing, Detecting, Characterizing, and Reporting Capabilities



Left to Right – Mr. Reiter, Mr. Shields, Rear Admiral (retired) Pittenger, Mr. Leroy

Mr. Joshua Reiter, U.S. ONI, chaired the third session, “Terrestrial Maritime Data Acquisition and Emerging Ocean-Deployed Sensing, Detecting, Characterizing, and Reporting Capabilities.” Session III focused on identifying new challenges regarding maritime operations and interdiction and opportunities for current and emerging ocean-deployed sensing.

Mr. Conor Shields, Maritime Analysis and Operations Centre (Narcotics) (MAOC-N) - Head of Joint Operations Coordination Centre, Portugal, discussed MAOC-N as a European Centre of Excellence in the fight against maritime and air transport of illicit drugs. MAOC-N is a European law enforcement unit with military support that coordinates maritime and aviation intelligence, resources, and trained personnel to respond to the threat posed by transatlantic cocaine traffic. Activities to date have resulted in the seizure or jettisoning of over 83 tonnes of cocaine, over 160 tonnes of cannabis, 130 million cigarettes, and 32,000 liters of fuel. As well as EU country assets, assets from countries in source and transit zones in Latin America, the Caribbean, and West Africa have provided assistance and successful prosecutions have taken place in a number of these countries outside the EU following the operational activity. MAOC-N has a partnership with the European Space Agency (ESA) and European Maritime Safety Agency (EMSA) using the latter's integrated maritime information systems to help discriminate between the target vessels and normal traffic. MAOC-N has been working with EMSA since 2012 for the provision of AIS information, vessel tracking, previous vessel movements, movement alerts, and area based searches and queries.

Mr. Francois Leroy, Liquid Robotics, provided insight into the Wave Glider underwater sensing platform. The Wave Glider is an underwater sensor tethered to a float and powered by ocean currents. The device can be deployed in shallow coastal water from a dock, small craft, or vessels; transit to the operational site, whether coastal or far offshore; operate at sea 24/7 for periods of one year between maintenance cycles; and operate at sea in all weather. Operationally, the Wave Glider can keep station with a small and precise radius; execute simple or complex survey and monitoring patterns; work from pre-programmed missions; be remotely tasked or repurposed by an operator; and automatically adapt its behavior from pre-scripted sensor detections or other events. As host of a single sensor or a suite of coherent sensors, the device can collaborate with other assets and vessels on site, broadcast real-time data and receive updated configurations or mission parameters, provide significant computing power at sea for in-situ analysis and processing, and augment ship assets with a force multiplier fleet. Mr. Leroy provided several scenarios in which the technology is used as a force multiplier for national security under the moniker SHARC (Sensor- Hosting Autonomous Remote Craft).

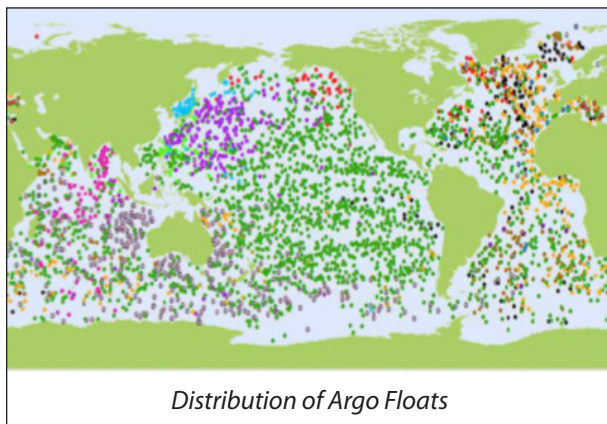
Participants asked how the Wave Glider sensor is presented or located by mariners from a safety of navigation perspective, and about the requirements for operators. The Wave Glider does have AIS data capabilities but, at the size of a surf board, is not classified as a vessel and does not pose a risk for collision. It is operated remotely by people with experience operating at sea.

Retired U.S. Navy Rear Admiral Richard Pittenger, representing the Woods Hole Oceanographic Institution (WHOI), provided an overview of ocean observing systems at the Woods Hole and their role in the Ocean Observatories Initiative (OOI). OOI is a project funded by the National Science Foundation (NSF) that uses a networked infrastructure of science-driven sensor systems to measure physical, chemical, geological and biological variables in the ocean and seafloor as well as the overlying atmosphere, providing a fully integrated system collecting data on coastal, regional and global scales. OOI puts observatories along the Northeast and West coasts of the United States and off South America, and renews them every year. The goal of the OOI is to deliver data and data products for a 25-year-plus time period within an expandable architecture that can



meet emerging technical advances in ocean science. This data will be freely accessible online through the OOI cyber-infrastructure.

Rear Admiral Pittenger also provided insight into the use of Argo floats for environmental monitoring. Argo is a system for observing temperature, salinity, and currents in the oceans. About 2600 Argo floats in the oceans are state-funded. Data from the floats are available in real time through two Argo Global Data Centers and the Global Telecommunications System (GTS).



Additionally, Rear Admiral Pittenger discussed WHOI's work in the U.S.-led Overturning in the Subpolar North Atlantic Program (OSNAP). OSNAP is an international program designed to provide a continuous record of the full-water column, trans-basin fluxes of heat, mass, and freshwater in the subpolar North Atlantic. International collaborators include scientists from Canada, the United Kingdom, Germany, France and the Netherlands.

Additional information regarding WHOI efforts is available at the following web addresses:

- O-SNAP: <http://www.whoi.edu/page.do?pid=114456>
- ARGO Floats: <http://argo.whoi.edu/>
- National Deep Submergence Facility (NDSF): <http://www.whoi.edu/main/ndsf>
- Arctic: <http://www.whoi.edu/science/PO/arcticgroup/projects.html>

Rear Admiral Pittenger also provided the following list of approved data repositories:

- National Climatic Data Center (NCDC)
- National Oceanographic Data Center (NODC)
- National Geophysical Data Center (NGDC)
- National Snow & Ice Data Center (NSIDC)
- Carbon Dioxide Information Analysis Center (CDIAC)
- Global Ocean Data Analysis Project (GLODAP)
- WHOI Data Archives/Woods Hole Open Access Server (WHOAS)
- Biological and Chemical Oceanography Data Management Office (BCO-DMO)
- CLIVAR & Carbon Hydrographic Data Office (CCHDO)
- Earth System Grid (ESG)
- Integrated Earth Data Applications (IEDA), and the Marine Geosciences Data System (MGDS)
- OceanSITES
- SeaBASS
- Global Ocean Data Assimilation Experiment (GODAE)
- National Data Buoy Center (NDBC)
- Incorporated Research Institutions for Seismology Data Management Center (IRIS DMC)
- GenBank
- Sequence Read Archive (SRA)
- WOCE Subsurface Float Data Assembly Center (WFDAC)
- Rolling Deck to Repository (R2R) cruise data catalog
- Ocean Biogeographic Information System (OBIS)

SPECIAL TOPIC: NATO Maritime Information Sharing and Maritime Situational Awareness



French Vice Admiral Christian Canova, Deputy Commander of NATO Maritime Command (MARCOM), addressed the workshop on the topic of Maritime Situational Awareness (MSA) from an intelligence perspective.

MARCOM is charged by NATO with providing command and control for the full spectrum of joint maritime operations and tasks. It plans, conducts, and supports the execution of the Operation Ocean Shield counter-piracy mission off the Horn of Africa and the Operation Active Endeavour counter-terrorism mission in the Mediterranean Sea. Central to these missions is the requirement to maintain comprehensive situational awareness throughout the maritime environment and to share that information to all nations and organizations throughout the Alliance.

For the MARCOM mission sets, the environment in which NATO operates largely defines the actors that are monitored and the patterns of life that are studied. In Ocean Shield, it is a matter of locating and following pirate action groups at sea as well as the camps from which they operate. Working with their own assigned standing NATO maritime groups, EU naval forces, Coalition maritime forces, independently deployed international counter-piracy forces, and various civilian maritime organizations, MARCOM is able to locate, identify, and track pirate action groups by widely sharing predominantly unclassified information among the deployed task groups and supporting headquarters to enable planning for operations.

In Active Endeavor, the focus is on deterring and disrupting terrorist groups at sea, largely by identifying the vessels used by terrorist groups in their exploitation of the maritime environment for the transport of personnel and weapons. MARCOM uses information largely provided by the nations that make up the Alliance to identify vessels of interest. MARCOM also substantially leverages its maritime groups at sea, using the information they collect to help build the MSA picture.

In treating MSA as a mission, MARCOM is devoted almost entirely to tracking more “historical” NATO adversaries or potential adversaries, typically meaning non-NATO state actors that pose a threat to the Alliance or are involved in operations of interest. This is achieved simply by using the classic intelligence cycle of defining requirements, collecting, evaluating and disseminating reporting.

Lastly, Admiral Canova shared the details of MSA collection, evaluation, and dissemination processes. NATO itself has few traditional intelligence collection assets that belong to the Alliance as a whole, which can be tasked as necessary. NATO remains overwhelmingly reliant upon member nations to provide the information necessary to meet MSA collection requirements. From the Atlantic to the Indian Ocean and beyond, a robust network of international partners provides NATO with inputs on military and civilian activity 24 hours a day. Just as information flows to MARCOM from multiple sources, the evaluation efforts are also often occurring across a continuum of organizations and nations. At MARCOM, dissemination occurs through the publication of regular (daily, weekly, or ad hoc) intelligence summaries, briefings, and analytical products.

KEYNOTE



The keynote speech on the second day of the workshop was given by Dr. Dino Lorenzini, CEO of SpaceQuest Ltd. Dr. Lorenzini conveyed a framework for collaboration that included relevant stakeholders and an associated process. He defined collaboration as “the willingness to

share information for a common objective to achieve a mutual benefit.” He then proceeded to broadly define the stakeholders in terms of technology (e.g., exactEarth, Orbcomm, Naval Research Laboratory, EU Joint Research Center), policy (e.g., U.S. National Oceanic and Atmospheric Administration, International Maritime Organization, International Telecommunication Union, U.S. NMIO), and operations (U.S. Naval Meteorology and Oceanography Command, U.S. Naval Warfare Systems Command, Canadian Department of National Defense). He termed collaboration to be the process of sharing within each stakeholder group. In the technology arena, collaboration would be the sharing of sensor data, analytic capabilities, system integration, social networks, or crowd sourcing. In the policy arena, collaboration would consist of jointly creating AIS mandates, regulations, security grants, legislation, politics, and sharing or access. For operations, collaboration would entail cooperative agreements, reporting, intelligence, demonstrations, field exercises, and enforcement. Dr. Lorenzini said the area of most successful collaboration would be the intersection of technology, policy, and operations.

Dr. Lorenzini defined the collaborative process for technology as beginning with data sharing, then analysis, then collaboration, that finally yields insight. Data sharing from an information type perspective includes raw and processed sensor data, demographics, historical databases, and open source intelligence. Examples of file sharing include e-mail, File Transfer Protocol (FTP), websites, Amazon Web Services, Google, and Share to Receive (Maritime Safety and Security Information System example).

Analysis encompasses big data analysis tools not limited by storage and processing power, shared access to hosting platforms, public and open source data sets, open source analytical tools, and the ability to collect, process and display results in real time. Collaboration includes activities such as conferences, workshops, technical studies, and tabletop exercises with a collaborative attitude where everyone contributes something unique, looks for mutually beneficial solutions, and leverages skills to create complete solution. Insights may consist of discovering historical trends, technical understanding, social and economic impacts, or emerging environmental threats resulting in relevant discoveries, pathways to deeper understanding, and efficient allocation of resources. To further illustrate the collaborative process, Dr. Lorenzini walked through three examples; illegal fishing (technology led), Arctic baseline (policy led), and MDA in West Africa (operations led).



In conclusion, Dr. Lorenzini discussed the value of collaboration as the “whole” becoming greater than the “sum of the parts,” expanding the overall solution space, leveraging individual skills and resources, gaining economies of scale, and building trust, understanding, and synergy. Lastly, “...all must be willing to give, to get.” The collaboration roadmap starts with an overall framework, gets all the relevant stakeholders involved, tackles the most pressing problems, and implements collaboration.

SESSION IV: Data Integration Technologies: Format and Timing Challenges, Geo-registration, Selective Access



*Left to Right –
Commander Marras,
Dr. Shapiro, Mr.
Fitzpatrick, Mr. Best*

Dr. Paul Shapiro, NMIO, chaired the fourth session, “Data Integration Technologies: Format and Timing Challenges, Geo-registration, Selective Access.” Session IV focused on what data integration efforts are underway and identifying relevant gaps.

Mr. Rory Fitzpatrick, National Space Centre, Ireland, discussed the National Space Centre (NSC), Elfordstown Earth Station, and current collaboration efforts. Current NSC research projects include collaboration with the European Space Agency on Satellite Meteorology for SAR (METSAR), Atlantic Maritime Surveillance (ANASTIAMO), Anti-Spoofing Positional verification (ASTAR), and Regional Maritime Domain Awareness (NGRMP). Efforts to support EU projects (EC/FP7/H2020) include Immigration Control (SAGRES) and GroWave (Global Navigation Satellite System Seastate Analysis). Additionally, the NSC is working with Canada on “LOOK NORTH” Maritime Traffic Monitoring, UK Catapult data sharing, and Russia’s Skolkovo-Telemedicine. Mr. Fitzpatrick provided insight to the integration of maritime domain space data sources to include SAR, GNSS, Sat- Mobile, SB-AIS, infrared satellite, visible spectrum satellite, and meteorological data. Examples of terrestrial data sources considered include long-range identification and tracking (LRIT), mobile communications, closed-circuit television, social media and crowd sourcing, and mainstream media. Challenges posited by Mr. Fitzpatrick included cost and value, security management, time critical services, commercial conflicts, and data fusion demands.

Additional insights provided by Mr. Fitzpatrick on data integration highlighted the challenges of a private company supporting a non-NATO country. The Irish government wants to develop MDA because Ireland

extends well into the North Atlantic and therefore ice is a big issue. The Irish Navy only has eight ships and an expansive coastline.

Mr. Fitzpatrick said the Italian Navy has intelligence with extra tools that, like a pair of binoculars, enable them to see a bit better than they can without them. He said rapid adaptation is crucial, because European governments are in a war of attrition against drug lords and antagonists who adapt quickly, and governments need to do the same.

Mr. Fitzpatrick said integration also is crucial: “We tend to think of terrestrial as separate from maritime, but they’re integrated. We need assets from the ground out to sea to see the full range of activity.”

Mr. George Best, ORBCOMM, discussed the current state of AIS usage and options for achieving comprehensive MDA. For example, he said, Iceland uses AIS to track fishermen. “They told us it’s a huge degradation to their society if a fisherman is lost.” He described the European Space Agency MARitime Security Service (MARISS) project and its goal to demonstrate the usefulness and value of incorporating information coming from Earth observation satellites into more traditional information to have better control of sea borders and emergency situations. Mr. Best also stressed the need to correlate AIS data with other data sources such as LRIT from international databases.

Mr. Best also walked through the following array of technologies that, when integrated, provide a thorough picture of the maritime domain:

- Vessel Traffic Management and Information Systems



- Port and Coastal Surveillance Systems
- Terrestrial AIS
- Space-based AIS
- LRIT
- Over the Horizon Radars
- Underwater Protection Systems
- Global Maritime Distress and Safety System (GMDSS)
- Management Information Systems
- CCTV, sonars and other sensors
- Maritime Training aids
- Precision Navigation Systems
- Aids To Navigation (ATON)

Commander Francesco Marras, Plans and Operations Department, Command in Chief of the Italian Fleet (CINCPNAV), discussed international and interagency cooperation on MDA through monitoring and surveillance systems and presence at sea in conducting surveillance operations. Commander Marras discussed how integrated maritime surveillance incorporates shipping data exchange, Navy sensors, intelligence, and data sharing and matching. The Virtual Regional Maritime Traffic Center (V-RMTC) serves the wider Mediterranean community with the Trans-Regional Maritime Network (T-RMN) composed of 28 countries and the '5+5' net (Algeria, France, Italy, Malta, Morocco, Mauritania, Portugal, Spain, Tunisia, and Libya). Lastly, Commander Marras explained information flow and associated data sources used to achieve maritime situational awareness including military sources, coastal radar, LRIT, VMS, MARSUR, intelligence, and customs police data. The multi-layered approach to integrated maritime surveillance for maritime trade equates to an "organic function" performed by CINCPNAV.

SESSION V: Data Analytics: Analyst Tools, Automated Correlation, and Collection Tasking



Left to right –Mr. Palmer, Dr. Greidanus, Ms. Bryan, Mr. Stastny

Dr. Harm Greidanus, European Commission-Joint Research Centre, chaired the fifth session, “Data Analytics: Analyst Tools, Automated Correlation, and Collection Tasking.” Session V focused on how the latest advances in MDA analytics can exploit the potential of data being collected and on scaling these techniques to effectively use the increasing volume and diversity of data. Dr. Greidanus introduced the session with an overview of the PMAR (Piracy, Maritime Awareness & Risks) project focused on the Horn of Africa and Gulf of Guinea. As an EU-funded initiative, the project incorporated data sources from a vast number of international sources (European Space Agency, European Maritime Safety Agency, German Aerospace Center, U.S. Navy, U.S. Department of Transportation, NATO Centre for Maritime Research and Experimentation, Norwegian Defence Research Establishment, NCA, ASI, Astrium) and commercial satellite providers (exactEarth, Orbcomm, LuxSpace, SpaceQuest, MDA). For the Gulf of Guinea, data from 8 satellites yielded 7.7 million ship positions for the month of January 2013. For the Horn of Africa, data from 6 satellites yielded 2.2 million ship positions during January 2012. Dr. Greidanus demonstrated the effects of multiple data sources on the gap of time between ship messages captured.

Mr. Neil Palmer, Defence Science & Technology Laboratory, UK, briefly explained the complex maritime domain and its importance to our way of

life and economy. Focusing on data analytics, Mr. Palmer stressed the need to analyze data to make it useful, rather than just collecting dots on a screen. He said that only prior knowledge lets governments know which vessels pose a threat, considering the diversity of maritime tasks government is faced with. Consequently, they remain reactive in identifying risks. In order for governments to be proactive, they need to look at other methods of understanding what vessels are actually doing, be it illegal fishing or Maritime Counter Terrorism. The UK NMIC was stood up as a result of direction by government through the UK National Security Strategy and Strategic Defence and Security Review to enable exploitation and analysis of cross government and department information. Mr. Palmer discussed the development of a Maritime Event Tracking & Information System (METIS) fusing seven data sources, geographic information system (GIS), and user layers accessible via thin clients and a multi-touch 70” interactive table.

Mr. Palmer walked through the following MDA analytic requirements:

- Quickly sift through large amounts of data;
- Identify and alert on Vessels of Interest (VOI);
- Link contextual information with geo-positional data;
- Understand intent and associate level of risk; and
- Recognize vessels’ operating patterns (fishing, sailing, known transit routes, etc.)

He then laid out the following analytic challenges:

- Analytics often favors data visualization to communicate insight;
- Within government it is not always possible to bring all information together in one system;
- Technology is available, but policy and legislation can hinder;
- Utilize commercial, off-the-shelf capabilities; and
- It is important to build close relationships with the shipping industry.

Ms. Karna Bryan, NATO Centre for Maritime Research and Experimentation (CMRE), discussed CMRE's activities in support of data analytics for Maritime Situational Awareness. She described the economic environment, with 90 percent of global trade transported by sea, and the maritime security environment. Ms. Bryan also discussed the changing landscape of research to include collaboration and multi-disciplinary research, which has led to the solving of more complex questions by gathering perspectives from many fields and often with shared infrastructure. Industry gets more involved in research, including IBM Watson, Science@Microsoft, and the Google Engine.

Referencing "data-driven science," Ms. Bryan discussed Traffic Route Extraction and Anomaly Detection (TREAD) and its ability to extract traffic patterns without contextual information. She used an example of TREAD analysis on Brest harbor to illustrate the concept. The Collaborative Multi-Sensor/Source Fusion and Tracking (CoMSSoFT) aims to describe the fusion and tracking process to effectively "open the black box." She discussed Interoperability testing with regards to Coalition Warrior Interoperability eXploration, eXperimentation and eXamination eXercise (CWIX), where "Fusion as a Service (FaaS)" capability participates in NATO interoperability exercises. Data-driven sensor performance estimation was discussed in terms of new computational advancements that enabled Bayesian approaches to provide a real-time sensor network performance capability. This approach can be applied to understand current surveillance gaps, the value of additional data sources, and provide context for vessel AIS reporting issues.

Noting the EU CISE and NATO's Connected Forces Initiative (CFI), Ms. Bryan posited that the greatest technical challenge for global MSA is the implementation of Federated Information Environments enabling effective information sharing.

Mr. John Stastny, U.S. Navy's Space and Naval Warfare Systems Center Pacific, discussed improving the COP



with additional analysis tools and data, working toward regional operations centers and information sharing, and focusing on interagency partnerships among civilian and military agencies to improve information exchange and efficiency locally.

He focused on two specific MDA challenges in Ghana: canoe detection and tracking using radar corner reflectors, and commercial SAR, and industrial fishing fleet (trawlers) tracking using terrestrial AIS and SB-AIS. In support of U.S. Commander Naval Forces-Africa, he worked with partners to integrate coastal radar vessel tracks into a COP called SeaVision, and he developed and tested a correlation tool to fuse with other track data allowing both regional sharing of coastal radar data and the ability to quickly identify vessels without AIS. This provided key information about the location of unknown vessels, e.g., possible illegal, unreported and unregulated (IUU) fishing vessels.

Mr. Stastny discussed the value of the tool for multiple agencies within nations, as well as for regional and global coalition partners, to share data and information and view common maritime threats. The work toward regional MDA and partnerships relies on what is already in the operating environment. For example, the recently signed Gulf of Guinea (GoG) Code of Conduct governs how countries along the Gulf can interact within each other's territorial waters.

The referenced GoG Code of Conduct is available on the International Maritime Organization (IMO) website at the following web address:

<http://www.imo.org/OurWork/Security/WestAfrica/Pages/Code-of-Conduct-against-illicit-maritime-activity.aspx>



The current and future developments detailed by Mr. Stastny include automated vessel movement prediction and anomaly detection, integration of additional satellite imagery derived products and analysis (i.e., oil slicks), automated alerting, and an operations planning capability.

The discussion following the speakers' session focused on the challenges of understanding operator requirements and building a foundation or baseline for vessel behavior. It was noted that the majority of vessels are moving innocently, but some may have drugs onboard with knowledge of the crew. But the crew is not always aware, especially on huge container ships with many compartments. There is a need for intelligence to notify authorities in such cases. Additionally, there is a need to build relationships with industry to communicate requirements. Regarding common mathematical functions for maritime activities, there was general agreement that mainstreaming these functions would help to provide a baseline of vessel behavior. The research community should be able to advance this common understanding using the available literature and publishing through currently accepted journals. Achievement of this goal requires a good understanding of requirements and discussions with experts in relevant fields to provide a solid foundation.

SESSION VI: Overcoming Proprietary, Political, Strategic, Legal, Language, and Interagency Barriers to Information Sharing



Left to Right – Captain Vizzini, Commander Lardizzone, Mr. Bergeron, Mr. Watson

Captain Gianfrano Vizzini, Italian Navy, chaired the sixth session, “Overcoming Proprietary, Political, Strategic, Legal, Language, and Interagency Barriers to Information Sharing.” Session VI focused on the best ways to share ship, cargo, and people tracking information, and to develop global collaboration across maritime centers and commercial shipping interests.

Commander Alessandro Lardizzone, Commander in Chief of the Italian Naval Squadron (CINCNV), presented the principles, characteristics and developments of the System for Interagency Integrated Maritime Surveillance (SIIMS) project. Terrorism, piracy and other illegal activities at sea compelled the Italian Prime Minister to look for technological tools to provide better safety at sea. In 2009, an operational requirement was issued to allow participants to have situational awareness on vessels transiting to and from Italy. Each stakeholder collects its own data and contributes to creation of an integrated maritime picture that is shared with all participants.

The SIIMS project seeks to gain understanding of main naval and maritime traffic to combat and prevent illicit maritime activities in defense of national interests, and also to ensure security against possible threats from the sea, especially those of an asymmetric nature. The goals include rationalizing and optimizing public spending, achieving a synergy among all authorities (civil and military) both nationally and internationally, and harmonizing and boosting the operational capabilities of each organization involved without affecting the core

responsibilities. SIIMS provides the ability to aggregate and share any information generated by any agency or partner in order to avoid duplication of functions.

The collaborative environment presented by CDR Lardizzone included seven organizations and nine data sources. Notably, the achievement of SIIMS does not involve any alteration of the institutional responsibilities of each agency or department. It does not change the relative relationships within the command and control of forces or the specific institutional prerogatives. Lastly, Commander Lardizzone discussed the operations of the Integrated Interagency Maritime Surveillance Centre and specific software features of SIIMS.

CINCNV houses a naval operations center for this project, accommodating up to 21 liaisons. Compiling aggregated information in layers allows common data sharing with EU partners and enables European MDA.

Mr. Scott Bergeron, The Liberian Registry (LISCR, LLC), presented an overview of the maritime industry. He described the international nature of a typical ship scenario and the composition of the world fleet and associated operations of close to 50,000 ships. Mr. Bergeron provided statistics on the top 10 world merchant fleets by country of owner and country of registry. He discussed the nature of shippers and charters in terms of operating the vessels, vessel costs, and the types of shippers, charters, and voyages. He then described the composition of crews in terms of country of origin. The Philippines, India, and China are the largest providers of crews.

Traditional shipping companies were family-owned with three to five people ashore for every ship at sea. In a move away from the traditional methods, shipping ownership is shifting to public or private equity, with more internationalized cross-border financial arrangements. Shippers and charterers have commercial responsibility for directing the ships where to go, but many times, the crew does not even know what the ship is carrying.

As the CEO of The Liberian Registry, Mr. Bergeron provided his insight into the functions and responsibilities of a registry to include the following:

- Registrar
- Public Record

- Recordation of Liens
- Certification/Identity
- Operational Oversight
- Technical – Construction & Equipment Conformity
- Safety/Pollution Prevention – Inspections, Audits, Manning Levels, Procedures
- Security – Equipment, Procedures, Security Levels
- Investigation of Casualties
- Seafarer Certification
- Identification/Fraud Detection and Prevention
- Competency
- Medical Fitness
- Employment Conditions
- Policy Development

Lastly, Mr. Bergeron provided insight into regulatory bodies with an emphasis on the safety of human life, protection of environment, security, welfare of seafarers, and the protection of ship and cargo.

Mr. Will Watson, Maritime Security Council (MSC), focused on threats to commercial shipping, intelligence, and information sharing. The threats outlined by Mr. Watson included: piracy (Somali, Gulf of Guinea, Malacca, etc.), kidnapping and hostage ransom, crime (at sea, anchorage, in port), smuggling (human, drugs, arms), stowaways, terrorism, and acts of war. He detailed industry organizations involved in security and intelligence including:

- BIMCO (Vessel owners)
- Maritime Security Council
- International Chamber Of Commerce (ICC) – International Maritime Bureau
- Chambers of Shipping
- Regional Port Groups (American Association of Port Authorities, etc.)
- Sector Groups (Cruise Lines International Association, InterTanko, InterCargo, etc.)
- Trade Unions (International Transport Workers' Federation (ITF), Masters, Seafarers, Longshoremen)

There is a constant exchange of information among ships, regulatory bodies, militaries, and intelligence agencies. Shipping is traditionally competitive and companies closely guard what it considers proprietary data. Unfortunately, reporting incidents can cause the Coast Guard or law enforcement to deem ships "risky," costing time and money due to inspections, delays or investigations.

Lastly, Mr. Watson discussed the role of Information Sharing & Analysis Centers (ISAC) within industry. The Maritime ISAC brings together partners from various sectors within the commercial maritime sector: vessel

owners and operators, port and terminal operators, offshore operators, agents, lawyers, unions, chandlers, pilots and area Maritime Security Committee members.

In this model, representatives from the shipping community work with government to exchange intelligence and information. The crew notifies an ISAC (instead of government) that there is an incident, without mentioning the specific ship name, to protect the ship from distress with delays and fines. The ISAC as an intermediary then notifies the government. The MSC wants to increase this give-and-take between government and civilian organizations.



During the subsequent discussion, it was noted that a consolidated report of threats suitable for public release would be beneficial. Consequently, it was mentioned that U.S. ONI publishes the *World Wide Threat to Shipping* report through an NGA webpage.

The ONI report can be found at the following NGA web address for maritime safety information: <http://msi.nga.mil/NGAPortal/MSI.portal>.

RECOMMENDATIONS

GMF workshop collaboration sessions made recommendations at the end of each day. Six groups were established, each with eight or nine members with diverse backgrounds in subject matter expertise, organizational types (government, commercial or academic), and country representation. Additionally, a facilitator was assigned to each group to document the discussions. These six groups generated a number of challenges, opportunities, and recommendations.

Day One Recommendations:

The working groups identified short-term and long-term gaps, recommending the following areas for focus:

- Acquire persistent and historical data to obtain patterns of life and overcome the cost-prohibitive nature of data acquisition and the difficulties of sharing due to legal concerns.
- Establish algorithms to more efficiently address “lower end” threats or predictable behaviours. Assume higher end threats will adapt to enforcement techniques.
- Emphasize the need for more dedicated space-based assets answering to maritime surveillance requirements; maritime does not currently have a dedicated “seat at the table.”
- Evaluate current practices and models to encourage reuse, lower costs, and reduce duplicative collection.
- Make a common historical data set available to all stakeholders, including academia, to establish standard analytic techniques and findings for MDA.
- Establish a cost-benefit model to determine “what a pound of MDA is worth.”
- Establish an MDA concept of operations for working in and sharing data layers.
- Focus on small vessels through technology and policy to better identify vessels of interest. Investigate possible deployment of small-vessel transponders with associated policy and enforcement.
- Engage end users to better develop new technologies that can become operational; overcome the “acquisition valley of death”.
- Leverage non-traditional partners for big data analytics, foster public private partnerships and determine systematic approaches to equitable information and cost sharing.



Day Two Recommendations:

The working groups followed the collaboration framework detailed by Dr. Dino Lorenzini during his keynote address identifying a top objective and steps to achieve that objective. All of the groups arrived at a general consensus to focus on data standardization and sharing as the most important objectives.

- Share data and work with industry to automate.
- Create a lexicon for MDA with automated routines.
- Establish a public repository of data.
- Increase data sharing with standardized formats using a technical working group to formulate those standards.

AGENDA

Maritime Data Acquisition and Sharing Technologies International Opportunities to Enhance Maritime Domain Awareness

**Venice, Italy
May 21–22, 2014**

This workshop seeks to discover opportunities to enhance maritime domain awareness (MDA) through emerging technologies to improve data acquisition, sharing, and analysis while also providing strategies and recommendations to improve the global maritime community of interest (GMCOI). Day One presentations will highlight challenges to effective MDA and available and emerging technologies for observing the maritime environment. Day Two will focus on sharing information to achieve a holistic view of the maritime domain and understanding how to access and benefit from the many sources of available data.

Our panels will address the following questions:

1. What are the emerging technologies for ship detection and how far away is real-time global coverage?
2. What new capabilities are emerging from the Automatic Identification System (AIS) tracking of ship identities and other commercial efforts to provide maritime domain awareness?
3. What are the new challenges regarding maritime operations and interdiction and what are the opportunities for current and emerging ocean-deployed sensing? What is the role of crowd-sourced collection?
4. What data integration efforts are underway and what are the gaps?
5. What are the latest advances in MDA analytics to fully realize the potential of data being collected and how will these techniques scale to make sense of the increasing volume and diversity of data?
6. What are the best ways to share Ship, Cargo, and People tracking information, and to develop global collaboration across maritime centers and commercial shipping interests?

In general, the workshop attendees are encouraged throughout all the sessions to consider the linkages between data collection, data integration, and analysis to achieve a future vision of holistic or comprehensive MDA. Dedicated collaboration sessions are allocated to bring together the diversity of expertise and to formulate recommendations to integrate or progress the various emerging technologies and efforts.

Agenda

Pre-Workshop Social

Tuesday, 20 May	
Time	Event
1930–2100	Social at Italian Navy Officer Club hosted by Marina Militare (fee)

Day 1

Wednesday, 21 May	
Time	Event
0800–0830	Registration
0830–0845	Welcome Remarks Dr. Paul Shapiro, Science and Technology Advisor, National Maritime Intelligence-Integration Office
0845–0930	Welcome Address Vice Admiral Salvatore Ruzittu Commander, Italian Navy Naval Staff College Opening Remarks Major General Giovanni Caravelli Chief, Italian Military Intelligence Department Opening Remarks Rear Admiral Elizabeth Train Director, National Maritime Intelligence-Integration Office, Commander, Office of Naval Intelligence
0930–1100	Session 1: Emerging National Space-based Maritime Observation Phenomenology: Capabilities and Access Question 1: What are the emerging technologies for ship detection and how far away is real-time global coverage? Chair: Dr. John Mittleman, Naval Research Lab Speaker 1: Dr. Gordon Campbell, European Space Agency Speaker 2: Colonel Andre Dupuis, The Department of National Defence and the Canadian Armed Forces Speaker 3: Dr. Susanne Lehner, Remote Sensing Technology Institute, German Aerospace Center (DLR)
1100–1115	Coffee Break

Agenda

Wednesday, 21 May (cont.)	
Time	Event
1115–1245	<p>Session II: Emerging Commercial Space-based Maritime Observation Phenomenology: Capabilities and Access</p> <p>Question 2: What new capabilities are emerging from the Automatic Identification System (AIS) tracking of ship identities and other commercial efforts to provide maritime domain awareness?</p> <p>Chair: Dr. Charles Holland, Office of Naval Research-Global, Czech Republic Speaker 4: Mr. Simon Chesworth, exactEarth Ltd Speaker 5: Dr. Oliver Lang, Airbus Defence and Space Speaker 6: Dr. Dino Lorenzini, SpaceQuest Ltd</p>
1245–1300	Workshop Photo: Naval Staff College Entrance
1300–1400	Lunch: Italian Navy Officer Club
1415–1545	<p>Session III: Terrestrial Maritime Data Acquisition and Emerging Ocean-deployed Sensing, Detecting, Characterizing, and Reporting Capabilities</p> <p>Question 3: What are the new challenges regarding maritime operations and interdiction and what are the opportunities for current and emerging ocean-deployed sensing? What is the role of crowd-sourced collection?</p> <p>Chair: Mr. Joshua Reiter, Office of Naval Intelligence Speaker 7: Mr. Conor Shields, Maritime Analysis and Operations Centre (Narcotics)-Joint Operations Coordination Centre Portugal Speaker 8: Mr. Francois Leroy, Liquid Robotics Speaker 9: Rear Admiral Richard Pittenger (Ret.), Woods Hole Oceanographic Institution</p>
1545–1600	Coffee Break
1600–1700	Parallel Collaboration Sessions for Day One Topics
1700–1715	<p>Special Topic: NATO Maritime Information Sharing and Maritime Situational Awareness Vice Admiral Christian Canova NATO Maritime Command</p>
1715–1730	Wrap up and Adjourn

Agenda

Day 2

Thursday, 22 May	
Time	Event
0815–0830	Administrative Remarks and Recap
0830–0900	Keynote Dr. Dino Lorenzini, SpaceQuest Ltd
0900–1030	<p><u>Session IV: Data Integration Technologies: Format and Timing Challenges, Geo-registration, Selective Access</u></p> <p>Question 4: What data integration efforts are underway and what are the gaps?</p> <p>Chair: Dr. Paul Shapiro, National Maritime Intelligence–Integration Office</p> <p>Speaker 10: Mr. Rory Fitzpatrick, National Space Centre, Ireland</p> <p>Speaker 11: Mr. George Best, ORBCOMM</p> <p>Speaker 12: Commander Francesco Marras, N3 Division, Italian Fleet Command</p>
1030–1045	Coffee Break
1045–1200	<p><u>Session V: Data Analytics: Analyst Tools, Automated Correlation, and Collection Tasking</u></p> <p>Question 5: What are the latest advances in MDA analytics to fully realize the potential of data being collected and how will these techniques scale to make sense of the increasing volume and diversity of data?</p> <p>Chair: Dr. Harm Greidanus, European Commission– Joint Research Centre</p> <p>Speaker 13: Mr. Neil Palmer, Defence Science & Technology Laboratory, UK</p> <p>Speaker 14: Ms. Karna Bryan, NATO Undersea Research Centre</p> <p>Speaker 15: Mr. John Stastny, Space and Naval Warfare Systems Center Pacific</p>
1200–1300	Lunch

Agenda

Thursday, 22 May (cont.)	
Time	Event
1300–1415	<p>Session VI: Overcoming Proprietary, Political, Strategic, Legal, Language, and Interagency Barriers to Information Sharing</p> <p>Question 6: What are the best ways to share Ship, Cargo, and People tracking information, and to develop global collaboration across maritime centers and commercial shipping interests?</p> <p>Chair: Captain Gianfrano Vizzini, ITN Speaker 16: Commander Alessandro Lardizzone, N3 Division, Italian Fleet Command Speaker 17: Mr. Scott Bergeron, LISCR, LLC Speaker 18: Mr. Will Watson, Maritime Security Council</p>
1415–1430	Break
1430–1530	Parallel Collaboration Sessions for Day Two Topics
1530–1545	Break
1545–1645	Roundtable Overall - Takeaways
1645–1700	Closing Remarks

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ABBREVIATIONS

AIS	Automatic Identification System
CISE	Common Information Sharing Environment
CSA	Canadian Space Agency
CMRE	Centre for Maritime Research and Experimentation
COP	Common Operating Picture
EEZ	Exclusive Economic Zone
EO	Electro-Optical
ESA	European Space Agency
EU	European Union
GIS	Geographic Information System
GMCOI	Global Maritime Community of Interest
GoG	Gulf of Guinea
IMO	International Maritime Organization
ONI	U.S. Office of Naval Intelligence
ISAC	Information Sharing & Analysis Centers
LRIT	Long-Range Identification and Tracking
MARISS	MARitime Security Service
MDA	Maritime Domain Awareness
MMSI	Maritime Mobile Service Identity
MSA	Maritime Situational Awareness
MSC	Maritime Security Council
NMIO	National Maritime Intelligence-Integration Office
NSC	National Space Centre
OOI	Ocean Observatories Initiative
OSNAP	Overturning in the Subpolar North Atlantic Program
RCM	Radarsat Constellation Mission
SAR	Synthetic Aperture Radar
SB	Space-Based
UAVs	Unmanned Aerial Vehicles
VMS	Vessel Monitoring System



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The Reparto Informazioni e Sicurezza (Security and Intelligence Military Department) and its intelligence branch the “Joint Intelligence Center”, serves at the joint level in Italian Defense Services, performing military intelligence activities, through collection and analysis on foreign enemy forces, carried out by personnel operating under the authority of the Joint Chief of Staff.



The U.S. National Maritime Intelligence-Integration Office (NMIO) supports the Director of National Intelligence and the National Security Council Staff by coordinating and integrating the U.S. Intelligence Community’s perspective on maritime issues. NMIO leverages its deep and varied expertise to solve problems and build collaboration among the Global Maritime Community of Interest by breaking down barriers to intelligence integration and information sharing.



The Istituto di Studi Militari Marittimi (Naval Staff College) is an educational institution of the Italian Navy, conducting leadership and professional ethics training and education to support the ability of the future Navy’s Commanders to function effectively both as operational commanders and staff-level officers. The future Navy Leaders are operationally and strategically minded, critical thinkers, proficient in maritime strategies matters, and skilled naval officers prepared to meet the operational environment and strategic challenges of today and tomorrow.

