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Maritime Domain Awareness: Process Reengineering

Hutchins, S.; Gallup, S.; MacKinnon, D.; Miller, S.; Freeman J.

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14th ICCRTS: C2 and Agility

Maritime Domain Awareness: Assessment of Current Status

Topics: Topic 1: C2 Concepts, Theory, and Policy

Susan G. Hutchins,[1] Douglas J. MacKinnon,[1] Jared Freeman,[2] and Shelley P. Gallup[1]

[1]Naval Postgraduate School, Monterey, CA
[2]Aptima, Inc., Woburn, MA

POC: Susan G. Hutchins
Graduate School of Operational and Information Sciences
Naval Postgraduate School
1411 Cunningham Rd.
Monterey, CA 93943
831.656.3768
shutchins@nps.edu

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Maritime Domain Awareness: Assessment of Current Status

Abstract

Maritime Domain Awareness (MDA) is viewed as predominately a security issue, however the economic ramifications of an attack against a high-value target such as a container vessel, cruise ship, or petro-chemical facility elevate the problem from a national level to cause for global concern (Allen, 2008). A significant attack could cause the port to shut down and spread anxiety throughout the global marketplace. To mitigate the danger posed by maritime vessels, the United States (US) Navy, Coast Guard, and law enforcement agencies need greater maritime domain awareness, appropriate legal agreements, and partnerships. A large effort is underway to develop technologies to help maintain MDA, legal arrangements for sharing information, and guidance for military and law enforcement personnel on procedures to deal with this multi-faceted problem. In this paper, we report on the progress made in 2008 to improve the effectiveness of systems provided to the warfighter in MDA missions (including Coast Guard, law enforcement, and other agencies). In line with the theme for this year's symposium – command and control (C2) and agility – the maritime threat environment is a complex problem with multiple variables and requires a number of agile solutions.

Introduction

Maritime Domain Awareness (MDA) is a National Security concept that relies on the aggregate capabilities of multiple government agencies such as the Department of Defense (DoD) and Department of Homeland Security, as well as other federal, state, and local agencies to achieve comprehensive situational awareness of any threat associated with the maritime domain. The National Plan to Achieve Maritime Domain Awareness (Department of the Navy, 2005) defines the maritime domain as "all areas and things on, under, relating to, adjacent to, or bordering on a sea, ocean, or other navigable waterway, including all maritime-related activities, infrastructure, people, cargo, and vessels and other conveyances." Moreover, the National Plan identifies nation-state, terrorist, transnational criminal and piracy, and environmental and social threats within the maritime domain. In order to address these threats, the National Plan requires the capability to: (a) persistently monitor, in the global maritime domain, vessels and craft, cargo, vessel crews and passengers, in all identified maritime situation awareness areas of interest; (b) access and maintain data on vessels, facilities, and infrastructure; (c) collect, fuse, analyze, and disseminate information to decision makers to facilitate effective understanding; and, (d) access, develop and maintain data on MDA-related mission performance.

The DoD, following guidance set forth in the National Concept of Operations for MDA, developed the Fleet Concept of Operations for Maritime Domain Awareness (Department of the Navy, 2009) and the Navy MDA Concept (Department of the Navy, 2007), which describe the Fleet role in MDA and how Fleet commanders will develop and maintain MDA to accomplish Navy missions across the full Range of Military Operations. These and other publications provide a foundation for developing interagency and agency-specific policies, processes, procedures, and organizational relationships to align activities that contribute to achieving MDA throughout the Global Maritime Community of Interest. The U.S. Navy has the responsibility to develop a comprehensive, worldwide MDA capability. The Deputy Under Secretary of the Navy has appointed the Naval Postgraduate School (NPS) to assess the overall capabilities and needs

of MDA. In this paper we report on the progress made in 2008 to improve the effectiveness of the warfighter (including Coast Guard, law enforcement, and other agencies) in MDA missions.

This effort focused primarily on the set of MDA systems that the Program Executive Office (PEO), Command, Control, Computers, Communications, and Intelligence (C4I) has designated Spiral-1. Our assessment is based on data from numerous tests, experiments, and studies of MDA systems directed by PEO C4I and conducted by Operational Test & Evaluation Force (OPTEVFOR) or by NPS. Specifically, we have aggregated and analyzed data from observations, surveys, chat logs, and interviews from six experimental and empirical exercises where operators used MDA Spiral-1 technologies, and from other events in which those technologies were discussed by operational personnel. We applied a comprehensive assessment structure and methodology (Schacher, & Freeman, 2008) that was developed and validated in the Trident Warrior series of exercises that began in 2002. The assessment structure was customized to MDA, and it can be used throughout the MDA program to evaluate technologies, organizations, processes and other enabling components of the MDA solution. Our findings and recommendations are presented using this structure.

Background

This objective for this NPS effort was to: (1) Refine a project plan that provides a concept of operations (CONOP) around the core operational threads (e.g., standard work flows, or "business practices") to be then further used for operational field experimentation in Trident Warrior 08; (2) Specify measures and metrics related to decision making and the continued evolution of MDA system elements that will impact the Global War On Terror, and are also consistent with the DoD, Joint Capabilities Integration and Development System (JCIDS) experimentation and acquisition program needs; (3) Integrate efforts across MDA working groups, brought together in operational testing venues, under a consistent experiment design process that will also include standard metrics developed for MDA analysis of capabilities to ultimately assess Spiral-1 capabilities against fleet requirements.

Accordingly, this effort: (1) defined the current MDA workflow that new systems must support and how these new technologies will impact the current MDA workflow; (2) defines a measurement and assessment framework for evaluating MDA systems (technological, procedural, and organizational); and, (3) applies this framework in an assessment of MDA systems.

In 2007 the Secretary of the Navy directed the fielding of a prototype MDA capability by August 2008, and established a Cross Functional Team (CFT) to oversee the effort. Spiral-1 will: (a) Provide a capability to the U.S. Central Command (CENTCOM) and U.S. Pacific Command (PACOM) areas of responsibility (AORs), interagency partners, and select friendly and allied nations. (b) Create a network that, at multiple levels of security and across multiple domains, will feed many data streams into a common operational picture (COP) accessible throughout the United States Government and foreign or Coalition partners. (c) Be able to handle time-sensitive maritime threats. (d) Be designed for expansion. The effort will be used to resolve or develop new policy and procedures for MDA. Subsequent spirals will extend this capability and add functionality.

MDA Spiral-1 Technologies

This assessment reported on in this paper focused predominately on the eight Spiral-1 technologies, which were tested in 2008. Several other technologies deemed to have high

potential impact on the MDA mission were also included in this assessment. For a more detailed description of the tools see Hutchins, Gallup, MacKinnon, Schacher, Miller, Freeman, Dunaway & Poeltler, 2008. These technologies are:

- **Comprehensive Maritime Awareness (CMA)** – The Naval Research Laboratory's enhanced vessel tracking project
- **Law Enforcement Information Exchange (LInX)** – The Naval Criminal Investigative Service's non-classified system for information sharing of law enforcement information
- **Global Trader** – The Office of Naval Intelligence's cargo data and anomaly detection tool
- **Maritime Global Network (MAGNet)** – The Coast Guard's intelligence program backbone database with enhanced anomaly detection for people
- **Tactical Electronic-Maritime Interdiction Operation (E-MIO) System Wireless** – An E-MIO data collection and transfer system
- **Fast Connectivity for Coalition Agents Program (FAST2CAP)** – A common maritime operating picture that allows the watchstander to construct, implement and reconfigure search agents
- **Tripwire** – Office of Naval Intelligence's threat detection tools
- **Google Earth** – A commercial toolset for fusing data and displaying it on a globe

Data concerning other non-Spiral-1 MDA systems (e.g., MDA Data Sharing Community of Interest (DS COI), a system for disseminating automatic identification system (AIS) data, and Predictive Analysis for Naval Deployment Activity (PANDA) were also collected during the test events and these results are also included in this report.

In the following sections we describe our method of analysis, summarize our findings, present recommendations, and present detailed findings in each assessment area.

Assessment Method

The assessment method used for this MDA effort extends the methodology developed and refined for the Trident Warrior series of exercises, which has continued to be refined since 2002. The elements of this method include: (1) Define a framework for assessment in the MDA domain; (2) Collect data from test and experimental venues; and (3) Categorize data using the framework, assign scores to categorized data, and summarize the data. These steps are described in more detail below.

Assessment Framework

The MDA assessment framework specifies a three-level hierarchy of assessment areas, attributes that apply to each assessment area and the associated metrics used to evaluate performance for that attribute, and specific measures. For example, the attribute 'accessible' – when applied to measuring the sub-area Information Retrieval, under Technical Performance – would be measured by collecting data on both the percentage of time information is *available,* and how *efficient* the process was for retrieving information, i.e., number of steps involved to access the information. However, when applying the attribute 'accessible' to the sub-area Information Sharing (also under Technical Performance) it would include a combination of a measure for compatible (system interoperability), in addition to measures for available, and efficient. This framework is designed to address technological systems, organizational structures and processes, policy or guidance, and other factors that ensure a robust mission capability. (See MDA Assessment Areas and Structure, in Appendix A.)

The assessment framework addresses five distinct assessment areas, and two levels of sub-areas within them. The five assessment areas are:

- ***System Performance*** concerns how well a system performs its functions, its support of MDA operations, warfighter acceptance, automation, and system management and security functions.
- ***Operations Performance*** addresses the quality of knowledge management concerning vessels of interest (VoIs), MDA intelligence, surveillance, and reconnaissance (ISR), and MIO.
- ***Warfighter Performance*** focuses on operator acceptance and understanding of the MDA mission, as well as unit and individual capability to execute that mission.
- ***Organization/Guidance*** focuses on the fit of organizational structures and processes to the MDA mission including Maritime Headquarters with Maritime Operations Center (MOC), the sufficiency of agreements between entities, and the adequacy of guidance within entities.
- ***Supportability and Readiness*** concerns factors that ensure MDA Spiral-1 systems are robust and reliable.

Capability indicators (or assessment metrics) have been defined for each of the Assessment Areas. These indicators include both attributes and their measures. (These capability indicators were taken from those used for the Naval Network Warfare Command Capabilities Based Analyses for network-centric operations (NCO), command and control (C2), and battle space awareness. Table 1 shows the attributes used for the MDA assessment, however not all are used for each Assessment Area. The principal indicators are Effectiveness and Military Utility.

Table 1. MDA Capability Indicators (or Assessment Metrics)**.**

Area	**Effective**	**Utility**	**Area**	**Effective**
Systems	Accessible Capable Reliable Usable	Improved Needed Applicable Wanted	**Warfighter**	 Capable Reliable
Operations	Accessible Capable Reliable		**Organization /Guidance**	Accessible Capable Usable

Specific measures and the type/s of data required to are defined for each of the capability indicators. Examples are shown in Table 2 and the full list is contained in Appendix B. Metric Attributes are shown in bold and their measures in plain text. Use of the structure presented in Appendix A provides a consistent approach to MDA assessment and reporting across test venues that were used during 2008. This structure was used to correlate results from a variety of sources. Definitions of the attributes used in this assessment framework are found in Appendix C.

Table 2. Example of MDA Assessment Metrics: Assessment Area, Capability Indicators, and Metrics. (See Appendix B for complete set.)

Measure of Effectiveness		
System Performance Assessment Area	**Capability Indicators**	**Metrics**
Technical Performance		
	Improved:	*-5 to +5 rating of improvement over existing systems, by system aspect.*
	Needed:	*system fills a gap in existing capabilities, Y/N.*
	Applicable:	*system is applicable to MDA activities, by activity, Y/N.*
	Wanted:	*-5 to +5 rating of operator desire to have system available.*
Information Retrieval	**Accessible**: roll-up of information accessibility.	
	Available:	% of time information is available.
	Efficient:	number of steps to access information.
	Capable: roll-up of capability to retrieve required information.	
	Sufficient:	% of information needed for assessment.
	Timely:	time required to retrieve information.

Data Collection

Data were collected during multiple site visits and several Spiral-1 system test events.

1. As part of the Workflow Analysis and Process Engineering Workshop (PEW) an overview of MDA activities was conducted during site visits to US Naval Forces Central Command (NAVCENT), ONI, Second Fleet, Third Fleet, Fifth Fleet, and Sixth Fleet. The objective was to document the way MDA is currently done and to identify where new technologies are expected to have the greatest impact. The workflow for MDA as currently executed was documented in these visits (Freeman, Gallup, MacKinnon, and Hutchins, (2008). The workflow was validated in the PEW held at the Naval Postgraduate School, Monterey, CA, 15-17 Jan 2008, and was mapped to the Maritime Headquarters with Maritime Operations Center (MHQ w/MOC) core processes in a workshop in Norfolk, VA, in 29 January 2008.
2. The Technical Risk Reduction Limited Objective Experiment was held at Space and Naval Systems Center (SPAWAR), Lab 140, San Diego, CA, 2-6 June 2008, and was the first simultaneous testing of multiple MDA technologies using Fleet participants. The objective was to go through the test procedure to identify potential problems, with technologies, methodology, scenario, and so on, prior to the primary test event.
3. The Visit Board Search and Seizure (VBSS) School, in San Diego, CA, was visited 19 June 2008 to observe E-MIO usage and effectiveness.
4. Trident Warrior 08 was held aboard multiple Navy ships to test approximately 100 newly developed technologies and policies, 15 Jun -15 July 2008.
5. Empire Challenge 08 was held at China Lake Naval Station and in San Francisco Harbor as well as multiple other sites, 7-31 July 2008.
6. FAIRGAME was held at simultaneous, multiple sites: Naval Maritime Intelligence Center (NMIC), NAVCENT, US Pacific Fleet Command (PACFLT), Maritime Intelligence Fusion Center, Pacific (MIFCPAC), MIFCLANT, SPAWAR Systems Center, San Diego (SSC-SD), and Naval Criminal Investigation NCIS), 15-18 July 2008,

The data gathered in these venues were largely qualitative – including survey comments, chat logs, data collectors' observations, and interview notes – though some quantitative survey data were also collected. As noted above, the data largely concerned the Spiral-1 systems evaluated in most of these venues however, data were also collected on other systems with potential MDA utility. In sum, the systems assessed were: CMA, E-MIO Wireless, FASTC2AP, Global Trader, Google Earth, LiNX, MAGNET, MASTER, MDA DS COI, MIDAS, PANDA, and Tripwire.

Analysis Method

Data were aggregated across all venues and each datum was assigned to one or more areas (e.g., System Performance) of the assessment framework (depicted in Appendix A) at the lowest level of detail (e.g., Technical Performance, or sub-sub-areas). Each item in each category was rated to indicate that it described a strength (score = 3), a concern (score = 2), or a deficiency (score = 1) in an MDA system, suite of systems, or deployment concept for systems. Items scored as concerns (2) were relatively minor or could be addressed through revisions to training or interface design. Items scored as deficiencies (1) concerned missing or inoperable functions critical to the MDA mission. Average scores were computed for each assessment area. These scores focused our interpretation of the qualitative data. We have given special emphasis to describing reported deficiencies.

It is important to note that many of the reports are from a single source and, thus, may reflect the personal biases of those sources. Note also, that the quantitative findings reported here were developed by the NPS research team from qualitative reports, and thus reflect our interpretation rather than the interpretation of diverse operational experts or technology experts.

In the next sections, we summarize our findings from each of the assessment areas. Following this, we present recommendations based on these findings, and then describe the findings in detail.

Summary of MDA Capabilities Results

This section presents a qualitative and quantitative summary of MDA capabilities within the assessment framework developed for this effort. It summarizes findings across the assessment venues. The data presented here comprise a compilation of 194 observations, warfighter comments, and survey results. These were each assigned to one or more of the relevant assessment sub-areas. Many items were placed in multiple categories, resulting in a total of 304 assessments. Items were scored on the three-point scale described above. Average scores drove interpretation of the qualitative data.

Results by Assessment Area

The data generated across the MDA assessment venues focused on the use of MDA Spiral-1 technologies for developing and tracking vessels of interest (VOIs) and conducting MIO operations. Accordingly, as depicted in Table 3, most of the data were categorized in the system performance assessment area (219 items) and the operations performance assessment area (70 items). In both areas, the average assessment score was relatively high: 2.4 out of 3. No items concerned warfighter performance independent of the MDA technologies, and no assessment is made in this area. Only eight items concerned the organization/guidance assessment area, and

seven items concerned the system supportability and readiness area. Assessment scores were lowest in these low-frequency categories, largely due to overall concerns about the utility and supportability of new technologies from organizations being tasked with the new MDA mission. The frequency of reference to Spiral-1 and other MDA technologies is presented in Table 3.

Table 3. Distribution of data by assessment area.

Area	Items	Avg Score
Operations Performance	**70**	**2.4**
Organization/Guidance	**8**	**2.1**
System Performance	**219**	**2.4**
System Supportability and Readiness	**7**	**2.0**
Warfighter Performance	**0**	**-**
Total / Average	**304**	**2.4**

The data, which include warfighter comments, observations, interview notes, and survey results, specified 123 strengths of the tested MDA systems, 166 concerns, and 15 deficiencies, as displayed in Table 4. Ten deficiencies concerned System Performance, and five concerned Operations Performance. Because deficiencies are the most critical data, we address these in depth in the relevant assessment areas, below.

Table 4. Distribution of data by score by assessment area.

Count of Score	Score			
Assessment Area	**1: Deficiency**	**2: Concern**	**3: Strength**	**Total**
Operations Performance	**5**	**33**	**32**	**70**
Organization/Guidance		**7**	**1**	**8**
System Performance	**10**	**119**	**90**	**219**
System Supportability and Readiness	**-**	**7**	**-**	**7**
Total	**15**	**166**	**123**	**304**

We turn now to a qualitative assessment of each assessment area for which there was data.

System Performance

Of 219 items that concerned System Performance, 10 specified potential deficiencies regarding MDA system performance. Three of these concerned the inability to specify baselines against which to compare observed vessel behavior. Two items concerned perceived inadequacy of data quality and availability and two items concerned lack of connectivity of MIO technology. The remaining three items concerned specific features, data sharing, or security. Because deficiencies are particularly important in assessment, we present the detailed comments regarding potential deficiencies regarding system performance in Appendix D.

Some 119 items expressed reparable concerns with MDA systems. By far the largest group of these (33 items) addressed the completeness, correctness, conflicts, and timeliness of data or data processing. Usability of maps, search, alerts, and other features was cited in 24 items. Some 20 items addressed problems with training availability, fit to local needs, or speed. Operational utility was a concern in 7 cases, and the redundancy of technologies was an issue in 5 items.

Of the 90 strengths cited regarding System Performance (Table 4) across the various types of data collected (i.e., operator comments, observations, and survey results), 27 concerned operational utility for VOI detection and tracking and for MIO operations. Usability of search, maps, and other features accounted for 18 items. The speed of training (6 items) was also an indirect validation of the usability of the technologies. Nine items concerned the value of data fusion capabilities of these technologies. The speed of the technologies was cited in 6 items.

Operations Performance

Of 70 items that concerned Operations Performance five were potential deficiencies (see Appendix E for a list of potential deficiencies regarding Operations Performance). All but one item concerned E-MIO connectivity (reception or transmission) problems. The remaining item concerned gaps in track coverage by CMA due to failures of CMA servers. (Note that one of the five items in the table in Appendix E was coded in two assessment categories).

Of 33 items coded as concerns (i.e., a score of 2), the most frequent themes were the completeness, correctness, conflicts, timeliness of data and data processing (12 items), usability (10 items), and training (5 items). Of 32 items coded as strengths, 13 concerned operational utility for VOI; 10 concerned usability; 4 focused on the utility of alerts; and the rest addressed miscellaneous issues.

Warfighter Performance

No items concerned warfighter performance independent of the MDA technologies, and thus no assessment is made in this area.

Organization/Guidance

Very few items (8 out of a total of 304) concerned the assessment area of Organization and Guidance. Of these, none rose to the level of a potential deficiency. Seven items were coded as concerns. Two each concerned the constraints imposed by policies and agreements; coordination of MDA execution and ONI intelligence processes; and training. One addressed the challenge of customizing solutions to fit the local missions of organizations. One item, scored as a strength (i.e., a score of 3), concerned the alignment of MDA tasks with MHQ w/ MOC processes documented in the Process Alignment Workshop (Freeman, Heacox, & MacKinnon, 2008).

System Supportability and Readiness

Seven items addressed System Supportability and Readiness. All of these were areas of concern, either regarding the competency or size of staff (4 items), or potential deficiencies in infrastructure (2 items) or variance between facilities (1 item) that might hinder fielding and use of MDA solutions.

Results by Assessment Sub-Area

In this section, we summarize findings in each assessment sub-area. A summary of the results of the quantitative assessment is presented in Table 5, followed by a qualitative assessment that summarizes the strengths, concerns, and deficiencies observed in the various MDA assessment venues. Note, in the quantitative assessment, that areas of greatest concern (lowest average scores) were Operations Performance for MIO, several areas of Organization/Guidance (Guidance, MDA Compatibility, and System Management and Security), and System Supportability and Readiness. The most highly rated sub-areas were Operations Performance: Know-

ledge Processes, Organization/Guidance: MHQ/MOC Compatibility, and System Performance: Operations Support. Finer-grained categorization, a synopsis, and a score for each item can be found in the complete report on this effort (MacKinnon, Hutchins, Schacher, & Freeman, 2008).

Table 5. Average assessment scores by sub-area.

Assessment Sub-Area	Average score
Operations Performance: Knowledge Processes	2.5
Operations Performance: MIO	1.8
Organization/Guidance: Agreements	2.0
Organization/Guidance: Guidance	2.0
Organization/Guidance: MDA Compatibility	2.0
Organization/Guidance: MHQ/MOC Compatibility	2.5
System Performance: Automation	2.4
System Performance: Operations Support	2.5
System Performance: System Management and Security	2.0
System Performance: Technical Performance	2.3
System Performance: Warfighter Acceptance	2.4
System Supportability and Readiness	2.0
Average	2.4

System Performance: Technical Performance

Table 6 shows the majority of the 81 items concerning System Performance: Technical Performance involved Information Retrieval (54 items), all but 30 of which addressed concerns (i.e., score of 2) about the completeness, correctness, conflicts, timeliness of data and data processing. Usability strengths and concerns were the topic of 8 items. Also noted, with 5 items each, were data fusion (generally, a strength) and speed of data processing (which received mixed assessments). The remaining items addressed various issues.

Table 6. Number of items concerning System Performance: Technical Performance.

Sub-Sub-Area	Total
System Performance: Technical Performance: Information Processing	1
System Performance: Technical Performance: Information Retrieval	54
System Performance: Technical Performance: Information Sharing	21
System Performance: Technical Performance: Interoperability	5
Total	81

Also shown in Table 6, of the remaining items, 21 concerned Information Sharing. More specifically, 7 addressed the completeness, correctness, conflicts, timeliness of data and data processing. Three each concerned data sharing and transmission. Five items addressed Interoperability of systems. Of these items, three addressed requirements for specific software (e.g., Java, Direct-X), and two concerned the availability of data within or between nodes. One item addressed Information Processing, specifically the need for automated statistical analysis of data gaps to identify potential new sources of information and drive new collections. This capability – data-driven collection planning – is being developed in research efforts for ground warfare, and could be extended to MDA.

System Performance: Operations Support

Of 21 items that concerned System Performance: Operations Support, 20 concerned the utility of specific technologies to operations. As indicated by comments included in Appendices D and E, E-MIO technology exhibited a potential deficiency with respect to connectivity. Most items in this area were strengths or concerns about the general value of these tools. One item concerned the lack of tactics, techniques, and procedures (TTPs) and standard operating procedures (SOP) for applying MDA technologies.

System Performance: Warfighter Acceptance

Some 85 items addressed Warfighter Acceptance of specific technologies. Of these, 41 concerned Human-System Interaction, the majority focusing on usability of agents, alerts, briefs, help, maps, menus, and search. Five of these concerned CMA's data fusion capabilities, which were viewed as a strength in most cases. Training was addressed in 22 items, which was seen as fast but often incomplete. System Utility was addressed by 18 items, with an emphasis on acceleration of operational tasks, and benefits to situational awareness. However, MDA DS COI, LiNX, and Google Earth were each viewed once with concern (i.e., a score of 2) for being redundant with other solutions. Strategies for using the systems were seen to be lacking in four cases in an area we call System Usage.

System Performance: Automation

Automation was addressed in 27 items. Of these, 26 concerned Alerts, specifically their strong operational utility but mixed usability. One item, concerning Information Processing, addressed MASTER's strong automation to capture data on VOIs, relative to current solutions.

System Performance: System Management and Security

Of five System Management and Security issues, 4 were concerns about keeping systems up and running, and one – a potential deficiency – concerned loss of the original security classification of information to be disseminated.

Operations Performance: Knowledge Processes

VOI Development was the focus of 52 of the 62 items concerning Operations Performance: Knowledge Processes. In this area, usability (17 items), operational utility (14 items), and the completeness, correctness, conflicts, timeliness of data and data processing were the most frequent topics. VOI Tracking accounted for the remaining 10 items, and similar concerns arose in this area; completeness, correctness, conflicts, timeliness of data and data processing (4 items), and mixed usability (2 items) were the most frequently cited issues.

Operations Performance: MIO

In the area of MIO Execution, inadequate training was a concern in 3 of 8 cases; inadequate connectivity was a potential deficiency in 2.

Organization/Guidance: MDA Compatibility

The alignment of ONI with MDA activities was a concern in 2 items.

Organization/Guidance: MHQ/MOC Compatibility

Two items concerned compatibility of MDA and MHQ with MOC. Process Alignment between MDA and MHQ with MOC was seen as a strength in one item, due to the Process Alignment

Workshop. However, local Organization Alignment with MDA, that is, the flexibility of MDA processes to local needs, was a concern in one case.

Organization/Guidance: Agreements

Two items concerned the assessment area Organization/Guidance: Agreements, and both were concerns (i.e., rating of 2) about restrictions imposed by data sharing agreements about classified information or data concerning U.S. citizens.

Organization/Guidance: Guidance

Two items specified concerns (i.e., rating of 2) about the need to develop better MDA CONOPS and TTP/SOP.

System Supportability and Readiness

Seven items concerned System Supportability and Readiness. Of these, 4 were concerns (i.e., rating of 2) about the number or competency of staff, and 3 identified concerns about the adequacy of infrastructure to support MDA technologies generally.

Results by Technology

In this section, we summarize the scores for each MDA technology cited in the findings – including Spiral-1 technologies and others – at the lowest assessment level. For further detail concerning each technology, we refer the reader to the sections below, in which we present findings in each of the assessment areas.

The majority of the data gathered across venues concerned a specific technology (a total of 257 items), usually CMA (136 items). A minority of the data concerned no specific MDA technology, or an unspecified suite of technologies (47 items) (see Table 7). Note that the list of technologies includes some systems that are not Spiral-1 products, but that were evaluated in the various MDA assessment venues.

Those technologies that scored lowest, on the average (see Table 7), were Global Trader, for perceived incompleteness of data and lack of data replication; MAGNET, for lack of data due to data sharing agreements concerning U.S. citizens; MDA DS COI for lack of usability or training; and E-MIO wireless for connectivity problems. Those that scored highest were Tripwire, for its alerting and provision of contextual information, and PANDA, for the operational utility of alerts and quality of explanations of deviations that it presented.

Table 7. Distribution of data by technology.

Technology	Frequency	Average Score
All Spiral-1	**47**	**2.1**
CMA	**136**	**2.4**
E-MIO Wireless	**23**	**2.1**
FASTC2AP	**13**	**2.4**
Global Trader	**5**	**2.2**
Google Earth	**10**	**2.5**
LiNX	**5**	**2.4**
MAGNET	**2**	**2.0**

MASTER	**33**	**2.3**
MDA DS COI	**5**	**2.0**
MIDAS	**5**	**2.6**
PANDA	**13**	**2.9**
Tripwire	**7**	**2.9**
Total/ Avg	**304**	**2.4**

A more detailed assessment is presented in Appendix F, which contains the average assessment scores for MDA technologies at the finest level of assessment detail.

To make a more focused assessment of the operational utility of systems, we computed the average sum of scores for strengths and concerns[1] about systems. Several MDA technologies appear to have particularly high or low operational utility, based on this analysis (see Table 8). FASTC2AP, Global Trader, PANDA, Tripwire, and CMA received high marks for operational utility. MDA DS COI, E-MIO Wireless, and MAGNET received low marks for operational utility.

Table 8. Average Sum of Concern and Strength Scores by Technology.

MDA Technology	Avg Sum of Scores
FASTC2AP	3.0
Global Trader	3.0
PANDA	3.0
Tripwire	3.0
CMA	2.8
MASTER	2.7
Google Earth	2.5
LiNX	2.3
MDA DS COI	2.0
E-MIO Wireless	1.5
MAGNET	n.a.

An additional analysis was conducted to help the reader assess the impact of specific systems regarding fulfillment of MDA capability requirements (see Table 9). Spiral-1 technologies must help the Navy to fulfill several MDA capabilities: monitor, collect, fuse, analyze, and disseminate. One technology, E-MIO Wireless, has a low assessment score (Table 8, driven by connectivity deficiencies) and it addresses only one MDA capability (i.e., collect). This should raise concern about the value of this technology, and focus investment (or disinvestment) decisions on it.

Low assessment scores (of 2.0, or less), in Table 9, are also a concern with respect to MAGNET and MDA DS COI. However, these technologies address multiple MDA capabilities. Strengths in one area may compensate for concerns in others.

[1] The value here is computed as the sum of all scores for concerns (each valued at 2 points) and strengths (3 points) divided by the total frequency of these scores for items in these categories: System Performance categories for Operations Support: System Utility, and Warfighter Acceptance: System Utility. Note that scores for potential deficiencies were excluded from this analysis, as were scores in all other assessment categories.

Note that all MDA capabilities are addressed by more than one technology. Thus, the issues identified with respect to any one technology do not necessarily indicate a capability gap. More specifically, three SP-1 technologies (CMA, MAGNET, and Tripwire) address all of these capabilities. Three technologies (Global Trader, DS/COI, and FASTC2AP) address most capabilities. Three technologies address only one capability (E-MIO: Collect; Google Earth: Disseminate; and LiNX: Collect). A finer-grained understanding of the implications of findings on MDA capabilities can be had by considering the mapping of technologies to the performance thresholds that each technology must achieve, as presented in Appendix H.

Table 9. Mapping of SP-1 Technologies to MDA Capabilities.

Capability	CMA	E-MIO Wireless	Global Trader	Google Earth	LiNX	MAGNET	Data Sharing COI	Tripwire	FASTC2AP
Assessment Score	2.4	2.1	2.2	2.5	2.4	2.0	2.0	2.9	2.4
Monitor	X		X			X	X	X	X
Collect	X	X	X		X	X	X	X	X
Fuse	X					X		X	X
Analyze	X		X			X	X	X	
Disseminate	X		X	X		X	X	X	X

MDA Capabilities Recommendations

In this section, we make recommendations based on the findings, discussed in previous sections. Recommendations concern fielding and support, technology usability, technology functionality, data quality, training, organizational interoperability, and future MDA assessment activity. These recommendations are organized into three categories of the assessment framework, and an additional category concerning the programmatics of MDA assessment.

System Supportability and Readiness

***Strong technologies*:** PEO C4I and Office of the Chief of Naval Operations (OPNAV) should press forward with development and fielding of several technologies that received high marks for operational utility: FASTC2AP, Global Trader, PANDA, Tripwire, and CMA.[2]

***Weaker technologies*:** OPNAV should evaluate the expressed concerns, deficits, and return on investments for several technologies that received low marks for operational utility: MDA DS COI, E-MIO Wireless, and MAGNET.

***Fielding sites*:** OPNAV should consider placing technologies in reach-back facilities (e.g., at ONI rather than at NAVCENT) with robust technical support and operator competence for those technologies that have high utility but low accuracy, reliability, or usability.

[2] This list was determined by computing the average weighted sum of scores for items in two categories concerning operational utility: System Performance categories for Operations Support: System Utility, and Warfighter Acceptance: System Utility. Scores for potential deficiencies were excluded from this analysis.

***Fielding/support process*:** OPNAV and PEO C4I should ensure and advertise competent fielding and support for MDA technologies. This may involve educating these organizations about the processes for surveying infrastructure (e.g., the adequacy of power supplies and server space), configuring or customizing technologies to local needs, specifying technical support requirements, fulfilling them, and identifying and addressing shortfalls.

System Performance

***Usability*:** OPNAV and PEO C4I should systematically analyze the usability of MDA technologies – specifically programmable agents, maps, search features, graphs, alerts, and briefing products – to ensure that (1) the cost in errors and response time is estimated, (2) design modifications are prioritized accordingly and are funded, and (3) training enables operators to work around persistent usability problems. In MDA assessment events, CMA, MASTER, FASTC2AP, MDA DS COI, and E-MIO all had usability issues that raised concern.

***Redundant functionality*:** OPNAV and PEO C4I should evaluate reports of redundancy of MDA technologies with each other and with existing systems. Fielding decisions, tactics, techniques, and procedures (TTPs), and training should resolve these redundancies.

***Baseline specification functions*:** OPNAV and PEO C4I should ensure that technologies with alert/alarm capabilities enable the user to specify baseline behaviors for traffic in different regions. Without this function, alerts lose much of their value.

***Data sources*:** OPNAV should identify, develop, and link to critical data sources. For example, data sharing agreements are required to provide data concerning U.S. persons.

***Data source education*:** OPNAV and PEO C4I should ensure operators of new systems understand which data sources feed those systems, the reliability of those sources, which expected data sources do not feed those systems, and the implications of both for analyzing results. These explanations should identify the reason for data gaps, e.g., lack of institutional or international agreements to access data, lack of a connection to the data source, lack of data replication, or data loss during system failures. In MDA assessment events, unreliable sources or systems produced gaps in CMA track coverage; lack of data replication produced incomplete data in Global Trader; connectivity issues hindered use of E-MIO (e.g., below decks); and MAGNET data were sparse per policies about handling data concerning U.S. persons.

***Common Data*:** OPNAV should analyze and resolve significant differences in data sets between users who must coordinate their activities.

***Training*:** OPNAV should implement a dedicated course of instruction concerning MDA TTPs, standard operating procedures (SOPs), and the role of MDA technologies in them, and include it in the Navy Training System Plan (NTSP). Ideally, this training will be customized to local missions and conditions.

Organization/Guidance

***Process interoperability*:** OPNAV should evaluate and revise the emerging process architectures for MHQ with MOC, ONI, and other organizations to ensure they support MDA tasks, and they

can be customized to the conditions of MDA work in the varied Navy areas of operations. This analysis may entail developing MDA use cases or scenarios against which to test process architectures, and these use cases can serve double duty as exercise and training scenarios.

***Information flow impedance*:** OPNAV and PEO C4I should assess the impact of new technologies, procedures, and organizational structures on the rate of information flow between organizations, and between elements of organizations. New technologies have the potential to raise the information output of some organizations (e.g., ONI) well above the input and processing capacities of the organizations they support (e.g., NAVCENT).

Assessment

***MDA operational baseline*:** To estimate the return on investment in MDA systems requires that we define the baseline of MDA capabilities (e.g., the number of VOIs developed and tracked per unit time). This baseline might be estimated by operational experts. However, more reliable data will be obtained from direct observation of the effectiveness of current, fielded technologies for MDA missions. We recommend that observational data be gathered concerning the current MDA baseline.

***MDA system alternatives*:** The return on investment for MDA assessment may be increased if experimentation and observation address some promising systems outside the Spiral-1 suite. Such systems include CMA, NEPTUNE[3], GALE-Lite, Palaemon, PANDA, and Sea Watch. Evaluation of such systems is essentially a high-risk/high-return investment in the portfolio of MDA assessment activities.

***MDA assessment scenarios*:** OPNAV and PEO C4I should develop exercises that train and test MDA capabilities (technologies, TTPs, organizations, etc.), with a particular focus on handling realistic numbers of white vessels. Design these exercises to answer at least these questions: Can we develop a VOI and identify it among many vessels almost identical to it? Can we communicate securely and confidentially with a single ship among many ships in an area? Can we coordinate our actions in a crowded field of internationally flagged white vessels? Can we manage and address costs of delay to commercial shipping (estimated by NORTHCOM at $10,000/hour) and erroneous actions (e.g., damage or destruction of internationally flagged vessels)?

***MDA process modeling*:** OPNAV should ensure that future assessments use measures that support computational, "what if" modeling of the impact of new technologies, processes, manning, and organizational structures. Such measures should represent the speed-accuracy tradeoff curve for analysis, decision making, and action (throughput) given varied missions, staff size and competency, and related factors. By reusing these measurements in models, the Navy will multiply the answers it can extract from scant assessment data, and thus increase its return on every dollar spent on assessment.

System Performance Results

The assessment area System Performance concerns the performance of MDA technologies, including Spiral-1 technologies. The components of this assessment area concern the technical

[3] NEPTUNE, GALE-Lite, Palaemon, and PANDA are systems being developed to support MDA missions that are not part of the Spiral-1 set of technologies.

performance of systems, the support they provide to operations, warfighter acceptance of the systems, automation of important functions, and system management and security.

Organization/Guidance Results

The assessment area Organization/Guidance concerns the alignment of organizations to MDA missions, the alignment of MDA processes or tasks with those specified in the MHQ with MOC process architecture the alignment of international and inter-organization agreements with MDA mission requirements, and the availability of CONOPS, TTPs, SOP, and standing orders for MDA missions. The key data concerning this assessment area are presented in Appendix H.

Observer Log Results

The following results are for CMA, except where noted.

Information Acquisition Times – When data on information acquisition times was collected, although the systems were not being used in an operational environment, the amount of time required to obtain information was viewed as representative of what would be observed in operational environments. Very little time was required, e.g., 1 min to determine when a specified ship was built after the White Cell request for information; 7 min to determine a person-of-interest was not on the reported ship; 2 min to identify the type of cargo on a named ship; 10 min to locate a ship and identify its origin and anticipated arrival locations; and, 6 min to locate a ship, details on type and crew.

It is possible that these times are biased to shorter time because historical data was used for which the needed data was known to be present. Even so, these information acquisition times represent an improvement over existing times.

System Performance – Most system problems encountered were due to the lab environment and do not qualify as Spiral-1 system results. The following results are inherent to the systems, not the lab environment. These results are derived from limited tests of the systems and have not been validated. (1) Partial match did not work as anticipated when searching for a ship name. (2) Operators could not zoom in and draw a small geographical box around a VOI.

Summary of Findings

Most of the data reported here describe strengths or concerns of MDA systems. Few users identified deficiencies in these systems. The scores indicate all of the assessed technologies increased the warfighter's effectiveness to some degree, yet there was little information about the level of enhancement of MDA capabilities provided by the suite of Spiral-1 systems due to the lack of data on baseline levels of performance.

Specifically, in the quantitative assessment, areas of greatest concern (lowest average scores) were:

- Operations Performance for EMIO*
- Several sub-areas of Organization/Guidance concerning MDA Compatibility (specifically, alignment of MDA activity with ONI)
- Guidance (especially the need for MDA CONOPS, TTPs, and SOPs)
- Agreements (concerning data sharing)
- System Management
- Security
- System Supportability

- Readiness

*Assessment for EMIO was obtained through an actual operational experiment, not a system test. This differs from the rest of the results which were obtained from structured laboratory events.

The most highly rated sub-areas were:

- Operations Performance concerning Knowledge Processes for vessel of interest (VOI) development and tracking
- Organization/Guidance concerning Maritime Headquarters with Maritime Operations Center (MHQ/MOC) Compatibility with MDA
- System Performance concerning the Operations Support provided by these systems.

Finer categorization, a synopsis, and a score for each item are presented in the technical report on this effort (MacKinnon, Hutchins, Schacher, & Freeman, 2008).

Future Assessment Recommendations

We recommend that observations be conducted to establish a baseline on MDA capabilities using current systems, in order to better estimate the impact of Spiral-1 systems. We recommend that some experimentation and observation address other technologies that show promise to improve MDA effectiveness. Such systems include CMA, NEPTUNE, GALE-Lite, Palaemon, PANDA, and Sea Watch. OPNAV and PEO C4I should develop exercises that train and test MDA capabilities (technologies, TTPs, organizations, etc.), with a particular focus on handling realistically large numbers of cooperative, intentionally uncooperative, and inattentive white vessels. Finally, we advise OPNAV to ensure future assessments capture data that support computational, “what if” modeling of the impact of new technologies, processes, manning, and organizational structures. Such measurements will enable the Navy to reuse scant data productively and in a predictive manner, thus multiplying the return on each assessment dollar.

Appendix A: MDA Assessment Areas and Structure

System Performance
- Technical Performance
  - Information Retrieval
  - Information Processing
  - Information Sharing
  - Operator Configurable
  - Interoperability
- Operations Support
  - System Utility
  - Standards and Guidelines
- Warfighter Acceptance
  - System Utility
  - Human-System Interaction
  - System Usage
  - System Training
- Automation
  - Alerts
  - Information Processing
  - Smart Pull
- System Management and Security

Warfighter Performance
- MDA Mission
  - Mission Understanding
  - Mission Acceptance
- Unit Performance
  - Manning
  - Activities
  - Training
- Human Performance
  - Tasks
  - Training

Operations Performance
- Knowledge Processes
  - Information Retrieval
  - VoI Development
  - VoI Tracking
  - Information Sharing
- ISR
  - Planning
  - Execution
  - PED
- MIO
  - Planning
  - Execution
  - Assessment

Organization/Guidance
- MDA Compatibility
  - Organization Alignment
  - Process Alignment
- MHQ/MOC Compatibility
  - Organization Alignment
  - Process Alignment
- Agreements
  - Information Sharing
  - Shared Operations
- Guidance
  - CONOPS
  - TTP/SOP
  - Standing Orders

System Supportability and Readiness
- PEO Provided

Appendix B: MDA Assessment Areas and Associated Metrics

This table presents the measures that are to be evaluated for each Assessment Area. Attributes are in bold, followed by their associated measures.

		MDA Assessment Metrics MOE MOP or MOU
Spiral-1 System Performance (each system)		
Technical Performance		
		***Improved**: -5 to +5 rating of improvement over existing systems, by system aspect.* ***Needed**: system fills a gap in existing capabilities, Y/N.* ***Applicable**: system is applicable to MDA activities, by activity, Y/N.* ***Wanted**: -5 to +5 rating of operator desire to have system available.*
	Information Retrieval	**Accessible**: roll-up of information accessibility. **Available:** % of time information is available. **Efficient**: number of steps to access information.
		Capable: roll-up of capability to retrieve required information. **Sufficient:** % of information needed for assessment. **Timely**: time required to retrieve information.
		Reliable: roll-up of ability to obtain correct information when needed. **Assured**: information source is identified, Y/N. **Robust**: automatic failover during system problems, Y/N; database backup, Y/N. **Persistent**: % of time down due to system failure.
		Usable: roll-up of information usability for assessment and decision-making. **Clear**: 1-5 rating of information clarity; 1-5 rating of GUI presentation. **Trusted**: 1-5 rating of confidence in information.
	Information Processing	**Capable:** roll-up of ability to process ship and VoI information. **Available**: information processing capabilities, Y/N; list capabilities. **Efficient**: use of information processing capabilities, by capability, Y/N. **Sufficient**: information processing capabilities for operations needs, Y/N. **Automatic**: automatic information processing available? Y/N
	Information Sharing	**Accessible**: roll-up of information sharing accessibility. **Compatible**: M2M interoperability, by system, Y/N. **Available**: % of time information sharing available. **Efficient**: information sharing efficient, Y/N; number of steps required to share information.
		Capable: collaboration capabilities provided, Y/N; roll-up of capability to share information with other units. **Reach**: number of units with which information can be shared; number of units per collaboration session. **Sufficient**: % of required units with which information can be shared; % of required information that can be shared. **Timely**: time required to exchange information.
	Operator Configurable	**Capable**: 1-5 rating of the ability of operator to configure the system as desired. **Flexible**: Operator can configure information search, information presentation, Y/N. **Sufficient**: fraction of required profile types that can be developed. **Reach**: Number of profiles that can be saved. **Efficient**: 1-5 rating of system configuration efficiency; number of steps required to configure system, by configuration type.
	Interoperability	**Compatible**: M2M system interoperability, by system, Y/N; information formats compatibility, by system, Y/N.
Operations Support		
	System Utility	***Improved**: -5 to +5 rating of improvement of MDA operation activities over existing systems, by activity.* ***Needed**: system fills a gap in existing support to MDA operations, Y/N.* ***Applicable**: system is applicable to MDA activities, by activity, Y/N.* ***Wanted**: -5 to +5 rating of operations center desire to have system available.*

Standards and Guidelines	**Usable**: roll-up assessment of Standards and Guidelines for system usage. **Sufficient**: % of system operations covered by guidelines; standards to cover information formats, Y/N; standards to cover M2M interactions, Y/N. **Clear**: guidelines to direct system operation, Y/N.
	Prepare a list of those situations for which Standards/Guidelines are inadequate.
Warfighter Acceptance	
System Utility	***Improved**: -5 to +5 rating of improvement of operator's task performance over existing systems, by task.* ***Needed**: system fills a gap in existing support to task performance, Y/N.* ***Applicable**: system is applicable to MDA tasks, by task, Y/N.* ***Wanted**: -5 to +5 rating of operator desire to have system available.*
Human-System Interaction	**Usable:** 1-5 scale roll-up of human-system-interaction. **Clear**: 1-5 scale on GUI presentation. **Manageable**: GUI can be configured to operator desired presentation, Y/N. **Relevant**: information presented is relevant to operator task performance, Y/N. **Timely**: GUI layout and information presentation facilitates rapid retrieval of needed information, Y/N; time to retrieve needed information. **Efficient**: number of steps required to retrieve needed information; 1-5 scale on GUI facilitation of information retrieval efficiency.
System Usage	Prepare a table of frequency of Spiral-1 system use, by situation and by task.
System Training	**Usable**: 1-5 scale roll-up of training quality. **Clear**: 1-5 scale on training clarity. **Sufficient**: 1-5 scale on sufficiency of training to prepare operator for tasks. **Relevant**: 1-5 scale on whether training is relevant to mission and workflow.
Automation	
Alerts	**Capable:** alerts are provided, Y/N; roll-up of quality of alerts. **Automatic**: **Flexible**: alerts operator configurable, Y/N; number of different types of alerts available. **Trusted**: 1-5 rating of alerts eliminating need to monitor situation. **Sufficient**: % of needed alerts provided by system, % of needed alert types provided by system. **Timely**: alerts provided in time to take needed actions, Y/N.
	Efficient: 1-5 rating of efficiency setting up alerts; number of steps required to set up alerts.
Information Processing	**Capable:** machine assisted information processing provided, Y/N; system automated information processing available, Y/N; roll-up assessment of information processing capability. **Automatic**: hands-off information processing available, Y/N. **Flexible**: system information processing operator configurable, Y/N. **Trusted**: 1-5 rating of ability to accept hands-off information processing. **Sufficient**: % of information processing requirements performed by system.
Smart Pull	**Capable:** smart pull capable, Y/N. **Automatic**: smart pull automatic updates, Y/N. **Flexible**: smart pull operator configurable, Y/N; number of different types of smart pull available. **Trusted**: 1-5 rating of smart pull reliability to provide required information. **Sufficient**: % of required information available by smart pull.
System Management and Security	
	Accessible: roll up of system management functions for overall accessibility. List any significant causes for lack in accessibility. **Reliable**: % of time system is down. **Secure**: % of attacks that disrupt system performance. **Manageable**: time required to repair/reconfigure system after failure. **Sufficient**: information in status reports to manage system, Y/N. **Accurate**: % of system status reports that are correct.
Operations Performance	
Knowledge Processes	

	Information Retrieval	**Accurate**: % of retrieved information that conforms to ground truth. **Flexible**: number of sources that can be accessed to provide information, by information type. **Sufficient**: information available to assess vessels in AoR; information available to conduct MDA operations; **Timely**: time to retrieve information, by information type; information in time to take needed actions. **Efficient**: 1-5 rating of information retrieval efficiency, by information type; Number of steps required to retrieve information, by information type.
	VoI Development	**Accurate**: % of correct assessments of vessel classification, threat. **Timely**: time to complete VoI assessment and classification.
	VoI Tracking	**Capable**: 1-5 rating of ability to track vessels; roll-up summary of vessel tracking capabilities. **Accurate**: mean vessel location error, by vessel type. **Flexible**: number of different types of vessels that can be tracked by (radiating, AIS, etc) **Reach**: geographical area over which tracking can be accomplished. Sufficient: % of AOR over which tracking can be accomplished. **Timely**: time to locate vessel; frequency of vessel reports.
	Information Sharing	**Capable**: collaboration capabilities provided, Y/N; roll-up of capability to share information with other units. **Reach**: number of units with which information can be shared; number of units per collaboration session. **Sufficient**: % of required units with which information can be shared; % of required information that can be shared. **Timely**: time required to exchange information, ops centers and reachback.
		Compatible: system interoperability, Y/N; information formats, by unit, Y/N.
		Accessible: roll-up of information sharing accessibility. **Compatible**: M2M interoperability, by system, Y/N. **Available**: % of time information sharing available. **Efficient**: information sharing efficient, Y/N; number of steps required to share information.
	ISR	
	Planning	**Sufficient**: % of RFIs addressed; % of available assets assigned. **Timely**: time to plan; planning completed in time for execution.
	Execution	**Accurate**: % of assets conforming to planed actions. **Sufficient**: % of assets completing assignment.
	PED	**Accurate**: % of assessments conforming to ground truth. **Timely**: time to complete processing, exploitation, distribution; distribution in time to meet planning cycle.
	MIO	
	Planning	**Sufficient**: % of RFIs addressed; % of available assets assigned. **Timely**: time to plan; planning completed in time for execution.
	Execution	**Accurate**: % of assets conforming to planed actions. **Sufficient**: % of assets completing assignment.
	Assessment	**Accurate**: % of assessments conforming to ground truth. **Timely**: time to complete reachback, personnel assessment, ship threat assessment.
Warfighter Performance		
	MDA Mission	
	Mission Understanding	**Clear**: 1-5 rating of understanding of activities and tasks, by position.
	Mission Acceptance	**Clear**: **Compliant**: 1-5 rating of individual, unit readiness to undertake MDA mission, by position. **Compatible**: 1-5 rating on fit and ability to perform MDA tasks with other duties; percent of current tasks that match MDA needs.
	Unit Performance	
	Manning	**Sufficient**: manning to carry out assigned activities, Y/N, % of required. **Compatible**: personnel assigned with activity requirements, Y/N, % match.
	Activities	**Capable**: 1-5 rating of unit ability to undertake assigned MDA activities. **Timely**: time to complete activities. **Compliant**: activity performance complies with CONOPS, rules, agreements, Y/N. **Flexible**: 1-5 rating of unit's ability to respond to different situations.
	Training	**Sufficient**: 1-5 rating of training preparation to perform required activities, by activity and unit. **Relevant**: 1-5 rating of training relevance to assigned activities, by activity and unit.

Human Performance		
	Tasks	**Capable**: 1-5 rating of human ability to perform MDA tasks, by position. **Timely**: time to complete tasks. **Flexible**: respond to situation.
	Training	**Sufficient**: 1-5 rating of training preparation to perform required activities, by task and position. **Relevant**: 1-5 rating of training relevance to assigned activities, by task and position.
Organization/Guidance		
MDA Compatibility		
	Organization	**Capable**: roll-up of fit of the organization's structure to MDA requirements.
	Alignment	**Sufficient**: rolls and decision making agreements to cover MDA contingencies, Y/N. **Compatible**: organization alignment with MDA operations requirements, Y/N. **Flexible**: MDA responsible units can realign in response to situation, Y/N. **Timely**: organizations are self-synchronizing in response to situation, Y/N; time required to synchronize operations.
		Usable: roll-up of how workable organization alignment is to accomplish the MDA mission. **Clear**: responsibilities and command relations between MDA units, Y/N. **Trusted**: partner units to carry out their responsibilities without question, Y/N. **Manageable**: information and decision flow between units, Y/N.
	Process	**Capable**: roll-up of how capable MDA units are of sharing activities/tasks.
	Alignment	**Sufficient**: information sharing agreements to cover MDA contingencies, Y/N. **Compatible**: process is in alignment with MDA operations requirements, Y/N; information sharing between MDA units, Y/N. **Flexible**: MDA processes can realign in response to situation, Y/N. **Timely**: processes are self-synchronizing in response to situation, Y/N; time required to synchronize processes. **Automatic**: information sharing between MDA units, Y/N.
		Usable: roll-up of how workable activity/task sharing is between MDA units. **Clear**: information sharing processes, Y/N; activity/task execution processes, Y/N. **Trusted**: partner units to carry out their responsibilities without question, Y/N; information provided by partner units, Y/N. **Manageable**: information and workflow between units, Y/N.
MHQ/MOC Compatibility		
	Organization	**Capable**: roll-up of fit of MDA unit's structure to MHQ/MOC.
	Alignment	**Sufficient**: agreements to cover MDA contingencies, Y/N. **Compatible**: organization alignment with MDA operations requirements, Y/N. **Flexible**: MHQ/MOC and MDA units can realign in response to situation, Y/N. **Timely**: organizations are self-synchronizing in response to situation, Y/N; time required to synchronize operations.
		Usable: roll-up of how workable alignment of MHQ/MOC with MDA units is to accomplish the MDA mission. **Clear**: responsibilities and command relations between MDA units, Y/N. **Trusted**: partner units to carry out their responsibilities without question, Y/N. **Manageable**: information and decision flow between units, Y/N.
	Process	**Capable**: roll-up of how capable MDA units are of sharing activities/tasks.
	Alignment	**Sufficient**: information sharing agreements to cover MDA contingencies, Y/N; % of MDA activities that map to MHQ/MOC activities. **Compatible**: processis alignment of MHQ/MOC and MDA operations requirements, Y/N; information sharing between MHQ/MOC and MDA units, Y/N; % of activities that can seamlessly share information, workflow, and responsibilities. **Flexible**: MHQ/MOC and MDA processes can realign in response to situation, Y/N. **Timely**: MHQ/MOC and MDA processes are self-synchronizing in response to situation, Y/N; time required to synchronize processes. **Automatic**: information sharing between MHQ/MOC and MDA units, Y/N.
		Usable: roll-up of how workable activity/task sharing is between MHQ/MOC and MDA units. **Clear**: information sharing processes, Y/N; activity/task execution processes, Y/N. **Trusted**: MHQ/MOC to carry out their responsibilities without question, Y/N; information provided by MHQ/MOC, Y/N. **Manageable**: information and workflow between MHQ/MOC and MDA units, Y/N.

Agreements	
Information Sharing	**Reach**: Number of different types of information that can be shared. **Sufficient**: % of required information that can be shared. **Compliant**: with information security regulations, Y/N; list barriers to information sharing that impede MDA operations.
Shared Operations	**Clear**: responsibilities, chain of command. **Sufficient**: % of required units/organizations participating. **Reach**: number of MDA activities that can have shared participation, by activity, list activities, and list participating units.
Guidance	
CONOPS	**Usable**: roll-up assessment of CONOPS quality to guide MDA operations. **Sufficient**: guidance to conduct MDA, by operation, Y/N. **Relevant**: guidance applies to MDA, by situation, Y/N. **Applicable**: guidance can be applied, by situation, Y/N. **Clear**: guidance to direct activities, by activity, Y/N. **Compliant**: with higher-order directives/doctrine, Y/N.
	Prepare a list of those situations for which CONOPS is inadequate.
TTP/SOP	**Usable**: roll-up assessment of TTP/SOP quality to direct MDA activities. **Sufficient**: guidance to conduct MDA, by activity, Y/N. **Relevant**: guidance applies to MDA, by activity, Y/N. **Applicable**: guidance can be applied, by situation, Y/N. **Clear**: guidance to direct activities, by activity, Y/N. **Compliant**: with higher-order directives, Y/N.
	Prepare a list of those situations for which TTP/SOP are inadequate.
Standing Orders	**Usable**: roll-up assessment of Standing Orders (ROE, NSL, commander's guidance, etc.) quality to frame MDA operations. **Sufficient**: guidance to conduct MDA, by operation, Y/N. **Relevant**: guidance applies to MDA, by situation, Y/N. **Applicable**: guidance can be applied, by situation, Y/N. **Clear**: guidance to direct MDA operations, by activity, Y/N. **Compliant**: with higher-order directives, Y/N.

Appendix C: Attribute Definitions

Effective – Effective is an overarching attribute. It refers to how well systems, people, and processes meet their stated purposes. This attribute has meaning only in reference to that purpose. E.g., it is not sufficient to state that a system is effective without also stating at what.

Accessible – Users have access to needed capabilities and information. This includes access to communication means, data and processed information, systems, software, support, etc. Access will often be through a network. This attribute is one of the four MOEs its component MOP follows.

> **Capacity –** Number of users that can have access; number of services that can be provided; capacity of other systems required for its function, primarily bandwidth. Included is information or service throughput.
> **Available** – System or capability is ready for use, can be used, when needed. It is possible that a capability can be accessed but cannot be used at that time.
> **Compatible** – The system or capability can function with other elements external to it without modification to either. It can be integrated with other systems or capabilities. This can also refer to processes or organizations being compatible or integrated.
> **Extensive** – The system or capability is capable of servicing a large number of users, covers a large geographical area, services a large number of user types, and provides a number of different types of service.
> **Efficient** – The number of steps or effort needed to access and use the service is acceptable. This attribute is inherently comparative. Acceptable normally refers to a standard, or an improvement over what was formerly required. Efficiency can be a ratio, a judgment of (result obtained)/(effort required).

Reliable –The capability or information is there when needed, can be depended on. Human and organization reliability is included. This attribute is one of the four MOE; its component MOP follows.

> **Robust** – The system or process is able to withstand stress or attack. Changes in environment are managed with minimal loss of functionality or effectiveness.
> **Persistent** – The system maintains its status over long periods of time (primarily ISR capabilities). Information maintains its content and meaning across processing and distribution means (e.g., tracks).
> **Secure** – The system, process, information, has provisions that prevent unauthorized use, intrusion, or tampering.
> **Assured** – Information is warranted to be correct, the source identified, and non-repudiation in effect. The process is warranted to produce the desired result.

Capable – The system, capability, person, or organization provides the needed services. This attribute is one of the four MOE; its component MOP follows.

> **Sufficient** – What has been provided/received is adequate for the recipient to perform their function. For humans and organizations, the skills available are adequate for task performance. Sufficiency can refer to either quantity or level.
> **Flexible** – The system, process, human, or organization responds easily to the situation or to changing requirements. It is adaptable, can handle/utilize a wide range of types. It is tailorable/customizable to user needs and/or users can make modifications to suite their needs.

Accurate – Information provided is correct, matches reality within acceptable limits. Determinations of accuracy normally require definition of acceptable error limits.
Timely – The occurrence or delivery is within acceptable time limits. This can refer to an elapsed time or to meeting a schedule.

Usable – The system, capability, information, or process can be used. This attribute is one of the four MOE; its component MOP follows.

Clear – How the system or process is to be used is easily understood. Meaning of the information is easily comprehended. Instructions, guidelines, definitions are complete and meaningful.
Trusted – Users believe that the information, process, system, organization, will perform their function in a manner that supports current needs.
Manageable – The system or process can be easily modified or manipulated as needs dictate, often in response to changes in the environment. Included is insuring that the required level of performance is maintained. This includes installation of capabilities.
Relevant – Information provided applies to the current situation. System capabilities are what is needed for current tasks. Processes provide the actions required for current operations.
Compliant – The system or information complies with standards or defined structure and formats. Activities are in conformance with existing CONOPS and TTP.

Military Utility – Military utility the second overarching attribute, and actually is a faux attribute, not actually a description of characteristics but a determination to be made in Military Utility Assessments (MUA). It is used to express that something does/does not contribute to the successful performance of military operations. It is one of the most important considerations for military operations. The four measures of utility (MOU) follow.

Improved – The system, organization, or process improves the conduct of military operations for which they were designed.
Needed – The system, organization, or process fills a gap an identified gap.
Applicable – The system, organization, or process is pertinent to conduct of the operation. Its capabilities match the needs and conduct of the operation.
Wanted – Operational personnel want the capability and utilize it. They do not currently have the capability or would rather use it in place of other available capabilities.

Ready Ready is an official procurement term that refers to the system being ready for fielding. As indicated, it is a roll-up of the other fundamental measures and the life-cycle plan (which includes a personnel plan).

Appendix D: Potential Deficiencies regarding System Performance

Sub-Sub-Area	Technology	Item
System Performance: System Management and Security	CMA	CMA: Users sometimes lost track of the original security classification of the information they wished to disseminate. This increased the likelihood of a security violation as a result of passing classified information on the wrong domain.
System Performance: Technical Performance: Information Sharing	Google Earth	Google Earth has no embedded collaboration tool included, thus it was not possible to send information from Google Earth to other systems.
System Performance: Automation: Alerts	All Spiral-1	Spiral-1 did not automatically establish or display threat assignments based upon a user-defined alert.
System Performance: Automation: Alerts	CMA & FASTC2AP	Spiral-1 tools did not provide additional capability to establish baseline normal civil maritime operations worldwide and threat assessment criteria. CMA and FASTC2AP could alert based upon a geographic point/area/proximity, but did not support alerts employing algorithms based upon baseline maritime operations.
System Performance: Operations Support: System Utility	E-MIO Wireless	Tactical EMIO System (TES) - Although wireless, the TED devices were required to be in the vicinity of the Tactical EMIO Maritime PC (TEMP) in order to download data captured during the boarding. The radio frequency (RF) signals were not strong enough to transmit data when team members were below decks. (Visit, Board, Search and Seizure (VBSS) School)
System Performance: Operations Support: System Utility	E-MIO Wireless	Tactical EMIO System (TES) - While mobility of the Tactical EMIO Device (TED) was a clear advantage, enabling the collection of data from multiple locations within the vessel, one limitation noted was that the TED must be within the vicinity of the TEMP to download the data captured. The RF signals were not strong enough to transmit data when team members were below decks. The Maritime BGAN EMIO Terminal (MBET) device, in turn, failed to transfer data due to environmental issues and weak RF signal range of the commercial satellite. Contractors eventually departed the target vessel and drove inland with the TEMP and MBET device to acquire a stronger signal. The MBET link was then acquired and successfully transmitted data from the TEMP device. Contractors asserted that the satellite connectivity will not be a concern in the current AOR. Also, the boarding officer was not able to demonstrate the transfer of data via the Maritime Broadband Global Area Network (BGAN) EMIO Terminal (MBET) due to the satellite connectivity. (VBSS School)
System Performance: Automation: Alerts	All Spiral-1	The ability to capture and store baseline/normal maritime movement patterns was not observed. Spiral-1 tools did not alert users to deviations from normal route or behavior patterns.
System Performance: Technical Performance: Information Retrieval	CMA	The user's ability to monitor vessel, person, and cargo data was severely degraded by gaps in track data coverage. When a node's CMA server was down, or data was not transmitted, the data not received was not recoverable. The Naval Research Laboratory limited the National Technical Means data source input to CMA to 14 hours per day and filtered the data that was provided. This resulted in a gap of data which had a negative impact across all AORs.
System Performance: Technical Performance Information Sharing	All Spiral-1	There were significant differences in information available at different nodes.

Appendix E: Potential Deficiencies regarding Operations Performance

Sub-Sub-Area	Technology	Item
Operations Performance: Knowledge Processes: VoI Development & Operations Performance: MIO: Execution	E-MIO Wireless	TES - While mobility of the Tactical EMIO Device (TED) was a clear advantage, enabling the collection of data from multiple locations within the vessel, one limitation noted was that the TED must be within the vicinity of the TEMP to download the data captured. Although wireless, the TED devices were required to be in the vicinity of the TEMP in order to download data captured during the boarding. The radio frequency (RF) signals were not strong enough to transmit data when team members were below decks. The MBET device, in turn, failed to transfer data due to environmental issues and weak RF Signal range of the commercial satellite. Contractors eventually departed the target vessel and drove inland with the TEMP and MBET device to acquire a stronger signal. The MBET link was then acquired and successfully transmitted data from the TEMP device. Contractors asserted that the satellite connectivity will not be a concern in the current AOR. Also, the boarding officer was not able to demonstrate the transfer of data via the MBET due to the satellite connectivity. (VBSS School)
Operations Performance: Knowledge Processes: VoI Tracking	CMA	The user's ability to monitor vessel, person, and cargo data was severely degraded by gaps in track data coverage. When a node's CMA server was down, or data was not transmitted, the data not received was not recoverable. The Naval Research Laboratory limited the National Technical Means data source input to CMA to 14 hours per day and filtered the data that was provided. This resulted in a gap of data which had a negative impact across all areas of responsibility (AORs).
Operations Performance: MIO: Execution	E-MIO Wireless	TES - Although wireless, the TED devices were required to be in the vicinity of the TEMP in order to download data captured during the boarding. The radio frequency (RF) signals were not storing enough to transmit data when team members were below decks. (VBSS School)
Operations Performance: MIO: Execution	E-MIO	There were no positions provided with the latent print messages and for the cave collection, there was no Seek ID Global Positioning System (GPS) reception and therefore no position was included in the biometric messages.

Appendix F: Average Assessment Scores for MDA Technologies

Sub-Sub-Area	CMA	E-MIO Wireless	FASTC2AP	Global Trader	Google Earth	LiNX	MAGNET	MASTER	MDA DS COI	MIDAS	PANDA	Tripwire	All MDA Tech	Average
Operations Performance: Knowledge Processes: VoI Development	**2.5**	**1.0**		**2.0**	**3.0**			**2.1**	**2.0**	**3.0**	**3.0**	**3.0**	**2.5**	**2.5**
Operations Performance: Knowledge Processes: VoI Tracking	**2.3**							**3.0**						**2.4**
Operations Performance: MIO: Execution		**1.8**												**1.8**
Organization/Guidance: Agreements: Information Sharing							**2.0**			**2.0**				**2.0**
Organization/Guidance: Guidance: Concept of Operations (CONOPS)	**2.0**													**2.0**
Organization/Guidance: Guidance: Tactics, Techniques, Procedures (TTP/SOP)	**2.0**													**2.0**
Organization/Guidance: MDA Compatibility: Organization Alignment													**2.0**	**2.0**
Organization/Guidance: MHQ/MOC Compatibility: Organization Alignment													**2.0**	**2.0**
Organization/Guidance: MHQ/MOC Compatibility: Process Alignment													**3.0**	**3.0**
System Performance: System Management and Security	**1.7**												**2.5**	**2.0**
System Performance: Automation: Alerts	**2.3**		**2.3**					**2.5**			**3.0**	**3.0**	**1.3**	**2.3**
System Performance: Automation: Information Processing								**3.0**						**3.0**
System Performance: Operations Support: Standards and Guidelines													**2.0**	**2.0**
System Performance: Operations Support: System Utility	**3.0**	**2.0**	**3.0**	**3.0**	**3.0**	**2.0**		**3.0**				**3.0**	**2.3**	**2.6**
System Performance: Technical Performance: Information Processing													**2.0**	**2.0**
System Performance: Technical Performance: Information Retrieval	**2.3**			**2.0**	**3.0**	**2.5**		**2.2**		**3.0**	**2.5**	**2.0**	**2.3**	**2.3**
System Performance: Technical Performance: Info. Sharing	**2.2**	**3.0**		**2.0**	**1.5**			**3.0**	**2.0**	**2.0**	**3.0**		**1.8**	**2.2**
System Performance: Technical Performance: Interoperability	**2.0**		**2.0**		**2.0**									**2.0**
System Performance: Warfighter Acceptance: Human-System Interaction	**2.5**	**2.0**	**2.3**		**3.0**			**2.0**	**2.0**		**3.0**		**2.0**	**2.4**
System Performance: Warfighter Acceptance: System Training	**2.5**	**2.4**						**2.0**	**2.0**				**2.0**	**2.3**
System Performance: Warfighter Acceptance: System Usage	**3.0**											**3.0**	**2.5**	**2.8**
System Performance: Warfighter Acceptance: System Utility	**2.8**				**2.0**	**2.5**	**2.0**	**2.5**	**2.0**		**3.0**	**3.0**		**2.6**
System Supportability and Readiness: System Supportability and Readiness													**2.0**	**2.0**
Average	**2.4**	**2.1**	**2.4**	**2.2**	**2.5**	**2.4**	**2.0**	**2.3**	**2.0**	**2.6**	**2.9**	**2.9**	**2.1**	**2.4**

Appendix G: Mapping of SP-1 Technologies to MDA Capabilities Thresholds

This table presents a fine-grained mapping of Spiral-1 technologies to MDA capabilities.

Capability Class	Capability	CMA	E-MIO Wireless	Global Trader	Google Earth	LiNX	MAGNET	Data Sharing COI	Tripwire	FASTC2AP	Potential Gaps	Potential Redundancy
Monitor	**MT1**	X					X	X	X	X		**Y**
	MT2	X					X		X	X		**Y**
	MT3								X			**Y**
	MT4	X					X		X	X		**Y**
	MT5			X								**Y**
Collect	**CT1**	X		X			X	X	X	X		**Y**
	CT2									X		**Y**
	CT3										**Y**	
	CT4		X									**Y**
	CT5					X	X					**Y**
Fuse	**FT1**	X					X			X		**Y**
	FT2								X			**Y**
Analyze	**AT1**						X		X			**Y**
	AT2										**Y**	
	AT3	X						X				**Y**
	AT4						X					**Y**
	AT5										**Y**	
	AT6			X								**Y**
Disseminate	**DT1**				X							**Y**
	DT2										**Y**	
	DT3	X		X						X		**Y**
	DT4							X				**Y**
	DT5	X								X		**Y**
	DT6								X			**Y**
	DT7								X			**Y**
	DT8	X					X		X			**Y**
	DT9	X										**Y**

Note: This Table was developed from a presentation by PEO C4I concerning MDA test and evaluation, 21 Feb 2008 (PEO_C4I_MDA_TE Update Issues_FINAL rev2_20FEB2008.ppt)
Note: MDA Capability Thresholds are drawn from the OPNAV Scoping Document
Note: Key to capabilities.

Appendix H: Organization/Guidance Results

Item ID	Area	Item	Comments	Score	Technol-ogy	Venue
295	Agreements: Information Sharing	Information from a stand-alone MAGNET system was not available due to sharing agreements concerning U.S. persons information.	constraints imposed by policies and agreements	2	MAGNET	QRA
296	Agreements: Information Sharing	MIDAS: Respondents acknowledged that there is currently a need to collaborate with other agencies, coalition members and non-traditional partners, and most felt that MIDAS would help to facilitate that collaboration; however, 2 mentioned that sharing sensitive or classified information might be a problem.	constraints imposed by policies and agreements	2	MIDAS	TW08
299	Guidance: CONOPS	CMA - The envisioned CONOPS for future MDA will require training and familiarization with the new procedures as evidenced by the following: (1) "Have yet to truly collaborate with others, with the exception of perhaps shared watch areas;" and (2) "During the exercise there was a lot of confusion about being able to track vessels that come near a specific vessel at any time during its track - I still don't think this function is truly possible."	training for CONOPS	2	CMA	VBSS
302	Guidance: TTP/SOP	CMA - The envisioned TTP/SOP for future MDA will require training and familiarization with the new procedures as evidenced by the following: (1) "Have yet to truly collaborate with others, with the exception of perhaps shared watch areas;" and (2) "During the exercise there was a lot of confusion about being able to track vessels that come near a specific vessel at any time during its track - I still don't think this function is truly possible."	training for TTP	2	CMA	VBSS
290	MDA Compatibility: Organization Alignment	ONI expresses concern about lack of lack of re-engineering of processes and training.	coordination of MDA and ONI processes	2	All MDA Tech	TW08
304	MDA Compatibility: Organization Alignment	ONI is conducting process analyses concerning intel analysis. It is not clear that this effort is synchronized with the MDA technology effort.	coordination of MDA with ONI processes	2	All MDA Tech	Workflow, PEW
276	MHQ/MOC Compatibility: Organization Alignment	The NPS assessment team is concerned that MDA TTPs need to be sufficiently flexible to accommodate differences between COCOMS.	customization to local needs	2	All MDA Tech	TW08
303	MHQ/MOC Compat-ibility: Process Alignment	Second Fleet, NAVNETWARCOM, and others concur that the MDA workflow aligns with the MHQ w MOC process architecture as of early 2008. (See Process Alignment Workshop).	alignment of MDA and MHQ w MOC processes	3	All MDA Tech	TW08

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Maritime Domain Awareness: Assessment of Current Status

Susan G. Hutchins,[1] Douglas J. MacKinnon,[1] Jared Freeman,[2] and Shelley P. Gallup[1]

[1]Naval Postgraduate School, Monterey, CA

[2]Aptima, Inc., Woburn, MA

MDA Spiral 1 Tools, Features Provided and Benefits of Tools

Tool	Features Provided	Benefits of Tool
Comprehensive Maritime Awareness (CMA)		
	Anomaly detection	* Automates a previously manual process
	Info sharing across organizational nodes	* Facilitates collaboration
	Object tracking	* More tracks can be monitored
	Integrates multi-source data, search agents, confidence reporting, and information	* More comprehensive correlation across multiple sources of
	remote access	
FASTC2AP		
	Defines/automates info mgmt tasks	* Generates alerts, emails, OTH Gold msgs - update GCCS-M tracks
	Helps manage situation awareness	* Access to multiple databases
	Processes large amounts of data by analysis, fusion, and exploitation agents	* Helps manage situation awareness and track behavior in an AOR
TRIPWIRE		
	Mines unstructured text data and analyzed	* Increased relationships
	alerts analysts	

MDA Spiral 1 Tools, Features Provided and Benefits of Tools

Tool	Features Provided	Benefits of Tool
MAGNET		
	Intelligent agent logic	* Faster access to data
	Web browser to query other data sources	* More sources queried in less time
	System queries regarding topics of interest in area	* Increased number of analytic models
		* Increased archived data for analysis
TAANDEM		
	Real-time track processing	* Prediction and activity monitoring
	Identify deviant tracks	* Real-time track processing
	Provides annotated tracks with alerts	* Rule-based anomaly detection
E-MIO Wireless		
	Satellite transmission/ reception for unclassified boarding data authoritative dbs	* Automatically inserts data into
GOOGLE EARTH	Map capabilities	* Overlay analysis from other tools to detailed map
Global Trader		
	Anomaly detection, pattern matching/	* Supports queries regarding cargo

Maritime Domain Awareness: Spiral 1 Metrics

Program Metrics Structure

Structure is required to support results roll-up to higher-level metrics.

Effective				
Accessible	**Reliable**	**Capable**	**Usable**	**MOE**
Capacity	Robust	Sufficient	Clear	**MOP**
Available	Persistent	Flexible	Trusted	"
Compatible	Secure	Accurate	Manageable	"
Extensive	Assured	Timely	Relevant	"
Efficient		Reach	Compliant	"
		Automatic	Deployable	"
Military Utility				
Improved	**Needed**	**Applicable**	**Wanted**	**MOU**
Ready				
Effective	**Utility**	**Life-Cycle**	**Personnel**	**MOR**
System Readiness is a roll up of the component readiness measures (MOR).				

Readiness in the acquisition sense, not operational or deployment readiness.

Assessment Framework Addresses Five Distinct Assessment Areas

- ***System Performance*** concerns **how well a system performs its functions**, its support of MDA operations, warfighter acceptance, automation, and system management and security functions.
- ***Operations Performance*** addresses the **quality of knowledge management concerning vessels of interest** (VoIs), MDA intelligence, surveillance, and reconnaissance (ISR), and MIO.
- ***Warfighter Performance*** focuses on **operator acceptance and understanding of the MDA mission**, as well as unit and individual capability to execute that mission.
- ***Organization/Guidance*** focuses on the **fit of organizational structures and processes to the MDA mission** including Maritime Headquarters with Maritime Operations Center (MOC), the sufficiency of agreements between entities, and the adequacy of guidance within entities.
- ***Supportability and Readiness*** concerns factors that ensure MDA Spiral-1 systems are **robust and reliable**.

MDA Capability Indicators (or Assessment Metrics)

Area	Effective	Utility	Area	Effective
System Performance	Accessible Capable Reliable Usable	Improved Needed Applicable Wanted	Warfighter Performance	Capable Reliable
Operations	Accessible Capable Reliable		Organization /Guidance	Accessible Capable Usable

Example of MDA Assessment Metrics: Assessment Area, Capability Indicators, and Metrics

System Performance Assessment Area	Capability Indicators	Metrics
Technical Performance	Improved	-5 to +5 rating of improvement over existing system by system feature
	Needed	System fills a gap in existing capabilities, Y/N
	Applicable	System is applicable to MDA activities, by activity, Y/N
	Wanted	-5 to +5 rating of operator desire to have system available
Information Retrieval	Accessible	Roll-up of information accessibility
	Available	% of time information is available
	Efficient	Number of steps to access information
	Capable	Roll-up of capability to retrieve required information
	Sufficient	% of information needed for assessment
	Timely	Time required to retrieve information

Data Collection

1. Workflow Analysis and Process Engineering Workshop (PEW):

- **Overview of MDA activities, site visits ton NAVCENT, ONI, 2F, 3F, 5F, and 6F.**

- **Document the way MDA is currently done and to identify where new tech's are expected to have the greatest impact.**
- **Validated in PEW, NPS, Jan 2008, and was mapped to the Maritime Headqrtrs with Maritime Operations Center (MHQ w/MOC) core processes.**

2. Technical Risk Reduction Limited Objective Experiment, SPAWAR, SD, June 2008

- **First simultaneous testing of multiple MDA technologies using Fleet participants.**

3. Visit Board Search and Seizure (VBSS) School, San Diego

4. Trident Warrior 08 – held aboard multiple Navy ships

5. Empire Challenge 08 – China Lake Naval Station and in San Francisco Harbor, 2008.

6. FAIRGAME – Simultaneous, multiple sites: Naval Maritime Intelligence Center (NMIC), NAVCENT, PACFLT, Maritime Intelligence Fusion Center, Pacific (MIFCPAC), MIFCLANT, SSC-SD and NCIS, July 2008

- **Primary source for COMOPTEVFOR to perform the QRA on all MDA technologies**

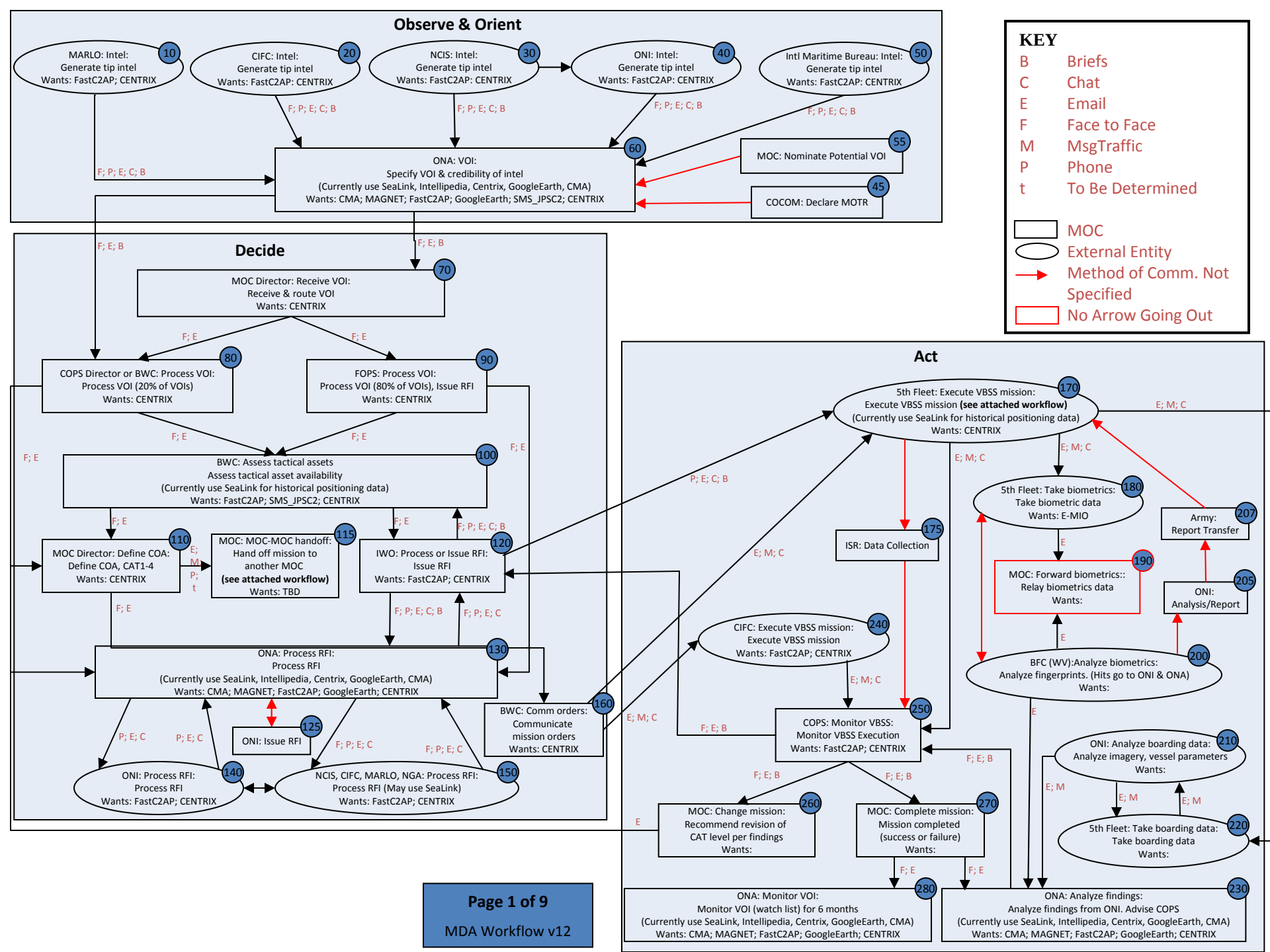
Observe & Orient
10 MARLO: Intel: Generate tip intel Wants: FastC2AP; CENTRIX
20 CIFC: Intel: Generate tip intel Wants: FastC2AP: CENTRIX
30 NCIS: Intel: Generate tip intel Wants: FastC2AP: CENTRIX
40 ONI: Intel: Generate tip intel Wants: FastC2AP: CENTRIX
50 Intl Maritime Bureau: Intel: Generate tip intel Wants: FastC2AP: CENTRIX
60 ONA: VOI: Specify VOI & credibility of intel (Currently use SeaLink, Intellipedia, Centrix, GoogleEarth, CMA) Wants: CMA; MAGNET; FastC2AP; GoogleEarth; SMS_JPSC2; CENTRIX
55 MOC: Nominate Potential VOI
45 COCOM: Declare MOTR
F; P; E; C; B
Decide
70 MOC Director: Receive VOI: Receive & route VOI Wants: CENTRIX
80 COPS Director or BWC: Process VOI: Process VOI (20% of VOIs) Wants: CENTRIX
90 FOPS: Process VOI: Process VOI (80% of VOIs), Issue RFI Wants: CENTRIX
100 BWC: Assess tactical assets Assess tactical asset availability (Currently use SeaLink for historical positioning data) Wants: FastC2AP; SMS_JPSC2; CENTRIX
110 MOC Director: Define COA: Define COA, CAT1-4 Wants: CENTRIX
115 MOC: MOC-MOC handoff: Hand off mission to another MOC (see attached workflow) Wants: TBD
120 IWO: Process or Issue RFI: Issue RFI Wants: FastC2AP; CENTRIX
130 ONA: Process RFI: Process RFI (Currently use SeaLink, Intellipedia, Centrix, GoogleEarth, CMA) Wants: CMA; MAGNET; FastC2AP; GoogleEarth; CENTRIX
125 ONI: Issue RFI
140 ONI: Process RFI: Process RFI Wants: FastC2AP; CENTRIX
150 NCIS, CIFC, MARLO, NGA: Process RFI: Process RFI (May use SeaLink) Wants: FastC2AP; CENTRIX
160 BWC: Comm orders: Communicate mission orders Wants: CENTRIX
Act
170 5th Fleet: Execute VBSS mission: Execute VBSS mission (see attached workflow) (Currently use SeaLink for historical positioning data) Wants: CENTRIX
175 ISR: Data Collection
180 5th Fleet: Take biometrics: Take biometric data Wants: E-MIO
190 MOC: Forward biometrics:: Relay biometrics data Wants:
200 BFC (WV):Analyze biometrics: Analyze fingerprints. (Hits go to ONI & ONA) Wants:
205 ONI: Analysis/Report
207 Army: Report Transfer
240 CIFC: Execute VBSS mission: Execute VBSS mission Wants: FastC2AP; CENTRIX
250 COPS: Monitor VBSS: Monitor VBSS Execution Wants: FastC2AP; CENTRIX
260 MOC: Change mission: Recommend revision of CAT level per findings Wants:
270 MOC: Complete mission: Mission completed (success or failure) Wants:
210 ONI: Analyze boarding data: Analyze imagery, vessel parameters Wants:
220 5th Fleet: Take boarding data: Take boarding data Wants:
280 ONA: Monitor VOI: Monitor VOI (watch list) for 6 months (Currently use SeaLink, Intellipedia, Centrix, GoogleEarth, CMA) Wants: CMA; MAGNET; FastC2AP; GoogleEarth; CENTRIX
230 ONA: Analyze findings: Analyze findings from ONI. Advise COPS (Currently use SeaLink, Intellipedia, Centrix, GoogleEarth, CMA) Wants: CMA; MAGNET; FastC2AP; GoogleEarth; CENTRIX
KEY
B Briefs
C Chat
E Email
F Face to Face
M MsgTraffic
P Phone
t To Be Determined
MOC
External Entity
Method of Comm. Not Specified
No Arrow Going Out
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Table 3. Distribution of Data by Assessment Area

Area	Number Data Items	Average Score
Operations Performance	70	2.4
Organization/Guidance	8	2.1
System Performance	219	2.4
System Supportability and Readiness	7	2.0
Warfighter Performance	0	-
Total / Average	304	2.4

Table 4. Distribution of Data by Score and Assessment Area

	Score			
Assessment Area	1: Deficiency	2: Concern	3: Strength	Total
Operations Performance	5	33	32	70
Organization/Guidance		7	1	8
System Performance	10	119	90	219
System Supportability and Readiness	-	7	-	7
Total	15	166	123	304

Distribution of Data by Technology

Technology	Frequency	Average Score
All Spiral-1	47	2.1
CMA	136	2.4
E-MIO Wireless	23	2.1
FASTC2AP	13	2.4
Global Trader	5	2.2
Google Earth	10	2.5
LiNX	5	2.4
MAGNET	2	2.0
MASTER	33	2.3
MDA DS COI	5	2.0
MIDAS	5	2.6
PANDA	13	2.9
Tripwire	7	2.9
Total/ Avg	304	2.4

Average Sum of Concern and Strength Scores by Technology

MDA Technology	Avg Sum of Scores
FASTC2AP	3.0
Global Trader	3.0
PANDA	3.0
Tripwire	3.0
CMA	2.8
MASTER	2.7
Google Earth	2.5
LiNX	2.3
MDA DS COI	2.0
E-MIO Wireless	1.5
MAGNET	n.a.

Mapping of SP-1 Technologies to MDA Capabilities

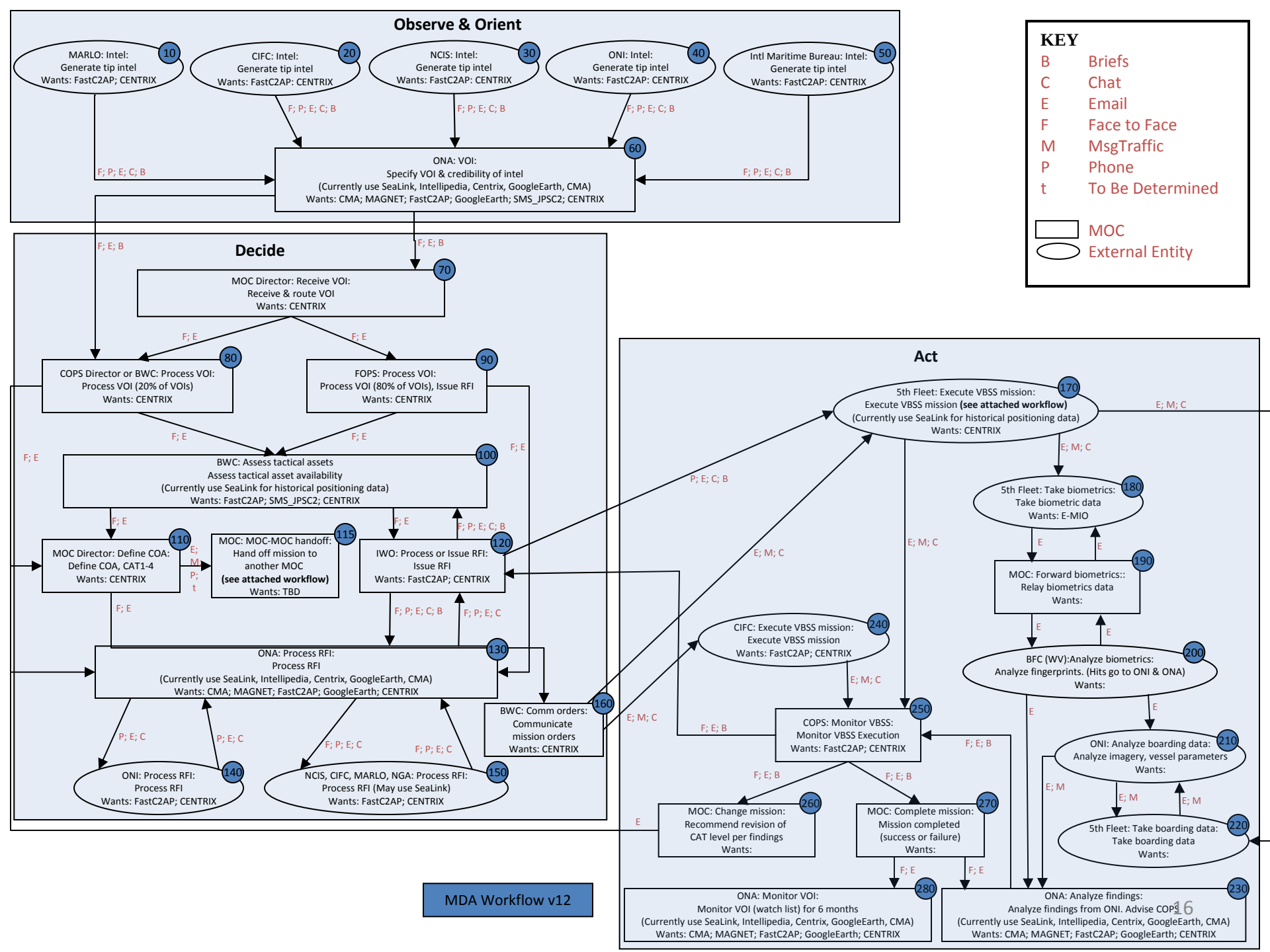
Capability	CMA	E-MIO Wireless	Global Trader	Google Earth	LiNX	MAG -NET	Data Sharing COI	Trip-wire	FAST C2AP
Assessment Score	2.4	2.1	2.2	2.5	2.4	2.0	2.0	2.9	2.4
Monitor	X		X			X	X	X	X
Collect	X	X	X		X	X	X	X	X
Fuse	X					X		X	X
Analyze	X		X			X	X	X	
Disseminate	X		X	X		X	X	X	X

Summary of Findings: Areas of Greatest Concern

- Operations Performance for EMIO
- Several sub-areas of Organization/Guidance concerning MDA Compatibility (specifically, alignment of MDA activity with ONI)
- Guidance (especially the need for MDA CONOPS, TTPs, and SOPs)
- Agreements (concerning data sharing)
- System Management
- Security
- System Supportability
- Readiness

Mapping of SP-1 Technologies to MDA Capabilities Thresholds

Capability Class	Capability	CMA	E-MIO Wireless	Global Trader	Google Earth	LiNX	MAG-NET	Data Sharing COI	Trip-wire	FAST C2AP	Potential Gaps	Potential Redundancy
Monitor	**MT1**	X					X	X	X	X		**Y**
	MT2	X					X		X	X		**Y**
	MT3								X			**Y**
	MT4	X					X		X	X		**Y**
	MT5			X								**Y**
Collect	**CT1**	X		X			X	X	X	X		**Y**
	CT2									X		**Y**
	CT3										**Y**	
	CT4		X									**Y**
	CT5					X	X					**Y**
Fuse	**FT1**	X					X			X		**Y**
	FT2								X			**Y**
Analyze	**AT1**						X		X			**Y**
	AT2										**Y**	
	AT3	X						X				**Y**
	AT4						X					**Y**
	AT5										**Y**	
	AT6			X								**Y**
Disseminate	**DT1**				X							**Y**
	DT2										**Y**	
	DT3	X		X						X		**Y**
	DT4							X				**Y**
	DT5	X								X		**Y**
	DT6								X			**Y**
	DT7								X			**Y**
	DT8	X					X		X			**Y**


Observe & Orient
MARLO: Intel: Generate tip intel Wants: FastC2AP; CENTRIX
10
CIFC: Intel: Generate tip intel Wants: FastC2AP: CENTRIX
20
NCIS: Intel: Generate tip intel Wants: FastC2AP: CENTRIX
30
ONI: Intel: Generate tip intel Wants: FastC2AP: CENTRIX
40
Intl Maritime Bureau: Intel: Generate tip intel Wants: FastC2AP: CENTRIX
50
F; P; E; C; B
60
ONA: VOI: Specify VOI & credibility of intel (Currently use SeaLink, Intellipedia, Centrix, GoogleEarth, CMA) Wants: CMA; MAGNET; FastC2AP; GoogleEarth; SMS_JPSC2; CENTRIX
KEY
B Briefs
C Chat
E Email
F Face to Face
M MsgTraffic
P Phone
t To Be Determined
MOC
External Entity
Decide
F; E; B
70
MOC Director: Receive VOI: Receive & route VOI Wants: CENTRIX
F; E
80
COPS Director or BWC: Process VOI: Process VOI (20% of VOIs) Wants: CENTRIX
90
FOPS: Process VOI: Process VOI (80% of VOIs), Issue RFI Wants: CENTRIX
100
BWC: Assess tactical assets Assess tactical asset availability (Currently use SeaLink for historical positioning data) Wants: FastC2AP; SMS_JPSC2; CENTRIX
110
MOC Director: Define COA: Define COA, CAT1-4 Wants: CENTRIX
115
MOC: MOC-MOC handoff: Hand off mission to another MOC (see attached workflow) Wants: TBD
120
IWO: Process or Issue RFI: Issue RFI Wants: FastC2AP; CENTRIX
130
ONA: Process RFI: Process RFI (Currently use SeaLink, Intellipedia, Centrix, GoogleEarth, CMA) Wants: CMA; MAGNET; FastC2AP; GoogleEarth; CENTRIX
140
ONI: Process RFI: Process RFI Wants: FastC2AP; CENTRIX
150
NCIS, CIFC, MARLO, NGA: Process RFI: Process RFI (May use SeaLink) Wants: FastC2AP; CENTRIX
160
BWC: Comm orders: Communicate mission orders Wants: CENTRIX
Act
170
5th Fleet: Execute VBSS mission: Execute VBSS mission (see attached workflow) (Currently use SeaLink for historical positioning data) Wants: CENTRIX
180
5th Fleet: Take biometrics: Take biometric data Wants: E-MIO
190
MOC: Forward biometrics:: Relay biometrics data Wants:
200
BFC (WV):Analyze biometrics: Analyze fingerprints. (Hits go to ONI & ONA) Wants:
210
ONI: Analyze boarding data: Analyze imagery, vessel parameters Wants:
220
5th Fleet: Take boarding data: Take boarding data Wants:
230
ONA: Analyze findings: Analyze findings from ONI. Advise COPS (Currently use SeaLink, Intellipedia, Centrix, GoogleEarth, CMA) Wants: CMA; MAGNET; FastC2AP; GoogleEarth; CENTRIX
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