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THESIS

MDA DEVELOPMENT: BY DESIGN OR BY POLICY?

by

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Maritime Domain Awareness may require reach across Federal, State, local and private agency maritime security systems to create an accurate, timely, and reliable common operating view. The view will provide the user with an in-depth, multi layer linkage of situational awareness and threat assessment developed from many databases, to support different needs at different levels of the national maritime security system. Implementing new and emerging technologies into the U.S. Navy system may enhance the Maritime Commander's ability to achieve situational awareness in a more timely, efficient, and accurate manner than what occurs now. Recognizing the advantage of new and emerging technologies, the SECNAV and CNO have tasked PEO C4I to develop a system, which will aid the U.S. Navy in meeting the MDA mission; this system is known as MDA Spiral-1. This thesis examines the effects of placing new and emerging technologies developed in Spiral-1 onto legacy systems and how the U.S. Navy as an organization will either absorb these technologies or make multi-dimensional changes to enhance the process of achieving MDA.

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MDA DEVELOPMENT: BY DESIGN OR BY POLICY

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Submitted in partial fulfillment of the
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ABSTRACT

Maritime Domain Awareness may require reach across Federal, State, local and private agency maritime security systems to create an accurate, timely, and reliable common operating view. The view will provide the user with an in-depth, multi layer linkage of situational awareness and threat assessment developed from many databases, to support different needs at different levels of the national maritime security system. Implementing new and emerging technologies into the U.S. Navy system may enhance the Maritime Commander's ability to achieve situational awareness in a more timely, efficient, and accurate manner than what occurs now. Recognizing the advantage of new and emerging technologies, the SECNAV and CNO have tasked PEO C4I to develop a system, which will aid the U.S. Navy in meeting the MDA mission; this system is known as MDA Spiral-1. This thesis examines the effects of placing new and emerging technologies developed in Spiral-1 onto legacy systems and how the U.S. Navy as an organization will either absorb these technologies or make multi-dimensional changes to enhance the process of achieving MDA.

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I. INTRODUCTION

The Maritime Domain Awareness (MDA) concept was introduced in December 2004 in the National Security Presidential Directive 41 / Homeland Security Presidential Directive 13. This directive established policy, guidelines and implementation actions for enhancing U.S. national security and homeland security by protecting U.S. maritime interests.[1] Most importantly the directive established the Maritime Security Policy Coordination Committee[2] and produced a working definition for MDA, "Maritime Domain Awareness is the effective understanding of anything associated with the global Maritime Domain that could impact the security, safety, economy, or environment of the United States."[3] NSPD 41 also directed the Secretaries of Defense and Homeland Security to work together and create a recommended interagency draft for National Strategy for Maritime Security, which was signed by the President, September 2005. The strategy is to align all the Federal government maritime security programs into one combined plan, and a unity of effort across Federal, State, local and private sector entities to achieve the directives set forth earlier by the President in NSPD 41. This document outlines the requirements for eight supporting plans along with a brief description of each plan. The eight plans developed in support of the strategy deal with specific threats and challenges of the maritime environment. Each plan is separate; however they are grounded in the security principles stated in the National Strategy for Maritime Security. These plans are: National Plan to Achieve Domain Awareness, Global Maritime Intelligence Integration Plan, Interim Maritime Operational Threat Response Plan, International Outreach and Coordination Strategy, Maritime Infrastructure Recovery Plan, Maritime Transportation System Security Plan and Maritime Commerce Security Plan, and Domestic Outreach Plan.[4]

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[1] *National Security Presidential Directive NSPD-41/Homeland Security Presidential Directive HSPD-13* (Washington, D.C.: The White House, December 2004), 1.

[2] Ibid. 3.

[3] Ibid. 5.

[4] *The National Strategy for Maritime Security* (Washington, D.C.: Department of Homeland Security, September 2005), 27.

The MDA requirements set forth in the National Strategy for Maritime Security can be found in the National Plan to Achieve Maritime Domain Awareness. This plan labels MDA as "the critical enabler that allows leaders at all levels to make effective decisions and act early against a vast array of threats to the security of the United States, its interests, allies, and friends."[5] For this to happen the plan calls for and will rely on a national maritime common operational view. This common view can be accessed by users at the Federal, State, and local maritime agency level with the goal of providing each user with the "right" amount of information to aid them in their pursuit of MDA. The National Strategy further states the need to harness emerging technologies and strap them seamlessly onto current legacy systems. Taking the concept a step further is the Fleet MDA Concept of Operations, implemented by Fleet Forces Command, 13 March 2007. It presents the U.S. fleet with a "how to", by defining standardized MDA-related processes and mechanisms while giving direction for the development of a Navy architecture to support MDA. While its main thrust is operational, it also deals with tactical as well as strategic issues.

Combined, the above-mentioned documents give a basis for how the U.S. Navy may reorient itself to take advantage of emerging technologies and efficiently deal with the latest threats to the maritime community. Using this perspective the question for this thesis is; As a system what affect will the MDA concept coupled with the adoption of Spiral-1 technologies have across the U.S. Navy? By adopting MDA into its current mission, the U.S. Navy must first decide how best to define Awareness in the Maritime Domain. The problem of "awareness" must be defined and scoped to what is possible and what can be known within the context of how the U.S. Navy operates. After a common understanding and scoping of awareness as it pertains to the mission of MDA is made, how the U.S. Navy will adopt that understanding will be discussed. Additions to a system, whether technical, or non technical, generally implies that change is required elsewhere within that system and across multiple dimensions of that system. Change may be necessary, for example, across organizational dimensions such as organizational,

[5] *National Plan to Achieve Maritime Domain Awareness* (Washington, D.C.: Department of Homeland Security, October, 2005), 20.

technological, cultural, paradigms, operational, and processes (work). While a study across the many dimensions would be helpful in understanding the range of change required, this thesis will specifically study the implications for change that may occur within the dimension of information processing, or the core work for system and organizations within the system. Specific data collected from a process engineering workshop will be used to demonstrate and align specific Spiral-1 technologies with specific MDA tasking. The results of that data will then be used to explain the changes that may occur and be needed in changing the processes used by the Navy to turn data into information and move that information to the appropriate user in the most efficient manner.

By adopting the MDA mission the U.S. Navy recognizes a need to make changes to the current Navy mission. Changes to the mission start with a common understanding of the new mission. Understanding MDA involves understanding "awareness" and how it is applied throughout the Navy system along with how it is implied in the guiding documents for MDA. Changes for the U.S. Navy to achieve MDA will undoubtedly need to take place. Any time change is initiated in a system multiple changes can occur. Changes to technology can trigger changes in the process. Changes in processes may lead to further changes in outputs from the system. Along with changes to the outputs the workers who use the process may change themselves. Studying change and the dimensions of change will lend insight to how MDA Spiral 1 technologies will affect the U.S. Navy system. Data will be presented from a study conducted at the Naval Postgraduate School establishing how technological change can affect processes already in place within the Navy system. The results of this study will be used to show how multi-dimensional change does not necessarily promote fundamental change across multiple systems. For multi-dimensional change to affect multiple dimensions changes across the systems using the processes must be purposefully implemented

While this thesis will address changes inside the U.S. Navy system, the same analysis can be made across the multiple systems, which are key stakeholders of Maritime Security. In order to maintain a secure maritime environment, the cooperation of Federal, State, local, and private agencies will be needed. It is important to develop a

layered in-depth approach to defending U.S. and ally maritime interests, but that development will occur on many levels and across many entities, which are beyond the scope of this thesis. Also, this thesis will not argue for or against implementing MDA, as this decision is a mandate. The current administration has made it clear, the MDA policy will be implemented and specific technologies have been tapped to make this possible.

A. OBJECTIVE

Maritime Domain Awareness (MDA) combines Situational Awareness and Threat Awareness (TA) to create working knowledge maritime commanders can use to better utilize resources, while allowing the tactical operator access to the same information.[6] Allowing the tactical operator access to the same information in the same format the maritime commander uses is vital to allowing the most efficient decision making to occur at the lowest level. Key to this understanding is the role of information. Thanks to advances made in how data is moved, stored, and accessed; the operator has the potential to retrieve and view the same data used by analysts who turn the data into information and add to the operator's awareness. This ability could eventually make the analyst obsolete or change how the analyst provides information to the operator or even how the operator gets their information. Full MDA achievement is difficult, requiring cooperation over many levels, agencies, and countries. The Information Age has created a culture in which the expectation for information can be fulfilled at almost real time. The use of routable networks allows for strategic commanders to see the same information available on the tactical operator's system. Technologies that allow the strategic commander to see the tactical operator's SA also allows the tactical commander to view the TA available to the strategic commander. Broadening the information shared across commands rather than up and down small information highways may cause an information overload and indecision, crippling the on scene commander rather than serving as another weapon upon which the commander can use to help thwart the enemy. This thesis will asses the abilities of technologies being presented in the MDA Spiral 1 project to increase SA, combine it with threat awareness to create a workable MDA

[6] *Navy Maritime Domain Awareness Concept* (Washington D. C.: OPNAV 00, May 2007), 4.

environment maritime commanders can use more effectively to assign resources more efficiently and thwart those threats. The argument for or against MDA is not in question, that work has been done before, and it was found that MDA is something the maritime community needs to make it safer. This thesis argues for the best implementation of technology to allow the maritime commander to succeed in achieving MDA, which will ultimately allow for more efficient and better decision making of the limited resources available.

B. BACKGROUND

Many argue the U.S. Navy has been doing Maritime Domain Awareness or some form of it since its inception. It is possible to believe this statement. After all weren't the original commerce raiders of the American Revolution required to find and overtake enemy British vessels? And not to mention the blockade-runners of the Civil War, who clearly needed some form of intelligence to aid in the support of the rebels. Both required a unique set of information to aid in their pursuit or evasion of the enemy. Scheduled arrivals and departures of vessels, helped create situational awareness, while number and relative position of British Man of War vessels aided in the threat assessment needed to overcome the seemingly insurmountable odds of the revolutionary sailor. Throughout history many examples can be found of MDA aiding the maritime commander in making the decisions necessary to overcome an enemy. The common thread throughout the examples is having the most accurate and up to date knowledge of what or who is the enemy, finding that enemy and swiftly prosecuting them with the most efficient means available. Today the challenge remains the same, find the enemy, and bring the appropriate force to bear with the most efficient use of the resources available. The scope of the problem has changed. No longer does the enemy take the form of a recognizable nation state with forces common to the U.S. Terrorists, piracy, and human trafficking are among the list of threats to international maritime commerce and the sovereign territory of the U.S. Along with recognizing the broadening scope of the enemy, the U.S. has realized the need for reducing such threats as far from U.S. shores as possible. By blending the traditional role of extending U.S. policy around the world, with the role of law enforcement, U.S. Navy must take strides in sharing multiple layers of

information across its own system as well with organizations outside the U.S. Navy. This shift in mission and sharing information will also ignite a change to traditional U.S. Navy maritime efforts to include a Maritime Domain Awareness perspective.

1. NSPD 41 / HSPD 13[7]

The Bush administration recognized the need for a document, which could bring together the many Federal, State and local agencies to work together in achieving maritime security. National Security Presidential Directive 41 (NSPD – 41) / Homeland Security Presidential Directive 13 (HSPD – 13) was signed by the president December 2004 and is the guiding directive to implement policy, authority and responsibility for a more secure maritime environment. It begins with a call for combined efforts at the state, federal, and agency level to oppose any threat to the US and partner maritime assets. It also required the creation and development of different programs to include: the founding of the Maritime Security Policy Coordinating Committee, the development of a National Strategy for Maritime Security; charging the Senior Steering Group for MDA to create a national plan for MDA, calling for the integration of Global Maritime Intelligence, coordinating International efforts and international outreach; developing a national Maritime Response Plan; developing a national maritime infrastructure recovery plan; produce recommendations for improvements to the national and international maritime transportation security system; and the development of a maritime supply chain security plan. The committee is an inter-agency body serving to coordinate all U.S. Government maritime security policies. It will review these policies along with inter-agency coordination and execution as it relates to maritime security and give any recommendations, which can improve maritime security.

[7] *National Security Presidential Directive NSPD-41/Homeland Security Presidential Directive HSPD-13* (Washington, D.C.: The White House, December 2004).

2. National Strategy for Maritime Security[8]

The National Strategy for Maritime Security was signed September 2005. Inside this document the requirements for MDA can be found. It begins with the reasons for establishing a more secure maritime environment:

> In today's economy, the oceans have increased importance, allowing all countries to participate in the global marketplace. More than 80 percent of the world's trade travels by water and forges a global maritime link. About half the world's trade by value, and 90 percent of the general cargo, are transported in containers. Shipping is the heart of the global economy, but it is vulnerable to attack in two key areas. Spread across Asia, North America, and Europe are 30 megaports/cities that constitute the world's primary, interdependent trading web. Through a handful of international straits and canals pass 75 percent of the world's maritime trade and half its daily oil consumption. International commerce is at risk in the major trading hubs as well as at a handful of strategic chokepoints.[9]

With the U.S. and global economy tied so closely to the world's oceans, a national strategy was needed to fulfill the Presidential directive and better establish a secure maritime environment.

The threats to the maritime security environment are spelled out and described. The threats listed range from the common nation state threat, to criminal and piracy organizations. And now include the not so common threat of environmental damage, illegal immigration and terrorist threat. Each threat is unique but they all still impact the maritime security environment, whether it's in a traditional use of sea power to capture and deny the usage of international water ways or the not so obvious threat of a massive storm wreaking havoc upon a coastal shipping town. No longer can the U.S. only be concerned with projecting power overseas and on the seas, it must look to how controlling sea lanes can benefit the security of the U.S. by other means. It's not enough to stop other nation states or piracy groups from threatening U.S. and allied merchant shipping. The illegal smuggling of migrants and terrorists is a relatively new and strategy, which must be addressed in order to keep the homeland, secure. And by

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[8] *The National Strategy for Maritime Security* (Washington, D.C.: Department of Homeland Security, September 2005).

[9] Ibid. 1-2.

including in this strategy the means for dealing with natural disasters that may occur in and around a port city the strategy rounds out a comprehensive plan calling for many agencies to work together.

After naming these threats, the strategy goes on to name three guiding principles to address these threats:

> First, *preserving the freedom of the seas* is a top national priority. Second, the United States Government must *facilitate and defend commerce* to ensure this uninterrupted flow of shipping. Third, the United States Government must *facilitate the movement of desirable goods and people across our borders, while screening out dangerous people and material*.[10]

While these are the guiding principles upon which this strategy will be developed the United States does not ignore its inherent right to self defense and defend itself against all enemies. While using these guiding principles four explicit objectives are named: Prevent Terrorist Attacks and Criminal or Hostile Acts; Protect Maritime-Related Population Centers and Critical Infrastructures; Minimize Damage and Expedite Recovery; Safeguard the Ocean and Its Resources[11] Again each one is unique and poses it's own challenges. The strategy makes a case for each objective and what specifically is to be dealt with in each objective, while at the same time recognizing these objectives are part of an overarching strategy to secure the maritime environment against any threat. By enacting the aforementioned strategic objectives the original five objectives of the strategy can be met.[12] The focus of this thesis will be on the objective of Maximizing Domain Awareness.

It is from this section of the strategy that we get our working definition of Maritime Domain Awareness. Naturally any domain is a large area and may encompass all parts of the environment that can be recorded, processed and/or manipulated. Our strategy concerns itself specifically with having awareness and threat knowledge of the

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[10] *The National Strategy for Maritime Security* (Washington, D.C.: Department of Homeland Security, September 2005), 11.

[11] *National Plan to Achieve Maritime Domain Awareness* (Washington, D.C.: Department of Homeland Security, October 2005), 8.

12 The objectives are: Enhance International Cooperation, Maximize Domain Awareness, Embed Security into Commercial Practices, Deploy Layered Security, Assure Continuity of the Marine Transportation System.

relevant domain to achieve maritime security and prevent adverse events. The maritime domain is a large area; the oceans are vast areas that cannot come under complete full time surveillance with the limited resources available to the U.S. Couple that with intricacies found in any port city, the non-transparent ownership of vessels and cargoes, the high rate of turnover and poor record keeping of crew manifests and the result is a maritime security environment which is very difficult to monitor, detect within it significant anomalous behavior, and even harder--to prosecute under international or national law once a case against suspects can be made and the suspects found. Overall it could be a case of being too late when prosecuting a suspect vessel of having WMD before it reaches the U.S. shores. It could also be a problem of tracking and hand off from agency to agency or even from fleet to fleet for the purpose of pursuing a possible terrorist suspect before that suspect disappears in the miasma of the port city and country in which we may not be familiar. Or the suspect could possibly be lost until he is found after causing a catastrophic event on U.S. soil. The strategy speaks to these dilemmas and addresses them with calling for more information sharing and a new coordinated cooperation among various elements of the public and private sector. The strategy turns the problem into an information-sharing problem. By having various agencies and elements of the private sector work together both nationally and internationally a synergy can be developed to engage the enemy and prevent them from carrying out any plans to cripple the U.S. and it's allies by means of the maritime environment.

3. National Plan to Achieve Maritime Domain Awareness[13]

This document lists the goals, and objectives of MDA along with what types of organizations will be needed and how those organizations will need to process information to work together and achieve MDA. This document looks to fulfill needs put forth in the National Strategy for Maritime Security. The needs presented in the National Strategy call for the enactment of this plan in achieving Maritime Domain Awareness. This plan stems to meet the strategic goals of:

[13] *National Plan to Achieve Maritime Domain Awareness* (Washington, D.C.: Department of Homeland Security, October 2005).

- Enhance transparency in the maritime domain to detect, deter and defeat threats as early and distant from U.S. interests as possible;
- Enable accurate, dynamic, and confident decisions and responses to the full spectrum of maritime threats; and
- Sustain the full application of the law to ensure freedom of navigation and the efficient flow of commerce.[14]

The plan ties these strategic goals into objectives that directly relate to the MDA mission. Creating systems that gather data alone will not meet the needs of achieving a persistent and accurate system able to detect and alert users to maritime security issues. These objectives are listed in an essential MDA task list:

- Persistently monitor in the global maritime domain:
  - Vessels and craft
  - Cargo
  - Vessel crews and passengers
  - All indentified areas of interest
- Access and maintain data on vessels, facilities, and infrastructure
- Collect, fuse, analyze, and disseminate information to decision makers to facilitate effective understanding
- Access, develop and maintain data on MDA-related mission performance.[15]

The combination of stated strategic goals with a clear essential MDA task lists makes for a plan organizations can use to develop their own concept of MDA. The organizations the plan looks to for implementing MDA come from Government Organizations, International Organizations and Private Sector Organizations. The plan recognizes the unique capabilities each organization brings to the maritime domain and realizes MDA is not achievable without the direct support and cooperation of these organizations. Enabling actions for MDA are listed with an emphasis on information management. Key to making MDA achievable when working across multiple security agencies at home and allies abroad is: Enhanced Information Collection, Information Sharing, and Establishing Set Standards from which all can reference and adhere. And the technologies that make

[14] *National Plan to Achieve Maritime Domain Awareness* (Washington, D.C.: Department of Homeland Security, October 2005), 7.

[15] Ibid. 8.

these key acts possible are: Improved Sensors and Platforms, Communications that disseminate knowledge in a common operating picture, and technologies that exploit the information gathered, automating processes that assist the analyst in a rapid understanding of the data gathered.

The National Plan to Achieve Maritime Domain Awareness addresses a particular technique for building a more secure Maritime Environment. This plan along with the other eight named in the National Strategy for Maritime Security, address a complex and changing environment which the U.S. must operate and depends upon for its economic livelihood. Implementing this plan and the changes commiserate with achieving the objectives listed depends upon developing paradigms which reflect the urgent need for improved maritime security. Adding to current paradigms will take time and can be achievable, but understanding the plan and being open to change is essential to achieving MDA.

C. METHODOLOGY

U.S. awareness of the maritime domain is a product of Federal, State, local and private maritime security organizations and systems. As directed by the President of the United States these systems will coordinate and cooperate at varying levels to achieve a comprehensive plan to enhancing maritime security. The U.S. Navy has chosen to implement a set of technologies labeled MDA Spiral-1 as its part in enabling the Navy to add in the achievement of MDA. Adding or taking away from a system will have an effect on the system being changed. This thesis looks at the impact of implementing Spiral-1 technologies onto the U.S. Navy.

Research has been done in the area of situation awareness. A qualitative research into awareness attempts to build a framework for understanding the term "awareness" and how it is applied in the maritime domain. A model created by Endsley will be used to demonstrate how individual situation awareness is developed.[16] Referencing Nofi's discussion on shared situation awareness furthers how an organization and the individuals

[16] M.R. Endsley, "Toward a Theory of Situation Awareness in Dynamic Systems", *Human Factors* 31 (1) (1995).

within the organization build awareness.[17] Both are applied to how watch standers, decision makers and the organizations they operate within can hope to build their awareness.

Implementing MDA involves "change" and to understand how fundamental the change may be, an understanding of "change" must occur. This thesis describes concepts of change as presented from the perspective of large-scale organizational change. A qualitative description of the processes for change, the aspects of change, and how to recognize and process change is made.

Data is then presented reflecting the current state of MDA in the U.S. Navy. The data is taken from a qualitative study directed by OPNAV N3/5 and conducted by NPS. It presents Spiral-1 technologies, workflow diagrams for current MDA processes, and a table for matching technologies to MDA tasks. A qualitative analysis of the data follows highlighting common threads across varying levels of the U.S. Navy and the socio-technological affects of implementing technological change.

The presented perspective of awareness as it applies to individuals, and organizations in building MDA along with understanding the affects of change in large-scale organizations is used to reach conclusions on the implementation of MDA as a concept and technique within the National Strategy for Maritime Security. The conclusions specifically address the affects of implementing Spiral-1 technologies onto current U.S. Navy processes. The conclusions are based on a system analysis approach using a business process redesign (BPR) technique.

[17] Albert A. Nofi, *Defining and Measuring Shared Situational Awareness* (Alexandria, VA: Center for Naval Analyses, 2000).

II. AWARENESS

A key tenet of Maritime Domain Awareness is understanding the term Awareness and how it is meant in the context of the Maritime Domain. The Navy's Maritime Domain Awareness Concept signed by then CNO, ADM Mullen gives a U.S. Navy perspective on MDA, "consists of what is observable and known (Situation Awareness), as well as what is anticipated or suspected (Threat Awareness)."[18] This statement covers much of the maritime world. It locks us into Awareness of anything dealing with the Maritime Domain to include, ports, rivers, oceans, tributaries, straights, the vessels which float on them, the associations the crews who man those vessels have, the ports frequented by those vessels and routes taken to get to and from those ports, the association of the owners of those vessels, the cargo itself where it came from where it is going, who owns the cargo and who is moving it, the information systems used to track all this for each individual business, the means by which the many entities involved in the vessel or port go about communicating. Many more elements from the maritime domain could be added to create an exhaustive list that may never fully encompass the entire maritime domain. Which is exactly how the National Plan to Achieve Maritime Domain Awareness frames MDA, "Maritime Domain Awareness is the effective understanding of anything associated with the maritime domain that could impact the security, safety, economy, or environment of the Unites States."[19] It is from this posture the U.S. Navy can only hope to define MDA within the scope and boundaries of what is possible for the individual decision makers and as an organization and system acting within the National Maritime Strategy. A model was developed by Endsley to help explain and better understand Situational Awareness. This model will also be helpful in understanding the U.S. Navy's MDA concept and is presented as Figure 1.

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[18] *Navy Maritime Domain Awareness Concept* (Washington D. C.: Chief of Naval Operations, May 2007), 4.

[19] *National Plan to Achieve Maritime Domain Awareness* (Washington, D.C.: Department of Homeland Security, October, 2005), 1.

A. INDIVIDUAL SITUATION AWARENESS

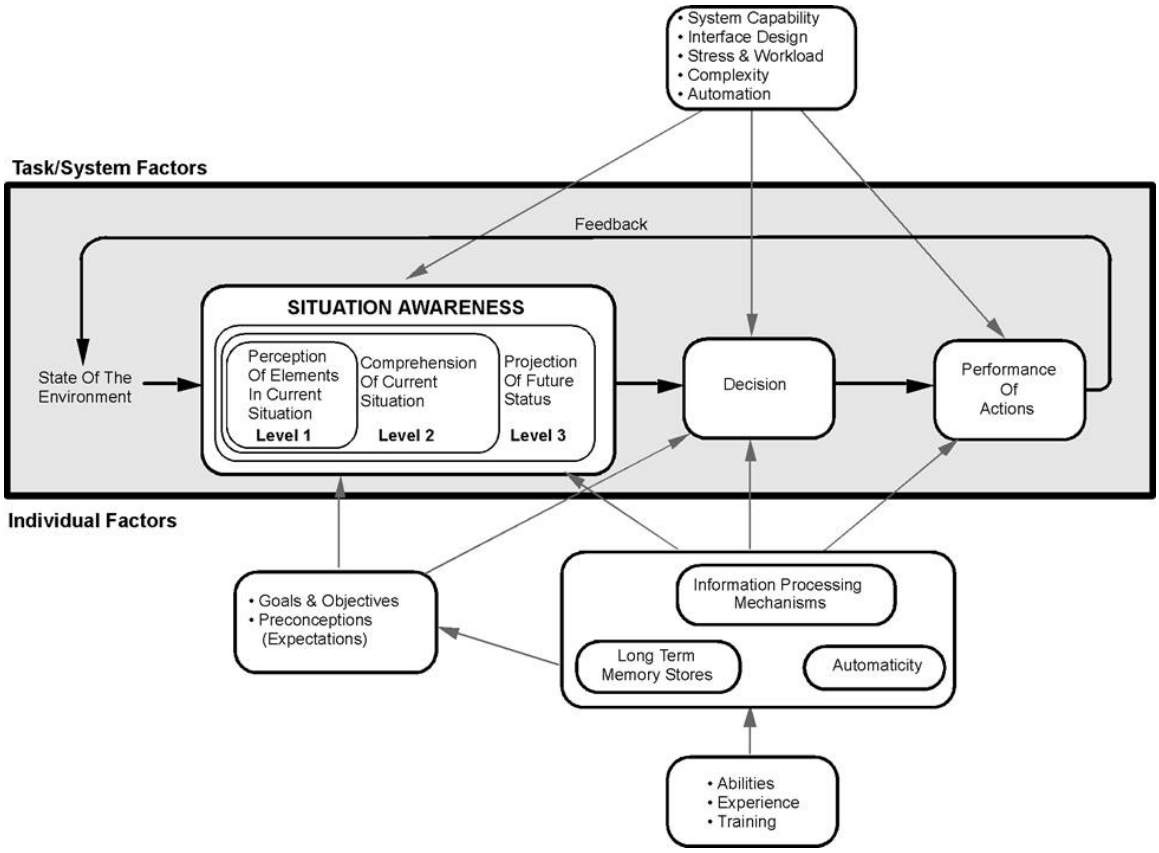

Figure 1. Model of situation awareness in dynamic decision-making.[20]

The model presents SA in the individual cognitive domain with three distinct levels of SA. These levels are: "Level 1 SA: Perception of the Elements in the Environment; Level 2 SA: Comprehension of the Current Situation; Level 3 SA: Projection of Future Status".[21] Level 1 is the raw data or information gathered within a particular environment. In the maritime domain it can be many elements to include vessel name, course and speed, local or regional weather to name a few. This process occurs anytime one ship is within sight or radar range of another and any information about that particular vessel is gathered. The next level is relating that information into a context that is useful or meaningful to the user. The decision maker takes level 1

[20] M.R. Endsley, "Toward a Theory of Situation Awareness in Dynamic Systems", *Human Factors* 31 (1) (1995): 4.

[21] Ibid. 5-7.

elements and puts them together to create a meaningful picture of the situation in relation to goals and expectations. An individual watch-stander's experience and knowledge is critical to forming level 2 SA. It is not enough for the user to look at the data collected without a frame of reference. To know the name, location, course and speed of a vessel doesn't mean much unless the individual can relate those elements back into a goal or why that information may be important. Perhaps the watch stander is looking for a vessel around the same location with the same course and speed. By comprehending the location, course, and speed with a desired goal of finding a match the watch-stander begins to build their SA. And the final level of SA (projection) becomes the most useful to the decision maker. At this level the watch-stander is using the comprehension (level 2 SA) of the environment (level 1 SA) to predict possible outcomes and subsequent actions to deal with the current environment. Relating this to the maritime domain, a watch-stander may notice a report or see a radar or satellite image of three small ships. By combining the elements of information regarding each ship the watch-stander comprehends these ships may be on a course to meet on the open seas and projects the time and place of their meeting.

Endsley's model can be applied directly to the mission of achieving MDA. The technologies involved in Spiral-1 allow the watch stander to gather elements of information to build level 1 SA. As the information is gathered and entered into a program, databases are queried and connections are made, level 2 SA is achieved. The watch-stander then projects the actions of the particular ships being reported by using their own level 2 SA. In addition, the watch stander then uses their level 2 SA in relation to their forces to produce an assessment, which allows the decision maker to assign resources to further investigate the anomaly or dismiss it. Through this process the individual has certain experiences and knowledge that add to their ability to achieve the different levels of SA. This may include the individual's technical prowess in regards to the program being used to gather information. Also the individual's amount of knowledge regarding the environment will determine how often level 1 SA information is addressed or looked for in adding to level 2 SA. If the watch-stander is unfamiliar with a particular region or particular shipping company, much more level 1 knowledge will have

to be gathered by the watch stander to build comprehension and further project where that particular ship may be going or what type of cargo it may have. The experiences of the individual and the limitations of the technologies used all contribute to the individual's SA. That individual may be a decision maker, or a watch stander tasked with keeping the most up to date operating picture. In both cases the individual is building their own individual cognizant picture. The assessments made by those watch standers are still individual situation assessments that may be used across the organization to aid in building an overall awareness. MDA spiral-1 technologies do just that, they enable the user to create their own situation assessment through different applications, queries inside those applications and the databases that are accessed. Keeping the intent of MDA in focus, these assessments must be transferable and usable for other decision makers to develop and create their own situation assessment.

B. ORGANIZATIONAL SITUATION AWARENESS

Each Situation Awareness level of Endsley's model depends on the lower level, however the linear progression from level 1 to level 2 and level 3 is not necessary. Endsley describes when this process is not beneficial, "The reality, however, is that a simple 1-2-3 progression (i.e., data-driven) is not an efficient processing mechanism in a complex and dynamic system, which is where expertise and goal driven processing come into play."[22] The U.S. Navy as an organization is in direct conflict with this statement. As an organization it lacks the ability to create a cognitive picture. What ever picture is being created that picture comes from the efforts of many individuals within the system. The systems being used by the individuals in creating their own maritime awareness pictures need to be a shared system. By making it a shared system the Navy ties the problem directly into a data-driven problem. Replacing and updating the systems in place that help build an individual's awareness is an ongoing endeavor. By using the most current and cutting edge technology in information sharing can the U.S. Navy as an organization hope to build an organizational awareness? The Navy Maritime Domain

[22] M.R Endsley, "Situation Awareness: Progress and Directions," in *A Cognitive Approach to situation awareness: theory and application*, ed. Simon Banbury, and Sebastien Tremblay, (Burlington, VT: Ashgate Pub., 2000), 317.

Awareness Concept gives a description of how it views MDA, turning it into a data-driven problem reliant on Global Maritime Situation Awareness (GMSA):

> A precondition to true MDA, and to successful execution of many of Navy's worldwide mission sets, is establishment of robust GMSA: a multi-layered, multi-domain picture that links the identity, location, known patterns and present activity of ships, cargo, people, and hazards within and adjacent to the maritime domain. This picture derives from the pooling of a comprehensive set of mostly unclassified data contributed by the many agencies and nations with knowledge of the maritime domain. It is a compilation of information, regardless of classification, ranging from environmental data (oceanographic, meteorological, etc.) to vessel positions and characteristics, to cargo manifests and supply-chain information, to biometric identification data, to regional activity patterns (fishing areas, commercial routes, seasonal variations, etc.).[23]

At best the U.S. Navy can hope to achieve shared situation awareness. Working across an organization an individual can build their own relational situation awareness of any given region or time. When that individual assessment gets passed onto another user perhaps in the same region, on the same watch, or across the organization to a user outside the context of that watch the assessment is no longer contained in the individual's cognitive "picture" of awareness. The assessment that is passed along is a snapshot of that individual's awareness, and the individual continues to create his or her own personal awareness by updating or asking for more level 1 SA. The organization and users within the organization must rely on the assessment made by each individual in the system to create their own situation awareness and subsequent assessment. Albert Nofi explains the dilemma in his study, "In any given 'situation' these people each have their own 'individual SA,' a unique dynamic picture of the situation, which exists in their minds."[24] Nofi also gives 3 distinct actions performed by the individuals to build shared situation awareness:

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[23] *Navy Maritime Domain Awareness Concept* (Washington D. C.: Chief of Naval Operations, May 2007), 9.

[24] Albert A. Nofi, *Defning and Measuring Shared Situational Awareness* (Alexandria, VA: Center for Naval Analyses, 2000), 26.

- Build individual situational awareness within the framework of the mission to be accomplished
- Share their individual situational awareness, which requires being "aware" of relevant actions and functions of other team members.
- Develop the group "shared situational awareness."[25]

The emphasis placed on the individual input to the organization cannot be ignored. For the individual to give a meaningful and useful input he or she must have a clear understanding of how their part contributes to the overall MDA mission. As the individual builds their levels of SA and makes queries back to the level 1 elements they must do so with the overall mission in mind otherwise they build an assessment which is of no use to the decision maker. As an organization that operates in a shared situational awareness environment the U.S. Navy must identify its own organizational impediments to building shared awareness across the organization and outside the organization.

Communications, both technical and as social network, is critical to building shared awareness. Not only must there be a common means (i.e., interoperable communications systems) through which data must flow, an agreement to how that data is viewed or read must also be standardized. For the most part the U.S. Navy communications systems work well. Communication plans establish the frequencies used within and across the organizations. Well-established circuit discipline dictates the use and manner for which an individual communicates across the system. And the use of Internet protocols within applications communicated over a routable network, users can view the same information at or near real time as the user who is creating that view. MDA Spiral-1 technologies look to do just that, allow a user to create a view from multiple sources that can then be used as an assessment in building awareness the decision maker can use in assessing the possible threat, and then prosecute the threat or allow the vessel of interest to pass. The U.S. Navy concept for awareness names three primary elements, which must be met to achieve MDA:

[25] Albert A. Nofi, *Defning and Measuring Shared Situational Awareness* (Alexandria, VA: Center for Naval Analyses, 2000), 26.

- Global network or regionally based maritime information exchange partnerships.
- Institution of worldwide standards for broadcast of vessel position and identification.
- Automated tools that discern patterns, changes, and potential threats."[26]

Clearly the view presented from these requirements presents MDA as a data-driven problem involving not only the U.S. Navy but also maritime partners around the world. The information shared across the U.S. Navy and with maritime partners creates a shared situational awareness built on individual assessments.

Once the common ground to communicating individual SA across the organization is established, truly shared situational awareness can happen. Within that shared awareness a question of accuracy arises. As individuals bring their own awareness to the combined awareness, the amount of overlap between individual awareness is finite. As established earlier each individual will bring their own unique SA to the group. The combined group SA will share only a portion of each individual SA. There is no way of knowing exactly what another person may know. None of us can read another person's thoughts, and our experiences help create what we know about any given situation. Nofi illustrates this with a diagram:

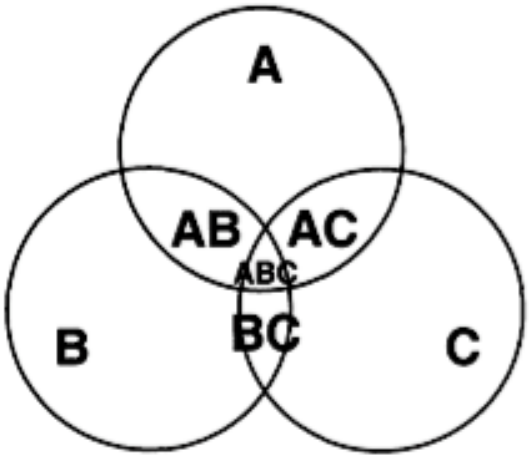

Figure 2. Diagram of Shared Situational Awareness.[27]

[26] *Navy Maritime Domain Awareness Concept* (Washington D. C.: Chief of Naval Operations, May 2007), 7-8.

[27] Albert A. Nofi, *Defning and Measuring Shared Situational Awareness* (Alexandria, VA: Center for Naval Analyses, 2000), 33.

Each letter can represent an individual within a group or each letter can represent a group within a system. Either way, when the knowledge contained within each is combined with others, the result is an awareness that is unique and smaller when compared to the original awareness. This illustration also demonstrates how accurate information in the original awareness elements is critical to the user in making the best, most well informed decision possible. The decision maker is making decisions based on the information passed along, and if that information is inaccurate the decision maker's conclusions about the situation and best pursuit of a course of action may also be inaccurate. To say accurate SA will enable the decision maker to make the best decision is not completely correct. Decision makers can only hope to get the most timely and accurate information enabling them to use their best judgment in making decisions. But how can that decision maker be sure the content he or she is viewing is the most accurate and timely information available? Nofi sites a model suggested by Barry McGuinnes,

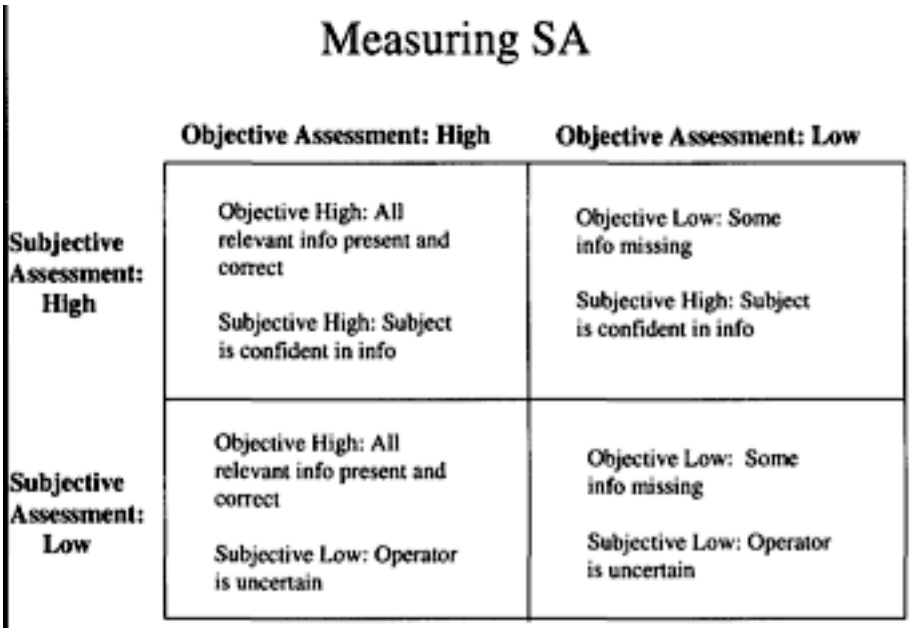

Figure 3. Measuring SA[28]

[28] Albert A. Nofi, *Defning and Measuring Shared Situational Awareness* (Alexandria, VA: Center for Naval Analyses, 2000), 41.

In McGuinness's model the objective is the actual information, or elements used to help build SA. The subjective measure is a relative number used by the user to describe their belief in their own SA. Of course the decision maker and individual want to reside in the upper left of the diagram. They want to know everything they can about the given environment and through their comprehension understand every facet and connection of the information present. This diagram does not give an empirical measurement of SA, it still relies on an individual assessment. It can become very dangerous when the individual resides in the upper right quadrant. Here the individual does not know all the information available, but believes they have a firm understanding of the situation. The assessment given by that individual may be lacking some vital piece of information, which would lead the individual to view the situation differently. Being in the lower left quadrant may show the individual lacks confidence in their assessment or does not have enough experience to comprehend the information and place it into a useable assessment. Being in the lower right quadrant the individual may recognize their inability to make an accurate assessment because of missing information. This individual may then begin to seek out that information to raise their comprehension and better assess the situation. In all cases the individual is making an assessment of their own SA. In no way is an outside source used to evaluate their SA. While this technique has limitations, it may be the best tool available to aid the decision maker in accepting or rejecting another SA in building their own SA.

Overall, awareness is subjective and dynamic. It exists inside within an individual's cognition. The individual's experiences and technologies used to build their SA all have an effect on their SA. Individuals bring with them elements of experience which can add to their subjective understanding of the world and cognitive view. The technologies they use can help build on their cognition or distract and not add value to their experience. How familiar an individual is with a technology can determine how much of an aid or hindrance the technology will be in adding to the individual's cognition. While an organization cannot posses a cognitive, working picture, it can enable sharing between individual SA to help build a common view, or understanding, across the organization. When building a shared situational understanding, systems must

be designed which build upon a common language (or taxonomy), understand and incorporate dynamics of cognition through which individuals build SA and include the ability to assess inputs from all relevant nodes allowing the decision maker to use their experience when assessing the information given to build the most accurate and timely view. As technology continues to develop and allow for better sharing across an organization, techniques and training must be part of the development to ensure a common view with discrete understanding of the system used is developed and useful. Allowing organizations to share data will not create awareness in the maritime domain. However, giving those organizations a template from which they can input data and use shared information to create a common view will aid in the organizations awareness of the maritime domain.

III. CHANGE

To understand an organization it is fairly common to look at it as a system of inputs, processes and output with some kind of feedback to the input process. Figure 4 from *The Congruence Model: A Roadmap for Understanding Organization Performance* published by the consulting firm of Mercer Delta gives a very simple and basic graphical depiction of an open system.[29] Any system can be understood by using this model as a basis. The system will have some kind of input from which it will manipulate or change that input via the different processes it has adopted and goals or missions it is attempting to perform, and produce some kind of output that is useable by the system, organization or another system outside its own organization.

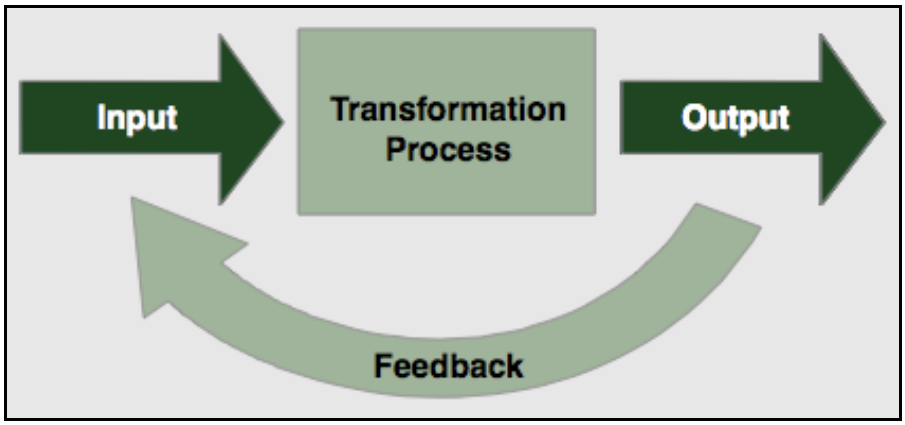

Figure 4. Basic Systems Model[30]

Changes to any part of the system can (and generally will) result in changes to the organization and other parts of the system.

The model used and presented here is a basic systems model. It represents how systems take inputs; puts them through a process which changes them to outputs of the system. In an information system the inputs can be raw data, numbers or figures. The data is then put into a system or application for example an application like Excel. A

[29] "A Congruence Model: A Roadmap for Understanding Organizational Performance," (Mercer Delta Consulting LLC, 1998), 3.

[30] Ibid. 3.

series or parallel set of actions take place changing the raw data into an output the system deemed usable. The outputs can then lead to further changes in what inputs the system may need to create useful outputs for the system. Or the feedback can help refine the transformation processes creating again more useful outputs for the system. The transformation process can be made from other systems creating multiple levels of system processes. But each level can be viewed from this basic system analysis approach.

The President in NSPD41/HSPD13 directed changes to the National Strategy to include Maritime Awareness. The mandated change put forth by the President developed a National Strategy for Maritime Security along with subsequent plans to support the strategy. The National Plan to Achieve Maritime Domain Awareness is one such plan used by the Secretary of the Navy and Chief of Naval Operations to direct change in the U.S. Navy. The CNO viewed MDA as an information problem, to be solved with new emerging technologies. The OPNAV office then tasked PEO C4I with identifying technologies to be added to the U.S. Navy systems. These technologies are now known as Spiral-1 technologies, as the first increment of MDA capability. Their purpose is to change the way the U.S. Navy interacts with the requirement for MDA, and its inclusion as a system that extends USN participation through the rest of the MDA system. This chapter will further investigate the different aspects of change in a large-scale organization. To include which aspects of change have the most impact on fundamentally changing a large-scale organization. And highlight which aspects of change the U.S. Navy is implementing to enact a change consistent with the direction of the President through the Secretary of the Navy and CNO?

Change in any organization must happen for that organization to survive. Anytime a new technology, policy, or process is leveraged onto an organization that organization will experience change across different dimensions. These changes will affect in different ways and amounts many aspects of the organization. An organization's culture, the way the organization is structured, the operational processes of the workers, the operating environment of the organization, what old technologies will be replaced, and which new technologies will be adopted are a few examples of the elements affected

by change. While all of the above mentioned areas would be affected by any change in the organization, they may not change to the same degree. Depending on the type of change, how it is implemented and the "to be" will determine how much overall change will need to occur to adapt to the changes made. The cumulative amount of change adopted by an organization may force that organization into making a fundamental shift or paradigm change. It is also possible for an organization to adopt one aspect of change that is so fundamental the organization must also make a fundamental shift.

A. LARGE-SCALE CHANGE

Large-scale change is one form of change associated with organizations. Change in any organization can take on many forms. Organizations change constantly to meet the continuous evolving dimensions it operates. Most changes occur when the environment changes. Inputs into the system may change because of resource constraints; changes in technology may affect the process and how the workers use the system, new management may take over and decide to change the output or goal of the organization. Determining if large-scale change is needed or has occurred is a function of how far reaching (depth), how pervasive and at what level (just upper management or through the entire organization, i.e., size) change is implemented. An agreed upon definition for large-scale change is, "As a starting point, we will define large-scale organizational change as a lasting change in the character of an organization that significantly alters its performance."[31] It is fairly common for organizations to make small changes affecting many departments and believe it is making large-scale changes affecting the whole organization. Moving personnel within a department, adding new technologies to ease or accommodate workflow or shifting responsibilities of departments are not large-scale changes. While many people may be affected by these changes, their behavior within the system does not need to change or the behavior of the system doesn't need to change to adopt the structural changes placed on the system or the organization. The system simply absorbs the changes and keeps the same processes with the same inputs and produces the same output. New technologies that allow the workers to process

[31] Allan M. Mohrman, Jr. et al., "The Phenomenon of Large-Scale Organizational Change," in *Large-Scale Organizational Change* (San Francisco: Jossey-Bass Inc., 1994), 2.

an input may require some training but the input stays the same with the same output. The process changed but the system remains intact. Shuffling personnel to different departments is the same as shifting responsibilities of departments. The inputs, processes, and outputs remain the same with different people doing the work, again not a large-scale change. Neither the character nor the performance of the organization changed in a lasting way to call this large-scale change.

1. Organizational Character

One of the elements necessary for large-scale change must occur inside the organizational character of the organization. The character of an organization is made up of the key aspects to the open system: inputs, processes, and outputs. The character of an organization will be affected with changes across the whole system, not just one of the key aspects. Environmental changes can affect the inputs of a system. For a data driven system like MDA it may be how the system acquires inputs. Is the input raw data, or information from processed data on another system? For MDA an emphasis has been placed on receiving the raw data from never before used databases outside the U.S. Navy. The change to inputs has been the ability to access the same databases different agencies access instead of relying on the reporting system in place to transfer information. The process itself within the system is another aspect of change. Once the inputs are received how does the system change or manipulate the data into a useable format for that particular organization. It can be argued the U.S. Navy already has systems in place to do such things. And from this description the process has not changed rather it is being "enhanced". Already, we see one aspect of how implementing MDA will be a change in the character of the U.S. Navy. This statement also points out how the adoption of Spiral-1 technologies will make a change in the coordination, integration and dissemination of information across the U.S. Navy system. The U.S. Navy will have to coordinate with systems outside their own organization and disseminate information out to other organizations. The change here is in communications and ultimately affects the inputs to the systems being used. Again the actual processing of the data will not change. The technologies will only enhance the processes in place. The outputs of this system will remain the same, although the output product will be enhanced through the

enhancement of the processes, which produce the product. No significant change in the process or product is leading to a large-scale fundamental change in the U.S. Navy system.

2. Organizational Performance

If an organization changes its processes it will then in turn change the outputs or uses different inputs. When all aspects of the system are changed the organization may be experiencing a fundamental change. When the character of the organization changes, so too may the performance of that organization. When this happens truly a fundamental change to the organization is occurring. Not only will the organization's character change, but that change will have an effect on how the organization itself performs, "Performance is a broad term that can refer to the system's effectiveness as measured on a number of dimensions or to the nature of the dimensions themselves."[32] Organizations can go from being regional to encompassing a more global influence. No longer will it be measured on the standards of the region it is operating but in the global environment it has chosen to participate. As the organization becomes more dependent on other organizations how it relates to the needs of the other organizations may change. Communications outside the organization, how it perceives itself compared to others perception of it may change. If other organizations find it hard to work with the processes in place the performance of that organization may need to change to accommodate the other organizations now that it is dependent on them. What were priorities inside the system may change due to greater influences from outside the system. "Thus we would expect large-scale organizational change to alter both the nature of the organization's performance and its effectiveness as measured on a number of performance dimensions."[33] The MDA concept calls for greater cooperation across Federal, State and private agencies. Having agencies work together in ways they haven't in the past will stimulate those organizations to change how they perform different tasks.

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[32] Allan M. Mohrman, Jr. et al., "The Phenomenon of Large-Scale Organizational Change," in *Large-Scale Organizational Change*, (San Francisco: Jossey-Bass Inc., 1994), 3.

[33] Allan M. Mohrman, Jr. et al., "The Phenomenon of Large-Scale Organizational Change," in *Large-Scale Organizational Change*, (San Francisco: Jossey-Bass Inc., 1994), 4.

No longer will the different agencies only output products for their own use. MDA requires agencies to make changes to their performance in prescribing what may be new priorities. For instance, each numbered fleet inside the U.S. Navy has its own procedures and construct for how intelligence targets are selected and prioritized. Each fleet may prioritize common targets differently as they move from fleet to fleet areas of responsibility. The MDA requirement of better coordination across Federal, State, local and private agencies may require a change in performance for the numbered fleets. As priorities are set in regards to obtaining information on vessels crossing AORs each numbered fleet may need to adopt and reflect the other numbered fleets priorities, changing how that fleet performs its information gathering. No longer can the numbered fleets act autonomously in the manner they gather, process, and disseminate information, if they are truly adopting the MDA concept. They will need to cooperate across AORs to provide and keep track of what is an interest globally.

B. ASPECTS TO LARGE-SCALE CHANGE

For organizations to make large-scale changes the changes must have a significant occurrence in three aspects: Depth, Pervasiveness, and Size.[34]. Implementing large-scale changes in any organization is very challenging. Understanding the affect a change has in each aspect will help determine how fundamental and large a change will be in an organization. Not only can this be used to determine the affects of a change, it can also be use to help implement a change on a large-scale. Large organizations have multiple subunits and subsystems, which make for a very complicated system of systems. Individual subunits may be very large and require large complex subsystems. Affecting change in a few subunits, or subsystems and not across the organization is not large-scale change. However, if a subunit, or subsystem enacts a change that force the larger organization and other systems to adopt the same change of the smaller unit or system, then the change is large-scale. The three aspects mentioned earlier are measures of change across the organization and the many subunits and subsystems that make it up. As the effect of each aspect is increased so too is the size of change. If only two aspects

[34] Allan M. Mohrman, Jr. et al., "The Phenomenon of Large-Scale Organizational Change," in *Large-Scale Organizational Change*, (San Francisco: Jossey-Bass Inc., 1994), 10-11.

of change are present and a third is missing or insignificant then large-scale change does not exist. Each aspect must be present and to a significant degree for large-scale change to happen. Figure 5 gives a graphical depiction of the three aspects and their affect on change.

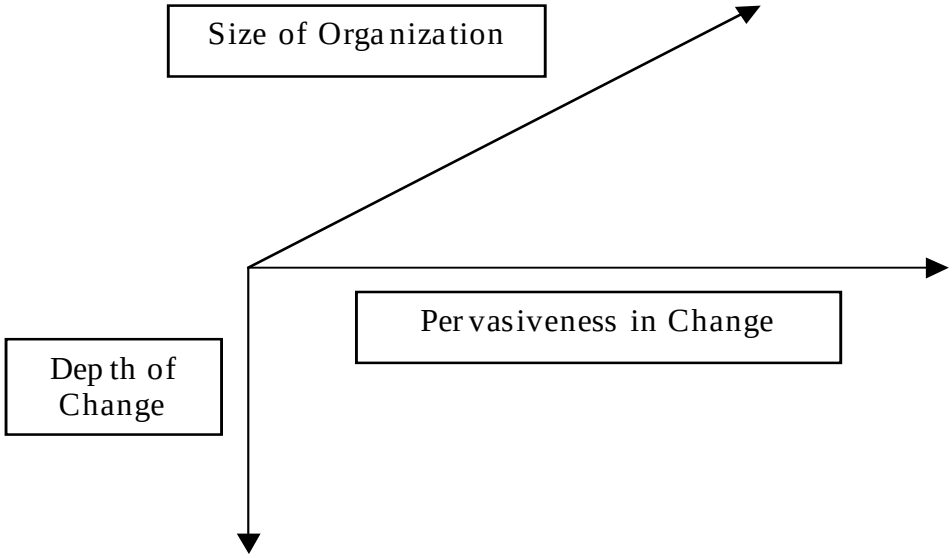

Figure 5. Dimensions of Large-Scale Organizational Change[35]

1. Depth

Measuring the depth of change involves individual paradigms and understanding of the goals or mission of the organization. Individual perception and understanding of the organizational goals help determine their subunit's goals. How the subunit or subsystem fit into the larger organization is key creating individual paradigms. The paradigms created are models for how the individual views the subunit or subsystem function as a process of the larger organization. The depth of change is not dependent on whether the individual agrees with the goal or structure, rather do they understand it and use it in their function. A common understanding of the subunit or subsystem goals are made from the individual understanding to form a paradigm in which the subunit or

[35] Allan M. Mohrman, Jr. et al., "The Phenomenon of Large-Scale Organizational Change," in *Large-Scale Organizational Change*, (San Francisco: Jossey-Bass Inc., 1994), 12.

subsystem exist and function. Changes that have greater depth enact a larger shift in paradigm to include a rejection of the old mindset and adoption of the new one. Shifting paradigms is not easy; it involves changing a person's way of viewing and understanding the world. Much resistance can always be found in the depth of change, because it is changing individual views of their purpose inside an organization and the purpose of the system to the organization.

MDA as a complete paradigm shift will not occur very easily and is still ongoing. The U.S. Navy already considers itself a significant player in the maritime security system. This view is no different from the position taken by the U.S. Navy in the Revolutionary War, Civil War, WW II and even now in a post 9/11 era. The difference in how information is processed and shared marks the paradigm shift necessary for the U.S. Navy to fully adopt MDA. Inside the U.S. Navy MDA may mean a shift in paradigm for the subunits and subsystems that contribute to the Navy mission of maritime security. But measuring the depth of change MDA will have across the U.S. Navy and the numerous subunits and subsystems that make up the Navy is too big a task for one thesis. Instead the technological change associated with MDA Spiral-1 technologies and their affect on specific processes within specific subunits and subsystems will be addressed.

2. Pervasiveness

Measuring how many subunits and subsystems of an organization change will enable a measure of the pervasiveness of change. If all the subunits and subsystems agree to adopt the same change, large-scale change will occur. It is not enough for one subunit or subsystem in the organization to enact change and label this large-scale. The more subunits and subsystems that adopt change, the more pervasive the change, hence the closer the change comes to being large-scale. The pervasiveness of change has three limits: time, multiple change agents, and group cooperation through coordination.[36] Complex large-scale organizations need time to affect change across the whole system.

[36] Allan M. Mohrman, Jr. et al., "The Phenomenon of Large-Scale Organizational Change," in *Large-Scale Organizational Change*, (San Francisco: Jossey-Bass Inc., 1994), 16.

Expecting long established subunits or subsystems to shift a paradigm is unrealistic. Formulating and enacting a plan to take change to every subunit or subsystem requires time. Change is an ongoing process to ensure it is received, adopted and implemented with the same intent the original change agent had in mind. To initiate change in multiple systems, multiple change agents are needed. Not one single person or technology is persuasive enough to affect change throughout the multiple subunits and subsystems that make up the larger organization and system. Each subunit and subsystem needs to make the same technological change or have someone with the same vision and goals leading the direction of change. For the change to be accessible to all subunits and subsystems, each of those subunits and subsystems must understand the change itself and then work together to build a consensus of what the change means. When all the subunits and subsystems work together to build a coordinated effort of change the change will take hold and be owned by the smaller units and systems, truly making the change pervasive. A new paradigm will be created within and by the smaller units and systems.

For the U.S. Navy, pervasiveness can be measured by how many numbered fleets, named fleets, task forces, etc adopt the changes mandated in the MDA concept. For the units and systems acquiring Spiral-1 technologies the change will be easier. Without placing the same technologies in every subunit and subsystem a large-scale change across the entire Navy will not be possible. However, the numbered and named fleets will experience pervasive change because the placement of Spiral-1 technologies in the units and systems which support them. The more wide spread introduction of the new technologies the more pervasive the technological change and the more large-scale the change. How well the technologies are adapted, and used everyday will also determine how much influence they may have on being pervasive. If the technologies are introduced with no training or not utilized the impact will be minimal. Also, if the fleets do not coordinate how best to use these technologies and learn from each other again the affect may not be very pervasive. Without coordination each fleet stands to use the technologies in the manner best fit to their needs. Their own unique adoption of the

technologies will not aid in the large-scale change, the change will be limited to each fleet and how they choose to adopt the changes, which come with the technologies.

3. Size

Size is a subjective term, and it may seem easy to understand. Large organizations are typically more complex requiring a large and complex change. Simple changes will not be complex enough to enact a large-scale change across a large organization. Large organizations contain certain aspects different and unique when compared to smaller organizations. When determining the affect or size of a change on an organization understanding the size of the organization will help render a change appropriate to the size of the organization. Determining the size of an organization requires a measurement of the organization in terms of it's complexity, stage of development, age, strength of culture, degrees of strategic freedom, power to alter the environment, and how loose of a coupling the large organization has on the subunits, and subsystems.[37] Resistance to change commonly comes from the size of an organization. The affects listed above can be dealt with and overcome individually but the overall character of the large organization is made from these.

The U.S. Navy itself is very large and complex. It takes many years for Officers to understand the system and many more to be knowledgeable enough to manipulate the system. The different changes and manipulations to the system are made through the different perspectives each administration and top ranking officers utilize in their understanding of the role of the Navy and its responsibilities to maintaining maritime security. Changes in the world order of power were affected by the collapse of the Soviet Union. Many saw that as a catalyst to develop a different military. Many would argue the development of the U.S. Navy to fit a post cold war era is still ongoing and therefore more susceptible to change. But how much the U.S. Navy can change is still grounded in the law of responsibilities the Navy provides for the defense of the nation. It cannot go off and rid itself of vital and key missions to maritime security. As a large and powerful

[37] Allan M. Mohrman, Jr. et al., "The Phenomenon of Large-Scale Organizational Change," in *Large-Scale Organizational Change*, (San Francisco: Jossey-Bass Inc., 1994),. 18-23.

organization the U.S. Navy has the potential to alter the maritime security environment, and how it operates inside of it. By sponsoring research into new technologies and ignoring others the Navy can attempt to shape how maritime security systems will function. The U.S. Being a super power with very few countries possessing the ability to outdistance the U.S. in leading research, the U.S. Navy gets an edge in deciding how the operating environment for Maritime Security will be shaped. The last aspect of size, loose coupling, does not match very well with most organizations when compared to the U.S. Navy. For the most part, fleets operate independently of each other, but there are specific protocols, which match across the fleets specific to the U.S. Navy and not the fleets themselves. Each fleet will have its own set of standard operating procedures loosely based on larger Navy doctrine. It would not be practical to send a unit from one fleet and operate in another fleet with a drastically different set of procedures. So while each fleet may appear autonomous there are underlying procedures common to the fleets which keeps them closely connected to the large Navy system. The challenge for implementing MDA in regards to size would be forcing the fleets to coordinate and cooperate with each other as well as the policy makers concerned with the development of MDA. The CNO may not be concerned with the specifics of how each fleet will achieve MDA making it a loose coupling for the interpretation of the concept. The technologies used are a concern, making the coupling very tight, and neglecting the uniqueness of each fleet.

C. IMPLEMENTING CHANGE

The type of changes (process, technological, organizational, etc.) and how fundamental those changes are for an organization will depend on many things to include; the mission or goal of that organization, how the organization and individuals view the organization, its operating environment, the technologies it chooses to adapt into its processes, its history, and the people doing the work. Any one of these factors when changed will have an affect on the components of the basic system (input, process, output). The process for recognizing a need for change is not easy and there are many techniques. The change can come from within or outside the organization. Changes outside the organization that signal change include: the existing environment is changing,

resources the organization depends on will no longer be available or are changing, technologies used in the process are changing or will not be used by other systems it interacts. Changes inside the organization include: new management with a different vision or way of processing inputs, a formal internal study can be performed to recognize inefficiencies in processes, new technologies may be introduced into the organization, new management may enter the organization with a different vision for the organization, new workers with different work skills or world views can be hired to deliberately change the organization's process, or a change in policy may force the organization to change. Change will always consist of some catalyst adopted by or placed onto the system used by the organization, a manager to enact the change and monitor the change process for effectiveness, completion, and keep the change in line with the intended goal of the change process.

1. Recognizing Change

For an organization's management to recognize the need for change the organization must have an objective understanding of the systems in use, how those systems add or take away from the goal of the organization or the "as-is" of the organization. In addition to the "as-is", the management must communicate a clear "to-be" vision for the organization. The "to-be" vision is a product of the management's ability to recognize change in four key areas. Noel M. Tichy describes the recognition process, "Problems, crises and/or opportunities emerge in the following areas: 1. Environment. 2. Diversification. 3. Technology. 4. People."[38] The environment in this model refers to the market or business the organization operates in, exclusive to how the organization may want the environment to change. The environment can change because of a number of reasons; usually these changes are outside the control of the organization and require more of a reaction from the organization than a planned change. Diversification refers to the expansion of an organization as it develops and grows. It can include an organization's reach into other markets, inputs, outputs, and the need to change processes in adapting to the new area of interest. Technology will continue to

[38] Noel M. Tichy, *Managing Strategic Change* (New York: John Wiley & Sons, 1983), 18-19.

develop and change and for organizations to survive they must understand the change and embrace it. It seems to be a given that organizations will want the best technology has to offer at a price it can afford. With that perspective Tichy describes technological change as doing the following, "it can lead to either incremental or strategic change."[39] And people, Tichy describes this change as happening in possibly two different ways, "people entering the organization may change in terms of education, expectations, or status, such as previous excluded minorities. Or the people already in the organization may change as the result of education, or shifts in attitudes or expectations."[40] As workers come and go they bring and take with them their individual visions and goals for themselves and the company. How they fit into the organization, and interpret the policies may change with their experiences in and out of the organization. A manager needs to recognize opportunities for change that allow the organization to continue flourishing and be successful.

2. Change Process

As managers find opportunities for change and recognize the need for change, they must also have the ability to recognize the best ways to implement change. Change for the sake of changing is not always the best method for keeping an organization poised to meet the challenges of a turbulent environment. The common saying, "If it isn't broken, don't fix it" comes to mind. However, organizations cannot become stagnant and allow opportunities to pass them by. J. Duane Hoover gives an explanation to the individual understanding of implementing change. He explains the importance of making sense of the change process, "successful organization change efforts based on accurate diagnosis of the elements that need to be addressed, especially during initial diagnostic phase of a change program."[41] As change is implemented the change agent responsible for overseeing the change process must have an accurate understanding of the change. The change agent will create a cognitive map of the change itself and how it affects the

[39] Noel M. Tichy, *Managing Strategic Change* (New York: John Wiley & Sons, 1983), 19.

[40] Ibid. 19.

[41] J Duane Hoover, "Cognitive Mapping and Diagnostic Aspects of Organizational Change". *Organization Development Journal* 26, no. 1 (2008): 37.

organization. The cognitive map of change for the individual is based on that individual's perceived understanding of the organization. A correct diagnostic interpretation of the organization, and change process is critical to the fulfillment of successfully implementing organizational change. Hoover relies on an "innovation-adoption process" developed by E.M. Rogers to model the actualization of implementing change. The model is: "1) Knowledge of the implementation. 2) Formation of an attitude, either favorable or unfavorable, toward the innovation. 3) Decision to adopt or not adopt the innovation. 4) Implementation, if adopted 5) Post implementation decision to retain or discard innovation."[42] Not only does the change agent need to have this actualization, the workers involved in the process of change must have this same actualization for the change to be successful. Taking Roger's model a step further, Hoover proposes actualization for change can also be measured across an individual's intellectual, emotional, behavioral, and perceptual actualization.[43] Hoover offers this model as another means to accurately interpret how best to implement change across an organization at the individual level.

Looking at the change process from an organizational point of view a model for congruent change presented by the consulting firm of Mercer Delta is used. This model like Tichy's view demonstrates how change in an organization happens in more than one dimension. For change to work it must fit and work with the structures of an organization. Figure 6 is the Mercer Delta model that shows how different structures must be considered when addressing change in an organization.

[42] J Duane Hoover, "Cognitive Mapping and Diagnostic Aspects of Organizational Change". *Organization Development Journal* 26, no. 1 (2008):. 39.

[43] Ibid. 40.

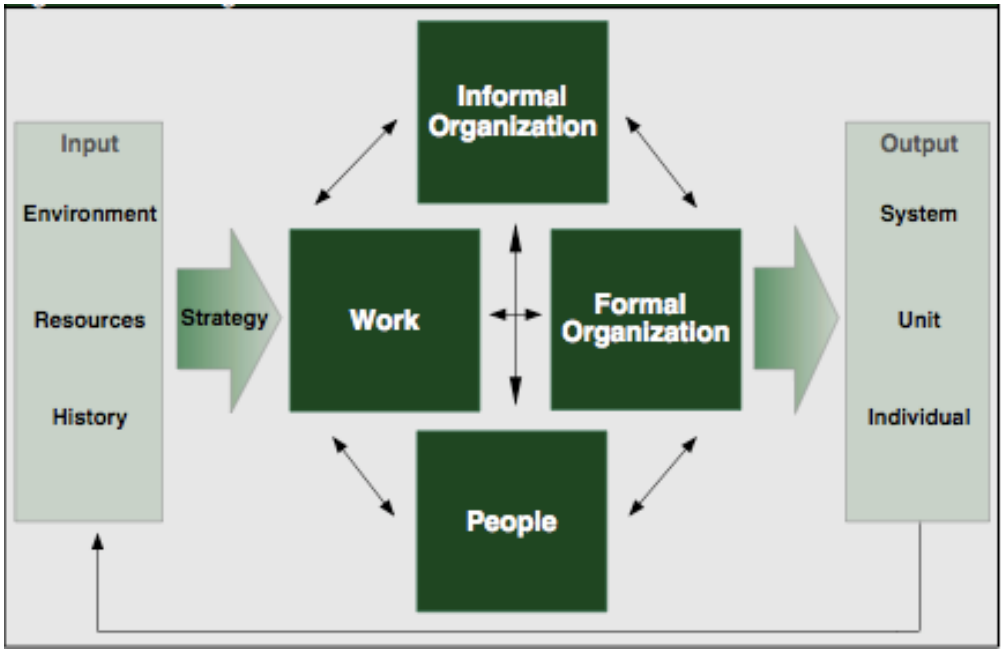

Figure 6. The Congruent Model[44]

The model looks at change as a process with inputs (environment, resources, and history of the organization) which are affected by structures within the organization (work, people, informal organization, and formal organization) that process the inputs in accordance with the organization's strategy leaving outputs (a new system, unit, or individuals).

Again to understand any system, a manager must be intimately familiar with the inputs into the system, the processes used and outputs of the system. In the congruence model there is no change to what make up the elements for a change catalyst. Ultimately, every system is affected by the environment; new rules, new policies, new technologies, new management, new resources are all changes outside the organization affecting the inputs into the system and creating the need for change. When the need for change is identified and a manager puts the process of change into motion, the plan to implement change must address the fit of the change in regards to the structures of process change. In the congruence model four processes are identified: work, people, informal

[44] *The Congruence Model: A Roadmap Understanding Organization Performance* (Mercer Delta Consulting, LLC, 1998), 14.

organization, and formal organization.[45] Work in this model refers to the actual processes of the system being changed and the people are the ones in the organization doing the work. How the people go about doing their work through the informal relationships created is a reflection of the informal organization inside the system. And the formal structures created by management to enable the people to do their work are example of the formal organization inside the system. Together these components make up the organization element of the change process system. While they are presented as separate components of the organization together they make up how the organization process inputs into outputs. The key to congruence is understanding how a change in one element will affect change in the other elements. By relating each element to the other, the change manager can create a plan that considers the best way to implement change across all the elements. Understanding the change process can save the organization, and change manager valuable time and energy. By applying congruence, an appropriate change that addresses change across all the elements of an organization can lead to a better fit within the organization. A better fit will ultimately lead to true large-scale organizational change that affects the character and performance of an organization in a lasting and meaningful way.

[45] *The Congruence Model: A Roadmap Understanding Organization Performance* (Mercer Delta Consulting, LLC, 1998), 8.

IV. DATA

The data used in this thesis comes from a study conducted by NPS to build a current or "as is" model of the U.S. Navy system in regards to how the movement of data and information enable the current MDA mission. The Naval Postgraduate School was contracted by OPNAV N3/5 to aid in the process of implementing MDA as a concept and the technologies associated with it (Spiral-1) into the U.S. Navy. The framework upon which the task was and continues to be worked is a system analysis approach using a business process redesign technique. The data reflects a study in the socio-technical dimension and will be used to present the affects of placing technologies on top of existing processes in a large scale organization like the U.S. Navy.

Portions of the data come from interviews with key stakeholders in the MDA process at varying levels. The interviews conducted were with personnel from CINCPACFLT (Commander in Chief, Pacific Fleet), MIFCPAC (Maritime Intelligence Fusion Center, Pacific), ONI (Office of Naval Intelligence), and NAVCENT. These specific commands were chosen for their direct involvement with current MDA practices and having been selected to receive Spiral-1 technologies. From the interviews a qualitative analysis of concerns for implementing MDA along with Spiral-1 technologies was made. In addition to interviews a Process Engineering Workshop (PEW) was conducted to provide inputs into a process analysis. The PEW took place 15-17 January 2008 at the Naval Postgraduate School. Participants included representatives from, ASN RDA, C3F, COTF, Dept. of the Under Secretary of the Navy, DISA, HFE LLC, JITIC, METRON, MIFCLANT, MIFCPAC, NAVCENT, NAVNETWARCOM, NCIS, NORTHCOM, NPS, NRL, NWDC, ONI, OPNAV, PMW 120, and SPAWAR. Individual participants included; subject matter experts (SMEs) from the MDA Spiral 1 technologies, representatives from the Trident Warrior 2008 (TW08) operational experiment where many of the MDA Spiral 1 technologies will be assessed, and members of the assessment team (NPS, Aptima, Pacific Sciences & Engineering, WBB Inc.).[46]

[46]Jared Freeman and et al. *Maritime Domain Awareness (MDA) Workflow Model Status Report* (Monterey, CA: Naval Postgraduate School, Draft March 2008). 5.

A. INTERVIEWS

The interviews were with members of CINCPACFLEET, MIFCPAC, NMIC/ONI, and NAVCENT. These organizations were chosen for their selection of receiving MDA Spiral-1 technologies. They represent varying levels of systems and units in the U.S. Navy system and organization. Each sub unit brings with it a sub system of processes for conducting current MDA. Their views are unique and specific to their geographic area and level within the U.S. Navy system and organization. The answers given represent the individual views of the personnel currently assigned to the commands at the time of the interviews and may not represent the current state of affairs. Common threads throughout the interviews reflect a concern for personnel issues, specifically; manning requirements, training, and high rates of turnover. Answers to questions regarding Spiral-1 technologies are given from the interviews conducted by the NPS study:

1. CINCPACFLEET

- The MOC to be stood up by 31 Jan 2008 will have a traditional organization. It will not include ONA; that function will be executed by N2. The intelligence staff is quite small (CPF N2 currently has 2 Information System specialists and one is an E-9), though there is an effort underway to extend the human resources by combining the CPF Intel Watch with the PACOM JIOC. Given the small size of its intelligence unit, CPF is concerned about the feasibility of learning, using, and maintaining new MDA technologies.
- CPF does not need to maintain awareness of white shipping for its routine operations, though the capability is seen as potentially useful. However, CPF does need this capability to support one, highly complex OPLAN (intentionally unnamed, here). Thus, use of Spiral 1 technologies may be sporadic or localized to very few staff.[47]

[47] Jared Freeman and et al. *Maritime Domain Awareness (MDA) Workflow Model Status Report* (Monterey, CA: Naval Postgraduate School, Draft March 2008). 8.

2. MIFCPAC

- MIFCPAC is responsible for all vessels approaching the US from continents except Europe. The organization provides considerable support to CINCPACFLEET, which has a small staff. However, MIFCPAC is focused on the Coast Guard mission, which concerns both terrorism and regulatory issues such as fisheries and pollution. Thus, its use of Spiral 1 tools may be unusual. For example, MIFCPAC may need alerts that discriminate reliably between loitering in fisheries by (1) American vessels and (2) potentially illegal foreign fishing vessels.

- MIFCPAC sees value in selected MDA technologies. It is already using CMA to support analyses (such as the fisheries analysis, above), and it sees promise in Google and Global Trader. MIFCPAC argues that FASTC2AP may not be "viable" for its uses.[48]

3. Naval Maritime Intelligence Center (NMIC)/Office of Naval Intelligence (ONI)

- ONI continuously monitors 220-350 Vessels of Interest (VOIs). The watch floor – staffed by 13 people – handles as many as six formal RFIs daily about these and other vessels, 15-20 informal external requests daily, and a small number of ONI internal queries. The watch forwards approximately one formal RFI to analysis cells (or “day shop”, e.g., counter-terrorism, counter-narcotics, counter-proliferation, homeland defense) each day. ONI’s capability to handle this, current volume of tasking is hampered by difficulty sharing track data across the Navy, insufficient training resources, insufficient staffing for some activities (e.g., analysis of biometrics findings), and rapid turnover of staff on the watch floor. NMIC/ONI is recruiting several hundred additional staff. However, staff capacity is currently a concern.

- Several Spiral 1 technologies are seen to have particularly high value within ONI or as data feeds to it: CMA, TRIPWIRE, TAANDEM, FASTCAP, and EMIO Wireless. However, ONI expressed concern that (a) the interoperability and integration of these and other tools (e.g., with GCCS) was not defined; (b) the process for

[48] Jared Freeman and et al. *Maritime Domain Awareness (MDA) Workflow Model Status Report* (Monterey, CA: Naval Postgraduate School, Draft March 2008), 8.

accrediting new tools for operational use is long (approximately and months) and somewhat uncertain; (c) the tools primarily increase the volume of data available for analysis but do not help analysts to manage those data; (d) the tools do not strongly enhance the capability to rapidly, reliably predict activity given cyclical and emergent events, or infer intent or culpability from scant entity-relationship data; and (e) the provision of tools (e.g., Google Apps for collaboration) is insufficient to provide the intended capability (e.g., improved collaboration) without new processes and training.[49]

4. NAVCENT

- MDA supports, but is subordinate to the primary missions of NAVCENT: maritime security, anti-terror, and Iran. The prospect of receiving Spiral 1 technologies sparked several concerns: the relevance of the technology effort to primary missions, the shortage of personnel and high rate of turnover (10% monthly), concerns about training staff to use technologies effectively for NAVCENT billets and processes, concerns about system reliability and maintenance, and the prospect that the flag might embark from NAVCENT. These concerns have led NAVCENT leadership to consider whether many MDA activities and Spiral 1 technologies should be housed at a JIOC or at ONI, provided that those institutions can reliably maintain awareness of NAVCENT's mission focus. That said, NAVCENT leadership views positively the Spiral 2 initiative to combine the shore-based radars of many nations with AIS data. This capability would benefit operations in the MOC, and also strengthen partnerships in the region.
- The knowledge of the Spiral 1 technologies among NAVCENT staff (at the time of the interviews) was scant, and so they had limited ability to assess the utility of these technologies. Watchfloor personnel see value in technologies that triggers or alerts concerning specific tracks. They state that they are unlikely to use technologies that require data mining or fusion across multiple sources.[50]

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[49] Jared Freeman and et al. *Maritime Domain Awareness (MDA) Workflow Model Status Report* (Monterey, CA: Naval Postgraduate School, Draft March 2008), 9.

[50] Ibid. 9-10.

B. WORKSHOPS

Two workshops provide data into this thesis, a Process Engineering Workshop (PEW) hosted by the Naval Postgraduate School in Monterey, CA and a Process Analysis Workshop (PAW) hosted by the MHQ wMOC team for process architecture at Second Fleet in Norfolk, VA.

1. Process Engineering Workshop (PEW)

Participants in the PEW held at NPS on 15-17 January 2008 were representatives from ASN, RDA, C3F, COTF, Dept. of the Under Secretary of the Navy, DISA, HFE LLC, JITIC, METRON, MIFCLANT, MIFCPAC, NEVACENT, NAVNETWARCOM, NCIS, NORTHCOM, NPS, NRL, NWDC, ONI, OPNAV, PMW 120, and SPAWAR. Other participants included subject matter experts (SMEs) from several of the MDA Spiral 1 technologies, representatives from the Trident Warrior 2008 (TW08) operational experiment where many of the MDA Spiral 1 technologies will be assessed, and members of the assessment tem (NPS, Aptima, Pacific Sciences & Engineering, WBB Inc.). The purpose of the PEW were the following:

- Refine, extend, and validate a process model of Maritime Domain Awareness;
- Define attributes of the activities that constitute MDA, specifically information requirements, processing activities, products, and resource (time, manning) requirements
- Specify which MDA activities may benefit from Spiral 1 technologies
- Develop concepts for assessing the effects of technology; and
- Identify barriers to fielding MDA Spiral 1 technologies[51]

From discussions on the potential benefit of Spiral-1 technologies to different sub units a Tasks to Technology Mapping occurred and is presented here:

[51] Jared Freeman and et al. *Maritime Domain Awareness (MDA) Workflow Model Status Report* (Monterey, CA: Naval Postgraduate School, Draft March 2008), 5.

Activities	**CMA**	**TAANDEM**	**MAGNET**	**FastC2AP**	**Global Trader**	**Tripwire**	**E-MIO Wirele**	**Google Apps &**	**Google Earth**	**SMS/ JPSC2**	**LInX**	**Austr AIS**
40: ONI: Intel	X	X	X	Tbd	X	X		Tbd	Tbd	X		Tbd
55: ONA: Nominate potential VC	X	*X	X	X					*	*		
60: ONA: Validate/(Re)Prioritize	X		X	*		*X		*X	X	*		
70: MOC Director: Receive/Decide/Route VOI									X			
80: COPS: Process VOI												
90: FOPS: Process VOI												
100: BWC: Assess Tactical Asset Availability				*						*		
110: MOC Director: Define CDR Estimate & COA	X	X		X		X		X	X		X	
112: CNO/NOO: Approve COA	X							X	X			
115: MOC: Coordinate MOC-to-I Handoff	X							X	X			
120: IWO: Issue RFI				*								
125: ONI issues RFI to MOC	X	X	X	X	X	X		X	X		X	X
130: ONA: Process RFI (Issue, F Assess Fulfilled)	X	*X	X	X	*X	*X		*X	X	*	*X	*X
140: ONI: Process RFI (Issue, Fu Assess Fulfilled)	X	X	X	X	X	X		X	X	X	X	X
150: NCIS, CIFC, MARLO, MIF NGA: Process RFI								X	X	X	X	
160: BWC: Communicate Missio Orders												
170: 6391: Fleet Asset: Plan & D VBSS Mission												
175: tbd#175: Fleet Asset: ISR D Collection												
180: Fleet Asset: Take Biometrics/Boarding Data							X					
200: BFC: Analyze Biometrics												

Activities	CMA	TAANDEM	MAGNET	FastC2AP	Global Trader	Tripwire	E-MIO Wireles	Google Apps &	Google Earth	SMS/ JPSC2	LInX	Austr AIS
205: ONI: Analyze biometric find					X	X					X	
207: NGIC/ONI:Store biometric r												
210: ONI: Analyze Boarding Data	X	X	X	X	X	X					X	
220: Fleet Asset: Receive Boardin Analysis							X					
230: ONA: Anaylyze Findings	X	*X	X	X	*X	*X		*X	X	*	*X	*X
240: Coalition: Execute VBSS M												
250: COPS: Monitor VBSS												
260: COPS: Recommend Change Mission/Revision of CAT Level												
270: COPS: Recommend Mission Complete												
280: ONA: Monitor Vessel of Int on Watch List	X	*X	X	X	*X	*X		*X	X	X	*X	*X

Note: An "X" in this table indicates that the activity would benefit from the Spiral 1 technology in the opinion of PEW participants. A "*" indicates that the assessment by NAVCENT MOC is opposite a PEW assessment.

Table 1. The utility of Spiral 1 technologies for each MDA activity[52]

The mapping occurred with the participants understanding of listed Spiral-1 technologies capabilities and how those technologies would match up with MDA tasks. The participants assumed the workers doing the process at the different levels of the Navy organization would be familiar with and have access to all the proposed technologies. It is also assumed the technologies presented perform within the standards discussed by the SMEs of the technologies. Participants selected technologies that best fit processes already in place to perform the tasks listed.

Also at the PEW was a discussion of workflow. Workflow diagrams using the DODAF OV-6c format were presented. The diagrams specifically addressed workflows on the NAVCENT MDA Process, the MDA Information from NMIC and how NMIC processed requests for information (RFI). The participants made recommendations to the

[52] Jared Freeman and et al. *Maritime Domain Awareness (MDA) Workflow Model Status Report* (Monterey, CA: Naval Postgraduate School, Draft March 2008), 7-8.

activities, precedence, and clustering of activities. An agreement was made that a formal Process Alignment Workshop would be more helpful in refining the processes presented.

2. Process Alignment Workshop (PAW)

The PAW was held in Norfolk, VA, hosted by the MHQ wMOC team for process architecture at Second Fleet, and participants included 20 warfighting functional area leads, system and process architects, process SMEs, and interoperability experts. The PAW focused on the following objectives:

- Review the MDA workflow and recommended limited revisions;
- Map activities in the MDA workflow to MHQ wMOC processes or activities, and identify any issues in doing so.[53]

Many recommendations to the MDA workflow were presented. The data concerning these changes is not available; the revision of the DoDAF OV-6c is currently awaiting funding decisions.

The alignment to MDA processes produced the following results:

- The MDA workflow represents a handoff between MOCs. There is no corresponding MHQ wMOC process or activity.
- The MDA workflow specifies that COPs plans responses to VOIs. The MHQ wMOC processes specify that FOPs plans, and that COPs does not.
- The role of the MOC Director in the MDA workflow may conflict with definitions in the MHQ wMOC architecture.
- The role of the Foreign Disclosure Officer is not yet represented in the MDA or MHQ wMOC processes.
- COCOMs each accomplish the MDA mission uniquely. These MDA roles therefore need further development and refinement.
- The role of the IWO in handling RFIs may need to be clarified in the MDA workflow.
- Some MDA activities map to more than one MHQ wMOC process. This may reflect ambiguity in the MDA workflow. It may be an inherent challenge of mapping tactical MDA activities to operational processes of MHQ wMOC[54]

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[53] Jared Freeman and et al. *Maritime Domain Awareness (MDA) Workflow Model Status Report* (Monterey, CA: Naval Postgraduate School, Draft March 2008), 10.

[54] Ibid. 10.

The discrepancies found and presented in the PAW may be the result of aligning processes with an “as is” while the MHQ wMOC processes are the “to be”. The refined workflow data presented in the NPS study will be used as a current look at the MDA processes. How that process is affected by the matching of tasks to technology will be discussed next. The “to be” is a product of implementing the tasks to technologies table with the MDA workflow and the possible changes that may come from such an implementation.

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V. DATA ANALYSIS

The data used present the concerns and issues that arise from viewing MDA as a concept change enabled through the adoption of specific technologies. The interviews conducted speak to the challenges of mission change at varying levels. From the interviews it was concluded a clear understanding of the different processes at the varying levels needed to be developed further. The "as is" needed further mapping to understand the "to be". The Process Engineering Workshop (PEW) conducted 15-17 January 2008 at NPS worked to build a coherent, current MDA workflow model. The workshop not only refined workflow models developed by NAVNETWARCOM, participants also created a task to technology mapping table. Both products have proven to be useful at the later process alignment workshop conducted at the MHQ wMOC team for process architecture at Second Fleet, in Norfolk, VA on 29 January 2008.

Conclusions from the Process Alignment Workshop (PAW) point out gaps in the alignment of MDA tasks to Maritime Head Quarters with a Maritime Operating Center (MHQ Wmoc) core processes. The current processes for MDA may not clearly align with the MHQ wMOC processes due to many reasons. A full and dynamic list of procedures for MHQ wMOC has not been developed. As the MHQ wMOC structure continues to be developed and implemented into fleet areas of operation specific processes will be developed to address concerns unique to those areas. The more unique and further from the original core processes developed for the MHQ wMOC structure the harder it becomes to map a workflow model from which to address MDA implementation. The uniqueness of each Combatant Commander (COCOM) is what enables them to make independent decisions aiding to the timeliness and efficiency found when operating in those regions. However, the uniqueness of each command can add to the confusion of what formal processes to use when conducting a mission. A standard set of MHQ wMOC procedures is needed to build a standard set of technologies, which can be easily implemented into the MHQ wMOC structure and MDA process. Without a clear set of procedures and processes for achieving MDA, the technologies chosen and implemented will continue to fail in aligning them with current processes as seen in the

PAW. While the standardization of processes and technologies is needed the processes and technologies must also be flexible enough to meet all the needs of each unique region and command. Standardization will benefit the users of the formal structure within each system, making it easier for tactical units to transition from one AOR to another with a small amount of time spent on learning a new system.

Clearly defining and standardizing watches and billets found inside the MHQ wMOC structure is also needed to aid in the development of MDA processes. As noted earlier current MDA processes are unique to the various fleets and COCOMs. The tasks to technologies table attempts to standardize the "to be" MDA concept by displaying which MDA processes will be affected by the implementation of Spiral-1 technologies. The method by which the table was created is problematic due to the small sampling of PEW participants when compared to the larger U.S. Navy organization, their own biases and limited knowledge of processes unique to the sub organizations they come from and have interacted. An example of this is displayed in the table with discrepancies between the PEW participants and NAVCENT representatives. The discrepancies represent differing opinions as to which Spiral-1 technologies will aid to specific tasks. The difference of opinions is most likely due to a difference in how the tasks are processed. The PEW participants' understanding of how best to complete a task with the technologies presented is their opinion unique to them. The NAVCENT differences in regards to which technologies will best add to the completion of MDA tasks is also unique to them. Again further highlighting the need to adopt standard MDA processes with standard technologies. Another reason for the difference in opinion comes from unfamiliarity of the technologies presented in Spiral-1. The misunderstanding of capabilities can be easily overcome with training, which must occur parallel to or before the implementation of said technologies. The concerns for implementing new technologies in regards to training personnel, the maintenance of and its implementation are not new and can be studied further independent of this thesis.

The data provided shows a strong inclination to enhancing intelligence processes already in place at various levels within the U.S. Navy organization. An observation of which MDA activities will benefit from the Spiral-1 technologies table demonstrates this.

Most of the matches between technologies and tasks benefit activities associated with or labeled with the terms intelligence, information or analyze. None of the technologies with the exception of E-Mio Wireless benefit the tactical operator, more specifically the units providing the data into the information process. Referencing the Request for Further Information (RFI) processes (activities 125: ONI issues RFI to MOC, 130: ONA Process RFI (Issue, Fulfill, Asses Fulfilled), 140: ONI: Process RFI (Isssue, Fulfill, Asses Fulfilled)) displayed on the table, it is believed all but one activity (120: IWO: Issue RFI) will benefit from the Spiral-1 technologies. This result displays the strengths of the Spiral-1 technologies. They directly benefit information-gathering processes already in place by adding to the number of queried databases, and displaying the information in a format useful to the analyst. It was determined fleet assets would not benefit from these technologies because they are currently not scheduled to receive them. Even if fleet assets were scheduled to receive the technologies they would have difficulty utilizing their full capabilities due to physical limitations of bandwidth in regards to communication systems currently employed. And it is not a function of the fleet unit to analyze the data collected in the analyst process of determining vessels of interests. Fleet units can and often do produce their own RFIs when tasked with shadowing or boarding VOIs. These RFIs are sent off ship for processing and are subject to a formal process within the system or AOR they are currently tasked. A formal process is displayed in Figure 7 below, it is a representation of RFI processes at the NMIC level.

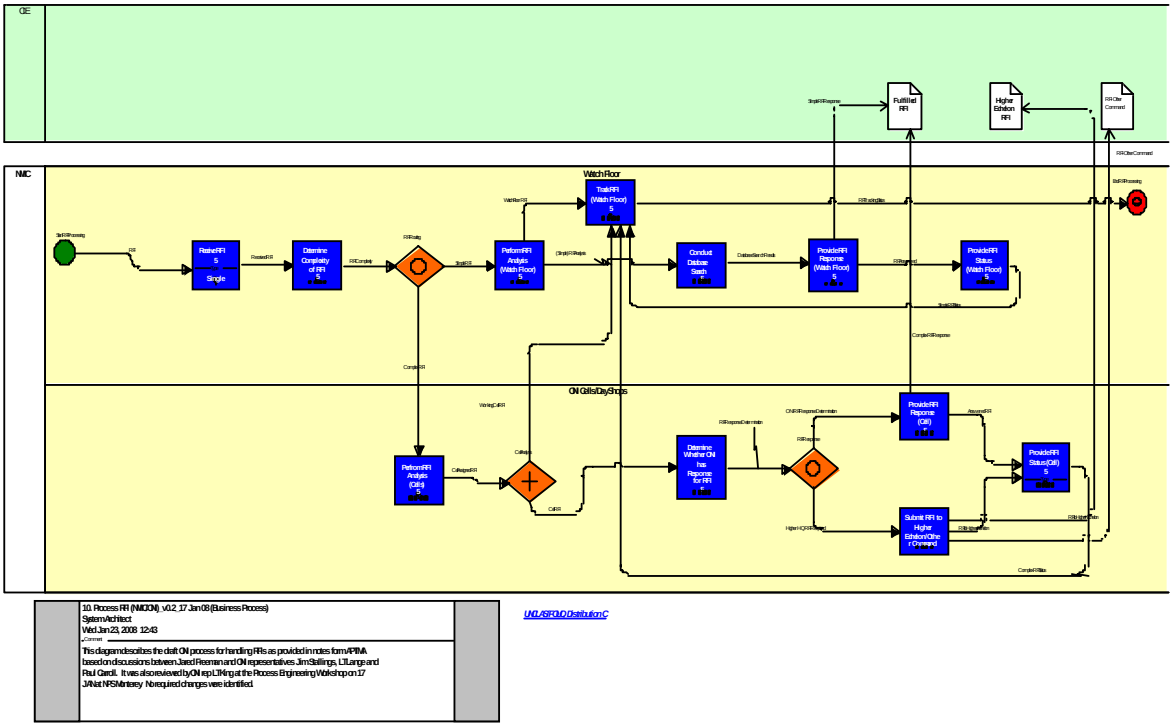

Figure 7. Process RFI[55]

The process further demonstrates the fleet unit's dependence on "outside the lifelines" processes in aiding their completion of mission. From this example it is no wonder the choice of technologies to enable MDA focus on the intelligence and information processes vice the operational afloat unit.

[55] Jared Freeman and et al. *Maritime Domain Awareness (MDA) Workflow Model Status Report* (Monterey, CA: Naval Postgraduate School, Draft March 2008), 44.

VI. CONCLUSIONS

In 2004 the President of the United States directed a change to the Maritime Security Policy; NSPD 41/HSPD 13, ”directs the coordination of United States Government maritime security programs and initiatives to achieve a comprehensive and cohesive national effort involving appropriate Federal, State, local and private sector entities.”[56] The directive requires, “the development of a National Strategy for Maritime Security” along with “a national plan to improve Maritime Domain Awareness”[57]. The words “development” and “improve” were specifically chosen, mandating a change to the processes already in place to provide maritime security. The National Strategy for Maritime Security presents the need for a more secure maritime environment. The means by which the strategy suggests making this change is in eight separate plans, the National Plan to Achieve Maritime Domain Awareness being one of those plans. The Secretary of the Navy and Chief of Naval Operations recognizing the U.S. Navy’s role as a key shareholder in the National Plan to Achieve MDA developed a U.S. Navy MDA concept. The common thread to these documents is a recognized need to change the processes in place to share maritime domain information across the Navy and outside the Navy with coalition partner nations.

MDA as a concept is a technique within the National Strategy for Maritime Security to address gaps in maritime security presented by the President of the United States. The U.S. Navy MDA concept addresses the challenges to a secure environment from a Navy perspective. The Navy concept makes some core assumptions about achieving MDA and they are:

- Acquiring and sharing maritime information with a broad array of partners reduces vulnerability to attack and improves cooperation toward maritime security and safety.

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[56] *National Security Presidential Directive NSPD-41/Homeland Security Presidential Directive HSPD-13* (Washington, D.C.: The White House, December 2004), 1.

[57] Ibid. 5.

- U.S. agencies and international partners perceive positive return on investment and recognize benefits of cooperating to achieve common maritime security goals.
- Overcoming cultural and policy barriers to information sharing requires changes in business practices and information security procedures.
- Planned Maritime Headquarters with Maritime Operations Center (MHQw/MOC) process and communication improvements will enable key aspects of this concept.
- Costs to implement this concept will not be prohibitive.[58]

These assumptions describe how the U.S. Navy views the problem of achieving MDA. The two key components of MDA are presented later in the Navy MDA concept as Situation Awareness and Threat Assessment. Both of these components and assumptions about MDA rely heavily on information sharing and management. It is also clear from the Navy concept that "changes in business practices and information security procedures"[59] is a must.

To implement the President's Security Policy the U.S. Navy has chosen to place new technologies on top of tasks already associated within the Navy mission to achieving MDA. The changes implemented by the CNO to achieve MDA come from the PEO C4I office. The technologies chosen come from programs already being tested and prototype technologies, collectively known as MDA Spiral-1. The technological changes associated with implementing Spiral-1 focus on extending existing technologies abilities to access various data-bases in a timely and efficient manner. The unique applications being developed as part of Spiral-1 attempt to enhance information gathering and present that information useable within the soon "to be" structure of MHQ wMOC. Spiral-1 technologies as presented earlier will have a limited affect on the intelligence systems in place. Special regard was given to RFI processes demonstrating how the technological change associated with Spiral-1 is limited to the units receiving the technologies and systems that will benefit from their capabilities. The conclusions made from this study provide insight as to how limited MDA implementation will be across the Navy system.

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[58] *Navy Maritime Domain Awareness Concept* (Washington D. C.: OPNAV 00, May 2007), 2.

[59] Ibid.

From an earlier chapter in this thesis it was established, large scale organizational change happens when change occurs abundantly in three aspects; depth, pervasiveness, and size striking a change to an organizations character and performance. By limiting the distribution of Spiral-1 technologies to a select few units, the level of pervasiveness and size is small. Limiting the change procedure to the implementation of technologies that benefit a few processes within a specific system (the maritime intelligence system) the size and depth of change are also small occurrences. However, large-scale change seems to be the intent of the CNO and PEO C4I office with the suggestion of continued spirals of technologies. Large-scale change does not occur overnight, it takes time and the management of change at multiple levels across subsystems and subunits. Just by naming the system of change Spiral-1 the suggestion is for follow on numbers of spirals, with the term spiral also suggesting a continuous path that wraps around itself leading to a center. In the name chosen it would appear the intent is to make multiple changes across multiple systems and processes across the U.S. Navy. However, by continuing research into technologies, which will enable faster, reliable, and more efficient information sharing the U.S. Navy will only enable current systems which rely on these processes and not change how they seek out and share information across the Navy and outside of it. Changing the view of information managers inside the Navy to accept and freely share data across Navy systems and outside entities will enable lasting changes in the character and performance of the U.S. Navy necessary to implementing MDA.

A technique which has proven useful in changing business processes by making them more efficient is the Business Process Redesign (BPR). A definition of BPR is: "the study, analysis, and redesign of fundamental business processes to reduce costs and/or improve value added to the business."[60] BPR is a way of viewing a process for its value in the whole system design. Studying how inputs are processed will give a view, sometimes overlooked, of the system. As processes are developed and new technologies introduced the technologies may not add to the value of the system, they just make the system more streamlined or even over burden the system with extra steps, "Many

[60] Jeffrey L.Whitten, Lonnie D. Bentley, and Kevin C. Dittman. *Systems Analysis and Design Methods* (5th Edition). (New York: McGraw-Hill Irwin, 2001). 21

processes are overly bureaucratic and do not truly contribute value to the business."[61] Key to the BPR is a good analysis of the system from the beginning. The tem often used is "value chain" to describe what processes actually bring to the system. Identifying the processes inside a system can be a challenge unto itself, but then an assessment of how that process adds value to the system must be made. A clear understanding of how processes work and the value for keeping them must be made. It would seem the U.S. Navy skipped this part of the change or redesign process. In the NPS study an attempt was made to do such an analysis of the current MDA system inside the U.S. Navy. The study mapped out a workflow based on a boarding scenario from the NAVCENT perspective and procedures in place. While this is a good start the same mapping needs to occur at every operational command. Displaying the procedures for how each command processes information in regards to a specific scenario will create a starting point from which common threads can be identified; difference in procedures can easily be identified and brought back to a standard. The process for gathering such information should involve interviews with the workers inside the system. Interviews should not be restricted to the officers who manage programs but include the analyst and watch floor members. These interviews should be structured to provide a set of answers which can be compared in a qualitative manner. The interviews conducted by the NPS study did such thing, but on a scale which cannot compare systems across the U.S. Navy. The comparison in the study is up and down a particular system. Another study must be done across similar systems, i.e., a similar examination of the same processes from numbered fleet to numbered fleet and named fleet to named fleet. By viewing the data process across similar systems, similarities can be found and discrepancies identified. Changes can be made to bring the similar systems into alignment in regards to data processes and information management. This change procedure should avoid the introduction of technology as noted in the BPR technique,

> Through process redesign, organizations seek to study the fundamental business processes to increase throughput and efficiency and to reduce waste and costs. Process models, in various forms including data flow

[61] Jeffrey L.Whitten, Lonnie D. Bentley, and Kevin C. Dittman. *Systems Analysis and Design Methods* (5th Edition). (New York: McGraw-Hill Irwin, 2001). 21

> diagrams, help organizations to visualize their processes and ultimately eliminate or reduce bureaucracy. Thus, process models can return value to an organization even if the goal is not to design or purchase software to automate those processes![62]

This technique has clear benefits to introducing change into a system and across systems. Conducting a clear study which identifies the value chain, how data is processed and flows through an organization is vital to making changes to the system. By just adding technologies on top of processes to enable a system, significant large scale change will not occur. When an organization's data processes and information flow is mapped managers can begin to identify unnecessary and inefficient processes. The inefficient processes can be removed or changed to benefit the organization. Only then can new technologies be introduced after the current or "as is" state is identified and understood. Even then the "to be" or what will make the processes more efficient must be agreed upon within the organization.

A clear mission or goal must be stated. In the case of MDA, HSPD 13 makes the case for a new maritime policy. The National Strategy created from the directed policy change lays the foundation for how Federal, State, local, and private entities will go about achieving a more secure maritime environment. The National Plan to Achieve Maritime Domain Awareness takes it a step further by specifying actions to take for a significant contribution in the security of the Maritime Domain. The U.S. Navy identifies with the plans goals and further states a mission commiserate with Navy capabilities. For the Navy to implement the MDA mission correctly, a comprehensive study of how MDA is performed needs to occur along with training as to the differences of how MDA was performed and how the goal of how it will be performed. Without a significant change in the outlook of what is MDA and how best to achieve it within the Navy and why it needs to change is not addressed change cannot occur. Individual understanding of the mandated change from the President down to and through the CNO must occur. The vision held by the individual must reflect the same understanding of the goal and mission as presented by the CNO. As the individual understands their role further questions can

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[62] Jeffrey L.Whitten, Lonnie D. Bentley, and Kevin C. Dittman. *Systems Analysis and Design Methods* (5th Edition). (New York: McGraw-Hill Irwin, 2001). 169.

be raised as to how and what the individual may need to achieve the agreed new mission. When all submissions are gathered an analysis of the answers should occur with a panel of subject matter experts. The SMEs will then look for the common threads and discrepancies in processes mentioned and highlighted earlier. They will make recommendations on how to improve the process reflecting the requirements stated in the MDA mission. As changes are implemented the managers of the systems must adhere to the changes and guide the change process to create the "to be" mission of MDA.

Taking a BPR approach to implementing MDA will involve further research into the current state of MDA across the U.S. Navy. Along with the study, a clear and agreed upon understanding of the MDA mission must be promoted. The time needed to conduct such a study may not be afforded with the mandate for change handed down from the President. Command understanding of what MDA is and how it is best achieved can happen at a rapid pace. Managers at all levels must identify the processes that lend and take away value to the MDA process. The managers must speak up and make note of which programs when introduced into current systems are not in alignment with the Plan to Achieve Maritime Domain Awareness.

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