

DA4500 Final Paper

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I. Introduction

The world has always been in a state of change, and since its foundation, the United States Navy has developed into an adaptive organization. As the National Maritime Strategy for the 21st Century makes clear, the U.S. Navy will need to operate in increasingly complex and crowded littoral regions. “Oceans are the lifeblood of the interconnected global Community,” and, by volume, 90 percent of trade moves across the oceans. The vast majority, of the world’s population, lives in the littoral region, 100 miles from the coast and most maritime economic activity, fishing, mineral extraction, and shipping occur within 200 miles of land. This report will discuss the principles that describe the types of tactics, platforms, and technologies that will best serve U.S. interests in the littorals of the future.

Percentage urban and location of urban agglomerations with at least 500,000 inhabitants, 2014

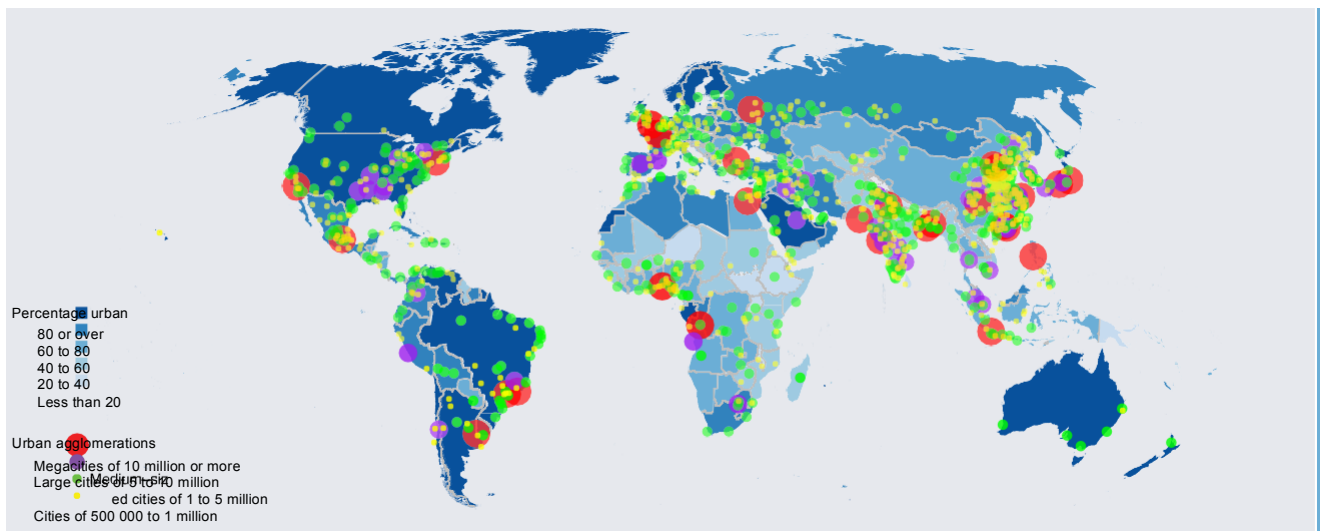


Figure 1.

Source: United Nations, World Urbanization Projects Report (2014)

Unpredictability is inevitable, yet pattern recognition is possible; organizations that recognize and posture for a position of strength, given these truths, will have the advantage.

A. Methodology

The analytic framework employed for this report included a review of existing research and literature through a systems dynamics perspective. The report begins with a summary of key terms, background information, a littoral piracy vignette, strategic approaches, system dynamics implications, and finally, a conclusion. While not exhaustive, the goal of this collaborative effort is to illustrate aspects of systematic thinking and playing that inform the Navy’s decision-making process regarding littoral operations.

B. Key Definitions

Hybrid Conflict: This is a blend of traditional and non-state conflict. Multiple other names were considered, however we selected hybrid for clarity. Other similar names include: Gray Zone, Political Warfare, Irregular Warfare.

Instruments of National Power: The various means of which nation states to exercise power is represented by the term, instruments of power. Throughout this report, the model selected includes the following subcomponents: Diplomatic, Information, Military, and Economy (DIME). Note: The broad topic has been bounded to place emphasis upon the military aspects of the DIME model.

Littoral Environment: This region consists of a seaward and landward operational area. The seaward are spans from the open ocean to the shore, which must be controlled to support operations ashore. The landward littorals are bound by inland areas from the shore that can be supported and defended directly from the sea.

C. Background

Commerce, people, information, and technology transfer throughout the ever increasingly connected world in greater quantities and in less time. Globalization, however, is not stability, peace, or panacea. The same globe is equally more accessible to a friend or hostile state or non-state actor.

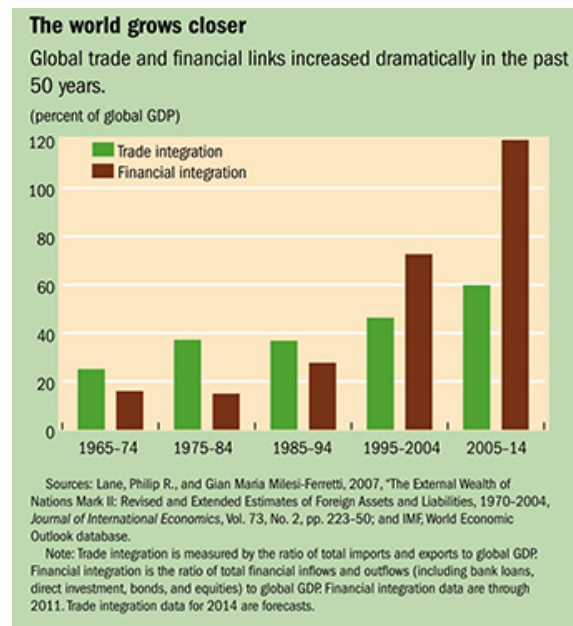


Figure 2.

Since the dissolution of the Soviet Union, defense efforts have not had the luxury of focusing efforts against threats from a united source. Instead, national security strategists must invest in capabilities prepared to support international law and counter threats from state competitors, transnational criminal and terrorist organizations. Revisionist state competitors, challenge the current world order below the traditional war threshold placing United States Naval assets, seeking to support international, law at risk.

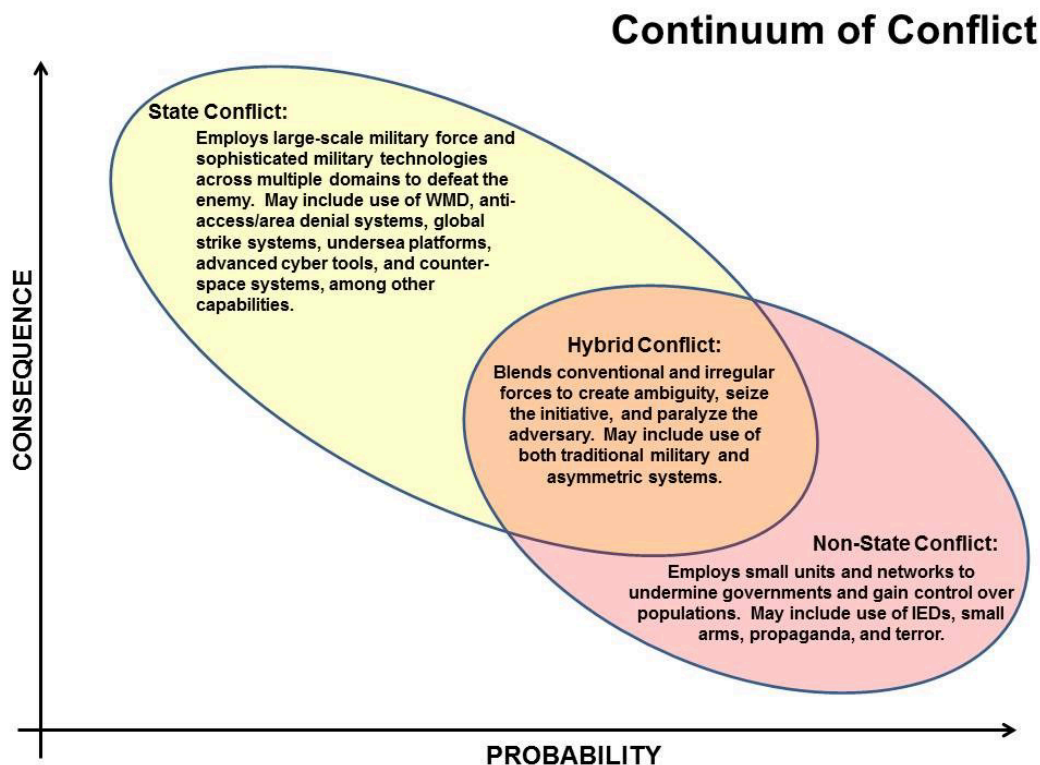


Figure 3.

Source: National Military Strategy (2015)

Chief among the instruments of power is diplomacy; which, coordinates and establishes the employment of the other instruments. The foreign policy aims may be achieved through the robust coordination and execution of each of all parts. However, a credible military capability underwrites the other components, by reducing the risk of yielding to conflicting strategic interests. Geopolitical challenges require skilled and pragmatic foreign affairs leaders. Standing security agreements test the efficacy of international law and affect our regional and global credibility. Therefore, a robust military is critical for sustained partnerships that will prolong the global rule-based system.

II. A Systemic Approach to Naval Operations in the Littoral Region: A DIME System of Systems Framework

This section presents a Diplomacy, Information, Military and Economics (DIME) framework for the littoral challenge using a systemic approach. The various entities comprising the DIME framework are viewed as systems, to simplify the complex problem. Each system is defined by its inputs, outputs, functions, and interactions with other systems. And collaborations of these DIME systems can be viewed as systems of systems. The creation of DIME system of systems models can provide insight into potential collaborative solutions to littoral challenges. Some systemic and strategic tools are presented with a goal of promoting understanding and initiating the development of a DIME framework for the littoral.

A. The Littoral Problem Space

Littoral regions around the globe are increasingly crowded and complex. The United States will need to operate its military assets in increasingly complex littoral environments. Littoral complexity factors include: the heterogeneous geography of land and sea; the often-highly-populated coastal

areas; the mix of civilian, military, commercial, and international maritime vessels and operations; the high concentration of economic assets due to ports, urban areas, and other industries; and other valued assets such as buildings, shipping resources, military assets, tourist locations, and infrastructure assets (i.e., information, communication, power facilities). From a military viewpoint, the littoral is a complex region, as depicted in Figure 1, due to the variety of different types of warfare capabilities and threats that can exist. These may include air and missile threats, mines, torpedoes, cruise missiles, small boat attacks, unmanned aircraft and boats, piracy, electronic warfare/jamming, and persistent ISR from the shore, space, and air. Military operations in the littoral are even more complicated due to the highly concentrated presence of nonmilitary entities, such as civilians, commercial operations, urban areas, and tourism.



Figure 4 – The Littoral Operational Environment

Effective naval operations in the littoral must consider Navy missions in the context of the DIME framework. Naval operations have a direct effect on diplomatic international relations. For example, a naval presence can support a climate of stability—helping to minimize and deter crime and violence. However, a naval action of self-defense, if an asset is provoked for example, could cause an international incident and strain relations. The stabilizing effect of a naval presence has the secondary result of a safe maritime environment supporting trade and boosting economic relations. Thus, a naval strategy for littoral operations must be developed within the DIME framework.

The primary naval missions in the littoral are:

1. Safety of navigation – to promote a safe maritime environment for military, commercial, and private vessels.
2. Environmental protection – to ensure that environmental laws are followed to protect the maritime environment.
3. Maritime security – to provide a safe maritime through deterrence, preventive measures, and defensive measures when necessary.
4. Sovereign rights – to support countries' sovereign rights to govern without interference from other countries.

5. Territorial claims – to support US objectives in territorial disputes among countries.
6. Coastal state cooperation – to support cooperation among countries, specifically with littoral borders.
7. Transnational crime organizations – to support organizations that prevent, deter, or respond to transnational crimes.

The development of a naval littoral strategy must balance its missions with supporting the DIME framework of supporting diplomatic, information, and economic objectives. A couple strategic questions can be posed:

- (1) What are the tactics, platforms, and technologies that will best serve the US interests in the complex littorals of the future?
- (2) How can future naval littoral operations support an effective DIME framework?

Viewing the Navy’s littoral challenge from a systemic perspective, allows one to identify the “players” (organizations, assets, individuals, threats, etc.) that the Navy may interact with in the littoral region. Each of these is represented as a system. Considering the Navy as part of a DIME system of systems (SoS) encourages and enables a framework in which naval operations support and effect DIME objectives. Figure 1 presents a context diagram for the littoral and places the DIME SoS as the central entity connected to the various system “players” that exist in the littoral region.

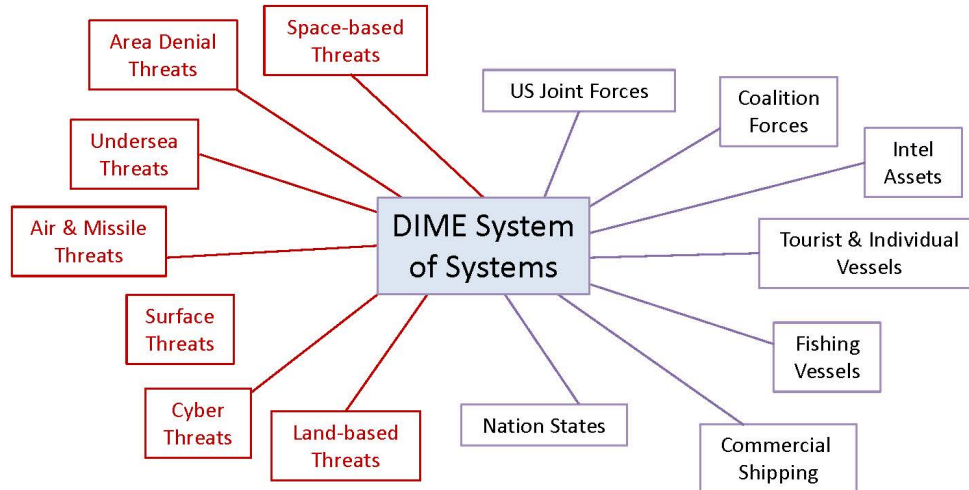


Figure 5 – Context Diagram for the DIME System of Systems in the Littoral

The DIME SoS includes environmental, political, and multi-disciplinary/international aspects as well as hybrid and cyber warfare, ISR, and geographical limitations. The context diagram depicts connections with littoral threat “systems” shown in red and friendly or neutral “systems” shown in black. A context diagram is a useful systemic tool for identifying “systems” and their interrelationships.

B. Systemic Solution Concepts for the Littoral

Feedback Mechanism

Obtaining accurate, sufficient, and timely feedback is critical to effective naval operations that support strategic DIME goals in a complex environment. The first solution concept presented is a mechanism for timely and effective feedback. The feedback is critical to effective planning that will ultimately support the achievement of strategic goals. Figure 3 shows a feedback mechanism with three primary steps: (1) situational awareness, (2) data/information analysis, and (3) course of action (COA) planning. This process needs to be continuous and iterative and shared amongst stakeholders to develop adaptive and flexible COAs for naval assets. The process supports the DIME framework in all three steps, by broadening situational awareness to include social-technical and economic information and knowledge; by considering DIME cause-effect relationships and hypotheses during analysis; and by planning operations within a DIME context.

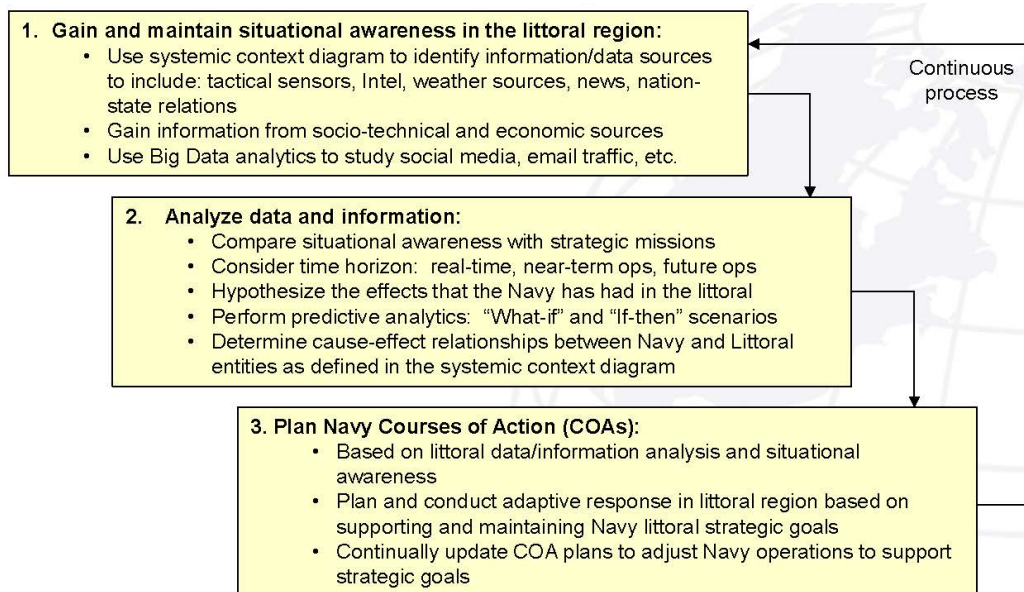


Figure 6 – A Feedback Mechanism for Naval Operations in the Littoral

Complex Adaptive Systems of Systems Approach

A second systemic solution concept to support effective naval littoral operations within a DIME framework is to develop a complex systems approach to the problem. By acknowledging that both the problem space and solution space are complex, an appropriate engineering approach can be taken to develop future architectures, systems, and technologies. The focus of this concept is on the "military" part of the DIME SoS.

Future military systems in the littoral can be conceptually viewed as complex adaptive systems of systems (CASoS). Figure 4 illustrates a CASoS architecture that distributes "intelligence" among the military platforms. Each warfare unit or platform is viewed as a "system" within the CASoS. Implementing intelligent decision-making capabilities for each system enables them to share data and information and gain a shared awareness of the littoral situation. Each system within the future CASoS is then empowered and equipped to "self-organize" and "adapt" to the complex environment. Each "system", or military platform, within the SoS is an "intelligent agent."

The following list contains potential characteristics of a future military CASoS implementation:

- Each constituent system can operate independently or as a collaborating member of an CASoS
- Individual systems may enter and exit CASoS's
- Multiple CASoS's may exist
- Multiple warfare mission areas can be addressed by single or multiple CASoS's
- Constituent systems have the ability to “self-organize”
- Each constituent system is “intelligent”: develops and maintains a “shared” situational awareness and makes decisions
- Lateral influences dominate vertical (hierarchical) influences
- Each CASoS adapts through its constituent system relationships and courses of action
- Each CASoS must be robust (resilient to external forces)
- Emergent capabilities are projected to include the force-level optimization of the use of the assets and enhanced situational awareness across the force
- Each CASoS must maintain a strong “self-identity”

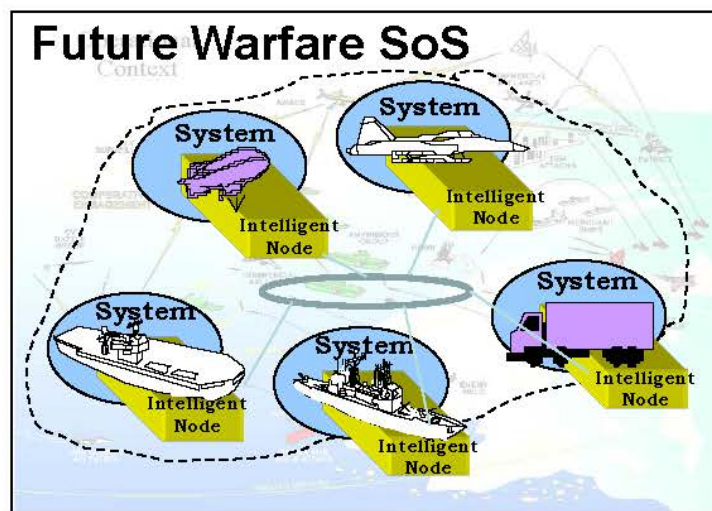


Figure 7 – A Future CASoS Architecture of Military Systems

By adopting a CASoS approach to engineering future military systems and architectures, two major capabilities can be achieved: (1) the ability for the system of system to adapt to a complex and changing threat environment; and (2) emergent properties—which are resultant system of system level behaviors that stem from collaboration and optimization of the constituent systems or warfare assets.

Complex systems adapt—they change their behavior to improve their chances of survival or success through learning or evolutionary processes. The littoral environment is shown to be complex and constantly changing. Therefore, military systems within the DIME framework will face complex situations involving multiple mission areas that may occur simultaneously and often may require time-critical decisions and responses. To add to the complexity, the military systems are heterogeneous, distributed, and often moving with respect to one another and within the littoral environment. The desired capability of being able to adapt, both as individual military assets and as collaborate systems of systems, is crucial to addressing the complex littoral problem space. Some desired characteristics of this adaptiveness are:

- Adaptation in the relationships of the warfare resources, resulting in responsiveness at both the system-level and SoS (or force) -level.
- Adaptation as changes to rules of operation/engagement/doctrine/missions
- Adaptation in the level of collaboration: formation of new SoS's, addition or deletion of systems from a collaborative SoS, different levels of collaboration within a SoS

Complex systems exhibit emergent behavior—through interactions and collaboration among their constituent systems, a higher level emergent behavior occurs. For future military systems, this emergent behavior can create a solution of optimization among distributed warfare assets and increases in defended areas, response times to threats, and integrated warfare concepts involving distributed sensors, weapons, and communications. Some characteristics of emergent properties are:

- System-level properties exist only at the system level as it functions, being different from and existing beyond the constituent element properties
- System-level properties are not held by any of the isolated elements
- System-level properties are irreducible. They simply cannot be understood, explained, or inferred from the structure or behavior of constituent elements or their local properties
- Understanding the cause-effect relationships can only be established through retrospective interpretation. This renders traditional reduction-based analytic techniques incapable of useful predictions of emergent system-level behavior
- Emergent patterns are not adequately understood without the appreciation of the context within which the patterns exist

Two desired primary emergent behaviors for the littoral are: (1) enhanced situational awareness from optimizing distributed sensors and fusing information from other entities in the DIME framework; and (2) force-level collaborative courses of action, such as Integrated Fire Control (IFC), coordinated layered defense, weapon/sensor pairing, managed multi-platform engagements, and coordinated area defense.

Distributed Assets

A CASoS approach can enable distributed warfare assets to self-organize to act independently or collaborate as SoSs in an adaptive manner. This will optimize the use of the distributed weapons in concert with other DIME entities to respond most effectively to unpredictable threat environments that are constantly in flux and span multiple mission areas. Effective use of distributed assets is also dependent on employing the feedback mechanism that allows the military in the littoral to support DIME initiative and take advantage of DIME resources such as a variety of stakeholders and information assets.

Causal Loop Diagram

A final systemic tool that is useful for understanding complex environments, such as the littoral, is the Causal Loop Diagram (CLD). The CLD can be used to support an understanding of the DIME framework at various levels—creating representations of cause and affect relationships among “systems.” In Figure 5, a CLD is provided that illustrates aspects of the littoral piracy problem, highlighting the military role in combatting piracy. CLDs can be created for many other littoral challenges within the DIME framework.

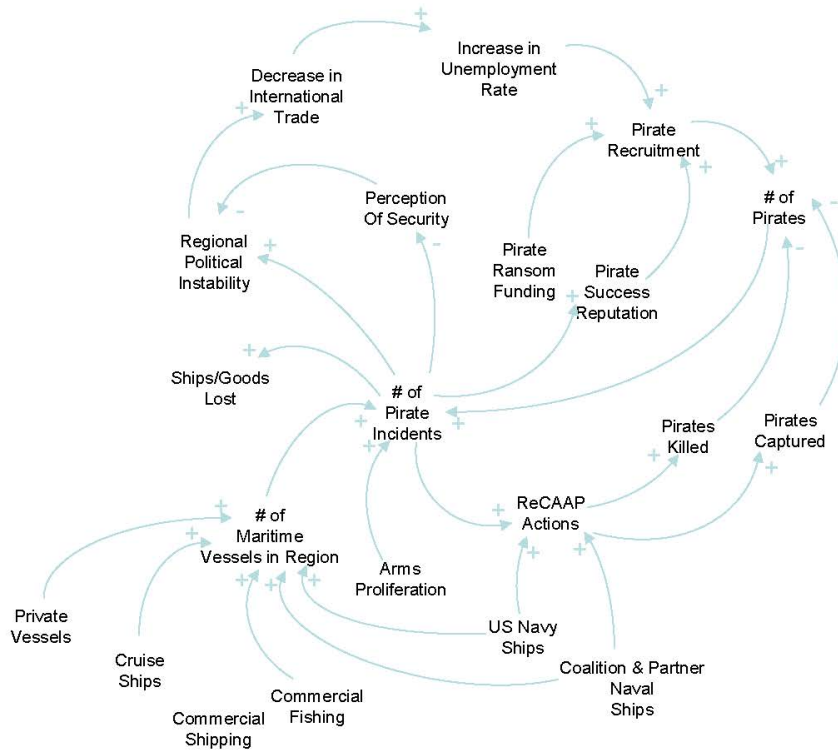


Figure 8 – Littoral Piracy Causal Loop Diagram

C. Outcomes of a Systemic Approach

The payoff of taking a systemic approach to developing the solution space to the complex littoral challenge is the creation of an effective military strategy within the DIME framework. An overarching strategy is: to enhance US and partner prosperity and security within the littorals while safeguarding US national interests. To that effect, the following list highlights contributions to the littoral military strategy:

- Establish and maintain littoral domain awareness:
 - Early warning
 - Early indication
 - Communication with military and non-traditional entities in the DIME framework
- Provide security measures:
 - Piracy incident prevention
 - Incident deterrence
 - Incident response
- Establish and maintain regional stability
- Decrease regional political corruption
- Create economic opportunities
- Increase educational opportunities

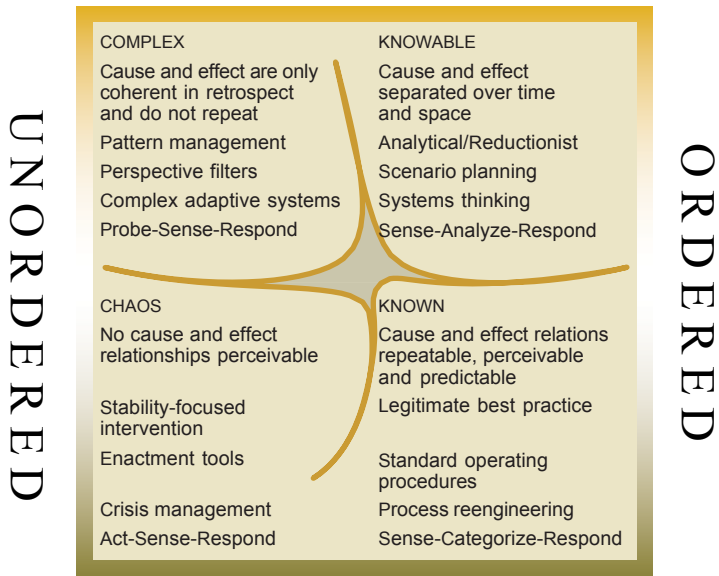
III. Sense-making in the Littorals: Piracy Vignette

In their Cynefin framework Snowden and Kurtz (2003) illustrate a way for strategists and policy makers to examine an issue and decide the best way to apply a systems approach to creating solutions. Their method allows one to determine where the situation lies along a spectrum, thereby providing a better ways to choose which means to apply to create sense and set a course towards a solution. The section will evaluate factors from two discretely defined and briefly described vignettes with the Cynefin framework to illustrate the difficulty in creating solutions across any facet of the DIME CASoS we have explored in the littoral regions of the world.

A. The Cynefin Framework:

Cynefin Domains can be seen in Figure 9 below. There are two Ordered domains, Known and Knowable, and two Unordered domains, Complex and Chaos. Each domain in this table contains a relationship with cause and effect, the type of reasoning best applied to it, the work that normally occupies the space, and a decision-making model for use within it. In the ordered domains cause and effect appear mainly visible to observation and explicable. The system can be categorized observed and tracked in its entirety. In the littorals problem we may see commercial shipping as known or knowable problems. Ships are easily tracked, have homeports and countries of origin. Through bills of lading, cargo manifests and like databased information we do or can know all there is to be known about them. Given their draft, gross tonnage, and the like data somehow we can and routinely do accommodate any number of vessels in and out of channels, canals, straits, and ports around the world. Even with varying delays in time between inputs and outputs of subsystems their behavior is known or at least knowable as they play out their purpose. As Snowden and Kurtz (2003) point out, the problem with easily categorizing and predicting systems is human interaction. In the same example of commercial shipping safety of navigation in the littorals there are aspects of the systems involved that can become Unordered due to the “interaction of many agents”, when “the number of agents and the number of relationships defy categorization or analytic techniques (p. 469)...”. The many ships passing through a strait could be helmed and captained by trained professionals from different countries or cultures, perhaps sharing a common language or perhaps not. Each crew may be more or less homogenous and cohesive, with variations of national and ethnic identities and cultural norms. The economic forces of incentive and punishment are at work in these often-competitive industries, and there is also a wide variance in adherence to safety and legal practices. When most of these factors are accounted for the systems of systems under inspection can readily be assumed to be complex. As we introduce unexpected change from various examples like natural disasters, acute ecological crisis, heightened tensions between state and non-state actors this complex system can quickly show properties of Chaos.

Figure 9 Cynefin domains (Snowden & Kurtz, 2003)



B. Somali Piracy Vignette:

Piracy is a concern of all nations even today, due to the global interdependencies of trade between modern nations. Markets worldwide suffer when the security of shipping is threatened on the open seas. The pirate-infested waters that became the focus of world attention within the last decade are the ocean waterways off of the coast of Somalia.

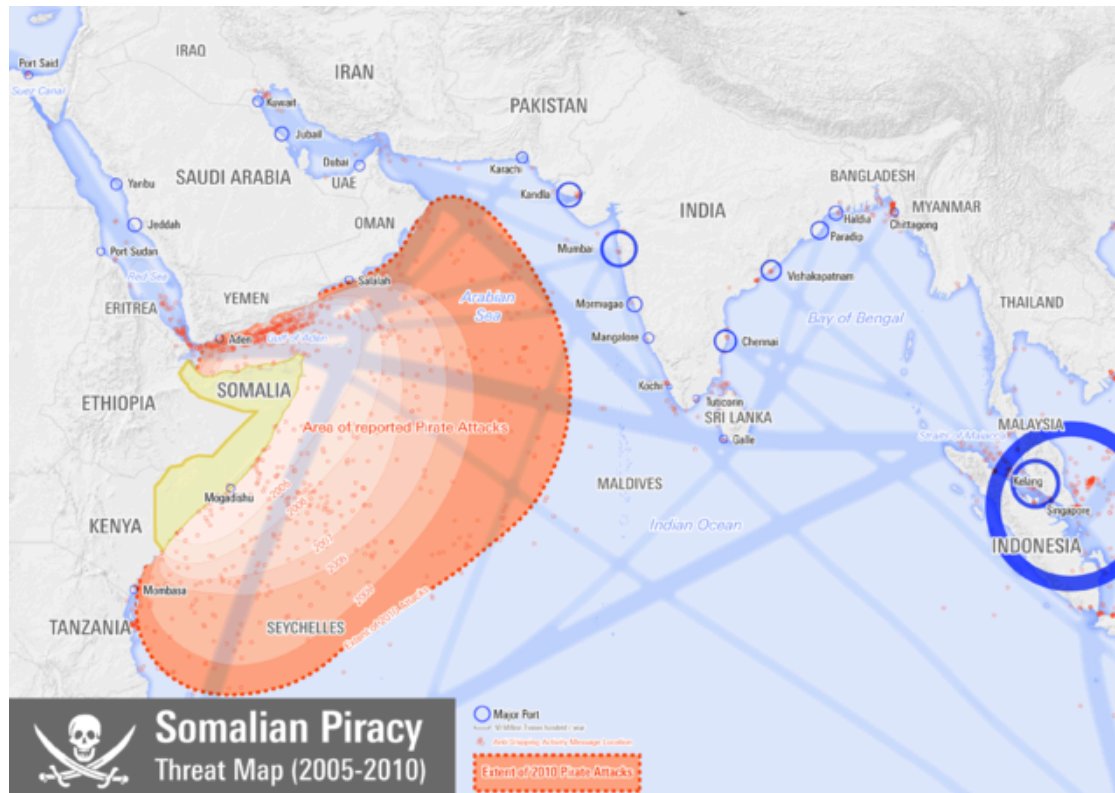


Figure 10(Creative Commons License, Ganush, 2010)

Figure 10, an independent cartographer's compilation pulled from various open sources, shows us that the pattern and frequency of Somali Piracy is known and knowable. Known and Knowable issues are Ordered. We know what pirates want—ransom and plunder. We know how they travel, small boats such as junks, dhows, and skiffs. We know their likely armament will vary and include clubs, blades, firearms, and possibly RPGs. Knowing the limits imposed by geography it is possible to plan routes, train crews, and project likelihood of contact and minimize loss to commercial shipping even when vessels must transit these high piracy areas. Change your concern about the piracy issue from commercial shipping loss prevention to elimination of the pirate threat and we begin to shift the foci within the Cynefin framework into the Unordered domain of the Complex. The problem of piracy there is tied to the failure of the Somali government, but it is not as simple a statement as lack of government leads to increase of piracy. Some point to the loss of a central government in Somalia as the point in time when traditional fishermen from Somali lost their means to make a living due to depredations by illegal fishing from outsiders and the loss of fish habitat caused by illegal toxic waste dumping. Without the ability to earn income and sustain their traditional lifestyles and culture from fishing, along with the breakdown of other cultural and societal structures, Somalis along the coasts

turned to violence to protect their waters from outsiders and soon turned to hijacking vessels for profit.

Treating this situation as a Known domain problem, the US used its maritime power projection assets. This was all to provide a military force answer to a linear cause and effect security problem. The application of Known domain mindsets and solutions is unlikely to provide long-term solutions to behavior of the many agents within these systems of systems who are seeking individual solutions to a wide range of problems and create larger scale problems to others with whom they themselves have no interaction (the U.S. and other global powers).

IV. Military Strategy

Strategies can improve the adaptability of an organization (military or other) in two ways. First, by explicitly examining alternatives that are superior to the current procedure and second, the organization may encounter environmental changes; if alternative (contingency) plans have been prepared for these changes, the organization can then react in a systematic way.

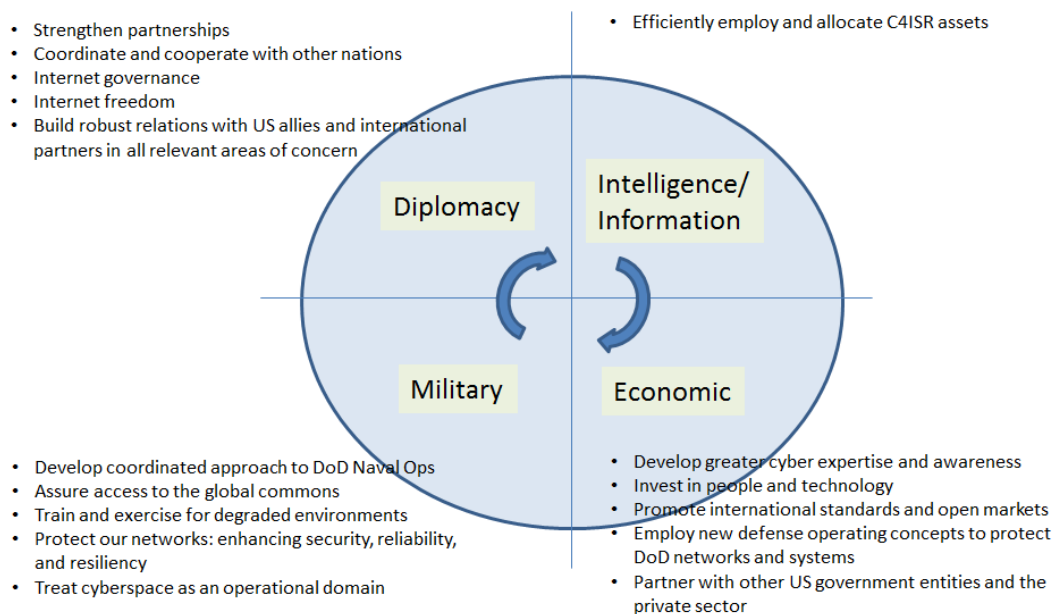


Figure 11. The DIME Framework

The DIME Framework in Figure 11, allows us to confront irregular challenges by focusing on the following outcomes:

- Increased effectiveness in stabilizing and strengthening regions, by securing and leveraging the maritime domain, with and in support of national and international partners.
- Enhanced regional awareness of activities and dynamics to include a deeper understanding of ethnic, cultural, and socioeconomic characteristics and norms.
- Increased regional partner capacity for maritime security and domain awareness.

- Expanded coordination and interoperability with joint, interagency, and international partners.

These outcomes support promoting regional security and stability, advancing the rule of law, promoting good governance and prosperity, and help partners better protect their people and resources. They will inhibit the spread of violent extremism and its associated terrorist, insurgent, and criminal activities.

Our Strategy describes how we will employ the Military Component of the DIME to protect and advance our national interests in the Littoral regions of the world. For the Military component, we must be able to rapidly adapt to new threats while maintaining comparative advantage over traditional ones. Success will increasingly depend on how well our military instrument can support the other instruments of power and enable our network of allies and partners.

A. The Strategic Environment for the Littorals

Complexity and rapid change characterize today's strategic environment, driven by globalization, the diffusion of technology, and demographic shifts.

Globalization is impacting nearly every aspect of human activity. People, products, and information are flowing across borders at unprecedented speed and volume, acting as catalysts for economic development while also increasing societal tensions, competition for resources, and political instabilities all over the world. Central to globalization is the spread of new technologies that enable a global information environment and empower people to see more, share more, create more, and organize faster than ever before. Individuals and groups today have access to more information than entire governments once possessed.

In the future, the United States is likely to face a number of very different threats to its security, interests, and way of life. Many of these will be associated with the littorals Figure 12, those areas characterized by great cities, well-populated coasts, and the intersection of trade routes where land and sea meet. While representing a relatively small portion of the world's surface, littorals provide homes to over three-quarters of the world's population, locations for over 80 percent of the world's capital cities, and nearly all of the marketplaces for international trade. Because of this, littorals are also the place where most of the world's important conflicts are likely to occur. Close association with the littorals is one of the few things that conflicts of the near future are likely to have in common.

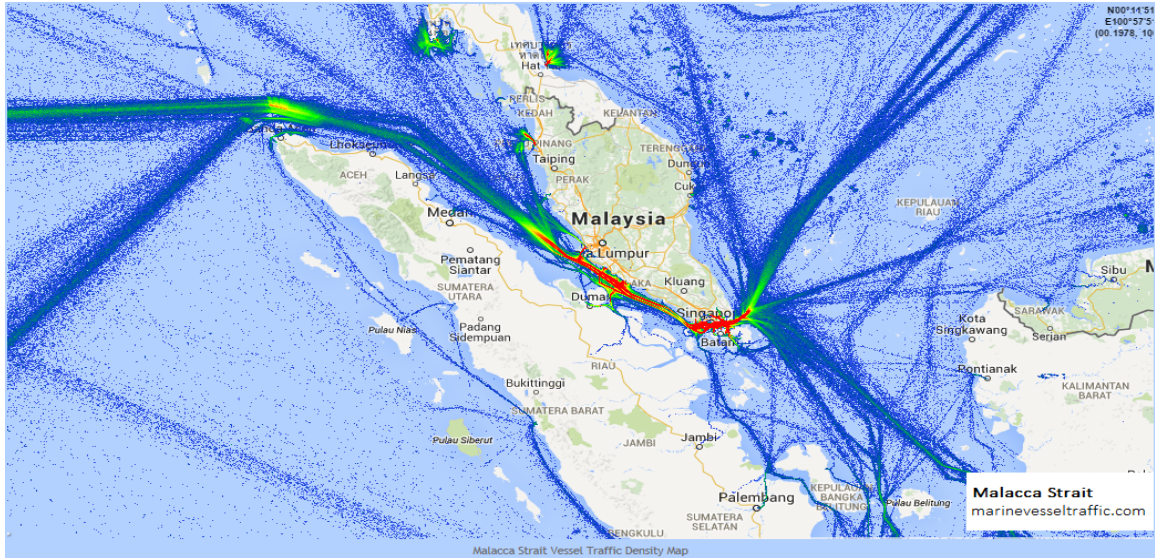


Figure 12.

Source: Marinevesseltraffic.com

B. Overarching Strategy

As an overarching strategy for the Littorals Problem, we incorporate lessons learned from experience and we need to make it sufficiently broad in its construction to adapt to both, unfolding events in the Littorals and adversary's countermoves. A strategy for the Littorals has to reflect a complex adaptive process with constant adaptation to shifting conditions and circumstances in littoral regions where chance, uncertainty, and ambiguity dominate.

Our Strategy describes how we will employ the Military Component of the DIME to protect and advance our national interests in the Littoral regions of the world. For the Military component, we must be able to rapidly adapt to new threats while maintaining the comparative advantage over traditional ones. Success will increasingly depend on how well our military instrument can support the other instruments of power and enable our network of allies and partners.

Therefore, the military strategy needs to synergistically support the other DIME instruments, to include potential first, second, third, etc., order effects upon other stakeholders.

D	I	M	E
<ul style="list-style-type: none"> Embassy/Ambassadors Recognition Negotiations Treaties Policies International Forums 	<ul style="list-style-type: none"> Military Information Public affairs Communications resources International forums Spokespersons Media Announcements 	<ul style="list-style-type: none"> Military Ops Engagement, security, deterrence Show of force Military technology Size and composition of Force 	<ul style="list-style-type: none"> Trade policies Monetary policies Embargoes Tariffs Assistance

Figure 13. Military Component of the DIME

More specifically, our overarching DIME (the Military system) strategy for the global littorals is to enhance US and partner prosperity and security within the littorals while safeguarding US national interests.

Effective planning to support our strategic goals will be accomplished by the feedback mechanism which was outlined in a previous section of the report. The outcomes and the data of the Feedback mechanism will be shared amongst stakeholders in an iterative planning and assessment process to develop adaptive or flexible plans or COAs or alternative strategies. Alternatives will then be screened to ensure that they do not violate any constraints. The feasible strategies should then be rated against each of the listed objectives. Various procedures can be used here, such as checklists,

The strategy should provide for explicit feedback at given intervals. To allow for corrective action, adaptation, the following should be monitored:

- (1) Changes in the environment
- (2) Changes in the organization's capabilities
- (3) Actions taken by the organization
- (4) Actions taken by competitors
- (5) Results

This then becomes a Systemic Perspective of the Military System in the Littorals.

- Implement a CASoS architecture that distributes the “intelligence” among the warfare units
- View each warfare unit as a “system” within the CASoS
- Implement intelligent decision-making capabilities for each system
- Data and information is shared among the systems
- Each system within the CASoS is empowered and equipped to “self-organize” and “adapt” to the complex environment

Each system within the SoS is an intelligent agent

C. Notional Net Assessment

The following chart summarizes the net assessment in the short and long Time Horizons. In the long term, the Navy should be postured and resourced in a flexible and resilient fashion for the rigors of littoral conflict. In the short term, the focus should be on increasing interoperability and building partner nation capability during combined exercises and engagements.

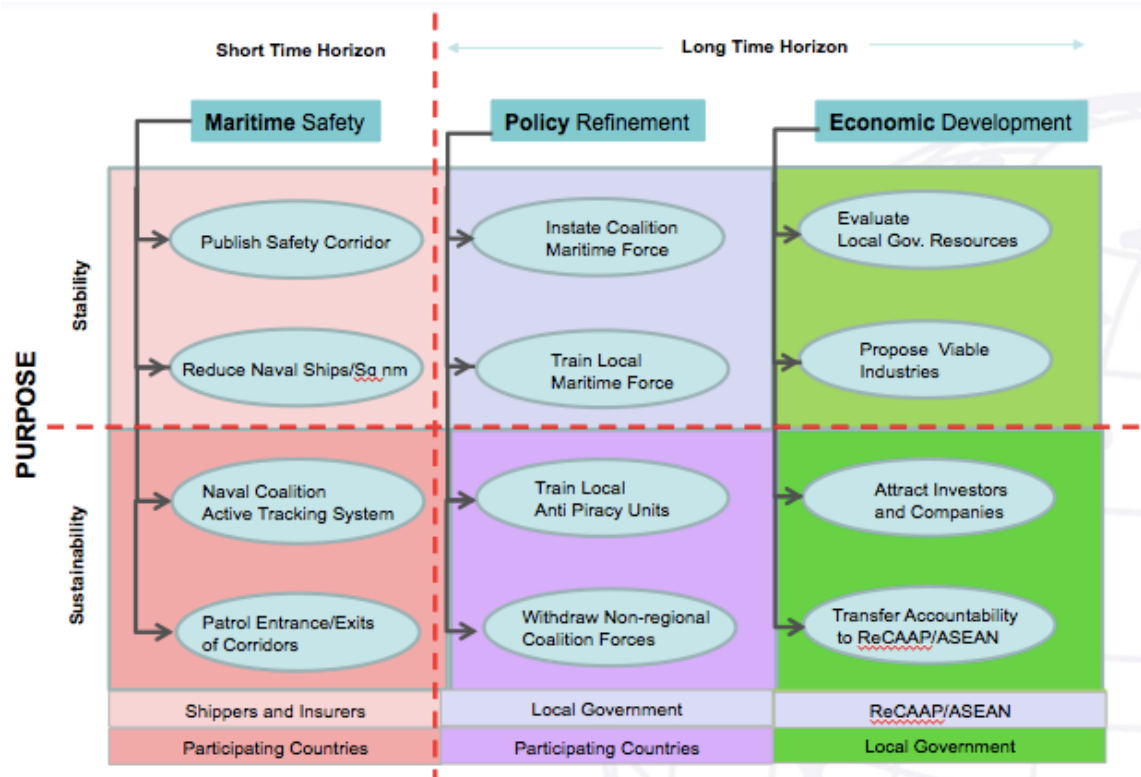


Figure 14.

Source: Adapted from Holland (1992)

IV Conclusion

Multiple threat sources make the forecasts of the future unpredictable, yet pattern recognition is possible. As an adaptive system of systems, the Department of the Navy must build resiliency and stimulate and reward disruptive thought leaders into action. The destructive effect of the information age necessitates continued adaptation across all occupations, from professionals to layman. Increased efforts are needed to prepare the U. S. and allied force for the application of decentralization and network-centric warfare. Distributed command and control of decentralized organizations have increased carrying capacity for responsiveness and innovation to enable competitive advantage. Information theory and the corresponding expansion in computing ability has allowed the modeling of complex nonlinear interactions by incorporating interdisciplinary principles and relationships through general systems theory.

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