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ORGANIC MINE COUNTERMEASURES: AN OPERATIONAL
COMMANDER'S KEY TO UNLOCKING THE LITTORALS?


By

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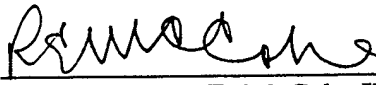
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ABSTRACT

This paper examines the U.S. Navy's organic mine countermeasure (MCM) strategy as it pertains to the operational commander. The U.S. Navy is embarking on a MCM concept that will rely heavily on organic countermine systems tied directly to surface warships, helicopters, and submarines. The Navy envisions this concept will prove a significant force multiplier for the operational commander. While organic MCM systems offer some advantages in terms of tactical mobility and situational awareness, a close examination of the concept identifies many shortcomings. Specifically, organic MCM assets alone will do little to assure littoral access for naval and land forces through a complex mined environment.

Though the conversion to the organic MCM concept will be an evolutionary process, the Navy hopes that as organic MCM systems mature, the need for dedicated MCM forces will decrease. This will facilitate an "in-stride" capability for a commander to operate in mined seas. Achieving this capability mainly through organic MCM systems, however, is dangerously optimistic.

Because of the complexity of the modern naval mine threat, and the operational limitations of organic MCM deployment, a substantial number of dedicated MCM forces will still be required to ensure maximum effectiveness in a mined operating area. Despite the sophistication of new MCM technology, mine warfare will remain a slow, tedious, and challenging discipline. Only through a prudent mix of organic and dedicated MCM forces will an operational commander be able to prevail against the formidable naval mine threat.

Introduction

With the U.S. Navy's commitment to project power from the littorals, and to facilitate the projection of forces ashore from the other services, mine warfare remains a formidable challenge for the operational commander. To meet this challenge, the Navy has embarked on a mine warfare plan that will ultimately depend upon the effectiveness of many new countermine technologies. As currently envisioned, future mine countermeasure (MCM) operations will bring about a dramatic reliance upon a fleet organic MCM capability. An organic MCM capability means that individual naval combatants will have the inherent ability to detect, classify and destroy sea mines utilizing advanced underwater sensors and neutralization systems. This self-contained capability will theoretically mitigate the need for unique MCM assets such as dedicated minesweeping ships. The Navy's ultimate vision is to use organic MCM systems to facilitate "in-stride" operations, meaning the operational commander will be able to neutralize a mine threat without having to wait for dedicated MCM forces to arrive on scene.¹

While these new technologies purport to offer significant capabilities, an MCM concept built upon organic systems unfortunately will not go far enough to provide significant operational advantages. At best, organic MCM asserts will only provide limited and local tactical advantages. Even if the full potential of the new MCM systems is realized, a commander's ability to quickly gain access to, freely maneuver, in a mined operating area will still require significant, dedicated MCM components.

Though the Navy acknowledges that new organic MCM systems are not a "silver bullet", current naval mine warfare doctrine implies that organic MCM assets will sufficiently enable naval forces to maneuver in mined environments without operational pause. This is a dangerous premise as the path from experimental organic MCM machines to dependable fleet systems is unproven. Furthermore, the Navy's organic MCM concept fails to address the considerable drawbacks of fusing countermine requirements to multi-missioned warships and helicopters. Also, it is unlikely that even the best new organic MCM systems will be sufficient to counter the wide array of modern, sophisticated, and lethal naval mines.

Though bold and forward thinking, there is a danger that the allure of a potential revolution in MCM technology may cloud the reality that mine warfare will remain an extremely complex and time consuming discipline requiring the synthesis of many organic and non-organic assets, and lots of effort. Worse yet, if the Navy's organic MCM concept fails to live up to expectations, the operational commander of tomorrow may very well be denied access or defeated in a region where he fully expects to dominate.

The intent of this paper is to analyze the organic MCM concept in terms of space, force, and time and its impact on the operational commander. Functional implications of the concept are also explored. An examination of the U.S. Navy's organic MCM vision follows a brief historical discussion of the naval mine threat. Organic MCM limitations are then discussed followed by recommendations of how to optimally merge organic and dedicated MCM assets.

A Historical Perspective

*"We have lost control of the seas to a nation without a Navy, using pre-World War I weapons laid by vessels that were utilized at the time of the birth of Christ."*²
RADM Allan Smith after losing two ships to mines at Wonsan, Korea

Conducting naval operations in the littorals is not a new concept for the U.S. Navy. With the exception of the Cold War, most American naval operations have routinely taken place in some sort of a littoral environment. Consequently, mine warfare has historically played an important role in sea control operations. From the Civil War to the 1991 Persian Gulf War, naval mines have had a significant impact on American military operations. Since 1950, enemy sea mines were responsible for 14 of the 19 Navy ships destroyed or damaged.³ For a commander to achieve the capability to neutralize the mine threat **and** do it without significantly impacting his scheme of maneuver or operational tempo offers tremendous advantages. This advantage, however, has yet to be achieved.

Some notable historical examples serve to illustrate the costs associated with an inadequate countermine capability. Many mine warfare lessons of the past are fundamental and timeless. They also provide a glimpse of what consequences await future commanders if the proper countermine strategies and operational concepts are not soon identified and put into practice.

Though both the Axis and Allied powers used mines extensively, the years leading up to the Second World War saw mine warfare as a low priority for American naval planning, procurement, and operational training. In the European Theater, Germany primarily deployed unsophisticated contact and magnetic mines. This simplistic mine strategy afforded the Allies time to evolve an effective and robust MCM capability as the conflict matured. During perhaps the most important operation of the war, over 306 Allied minesweepers supported the Normandy invasion force (only 32 were from the

U.S. Navy). Though this vast MCM flotilla provided substantial sweep coverage many days before the actual landing, a number of Allied combatants and landing craft were still lost to mines. It was later learned that through sheer luck, the landing force had missed detonating hundreds of Germany's new generation, pressure-acoustic activated mines.⁴ Since the U.S. Navy's MCM strategy was not equipped to counter such a sophisticated undersea threat, Germany might have dramatically impacted Allied key lines of operation had this technology been better exploited.

One of the most important and largely forgotten examples of the effectiveness of mines on a modern naval force was during the American amphibious operation at Wonsan during the Korean War. On the 10th of October 1950, Captain Richard Spofford arrived off Wonsan harbor with a small contingent of minesweepers and began clearing approach lanes for the impending amphibious landing. Despite an aggressive minesweeping effort, an enormous field of over 3,000 mines spread over a 400-square mile area rendered clearance extremely slow and difficult. This minefield stopped the landing force dead in its tracks. Two minesweepers, the *Pirate* and *Pledge* struck mines and were sunk, compounding the problem. After a considerable delay, and with substantial help from Japanese minesweepers, the landing eventually took place. The mine barrier at Wonsan proved to be a sobering wakeup call for the United States. In an after action report to the Chief of Naval Operations, RADM Allen Smith, the amphibious force commander, commiserated:

"The Navy able to sink an enemy fleet, to defeat aircraft and submarines, to do precision bombing, rocket attack, and gunnery, to support troops ashore and blockade, met a massive 3,000 mine field off Wonsan. The strongest Navy in the world had to remain in the Sea of Japan while a few minesweepers struggled to clear Wonsan".⁵

With remarkable parallels to the Korean War some forty years prior, the U.S. Navy, the most technologically advanced and dominant naval force in the world, was largely paralyzed by an unsophisticated Iraqi mine campaign. By randomly placing approximately 1,200 mines (mostly of World War I and II vintage) throughout the Northern Arabian Gulf, Iraq forced U.S. and coalition naval forces to pull back from the Northern Gulf and alter their concept of operations. Because of the Iraqi mines, coalition amphibious plans were significantly curtailed. Furthermore, while conducting and supporting mine clearing operations, two U.S. ships, the *Princeton* (CG-59) and *Tripoli* (LPH-10) were severely damaged by exploding mines. Once again the United States relearned that underestimating the naval mine threat equates to limited maneuverability, costly losses, and sea denial.

Today's sea mines are among the most affordable and effective means for a potential adversary to prevent naval forces from achieving sea control and power projection ashore. The most effective way a future enemy can challenge the powerful sea control capabilities of the United States is through an effective sea denial strategy. As demonstrated throughout history, naval mines are a key component of such a strategy.

The number of countries possessing a mining capability has grown significantly in the last ten years. As illustrated in Appendix A, technological improvements to mines, including camouflaged designs and anechoic coatings, make detection extremely difficult. Today, more than 50 countries possess a mining capability. This is a 40 percent increase since 1986. Most importantly, the types, sophistication, and lethality of mines available on the world market are rapidly increasing.⁶

The Organic MCM Vision

Naval mines can significantly impact the operational factors of time, force, and space as defined by Dr. Milan Vego's concept of operational art.⁷ These are the very factors that the U.S. Navy expects to favorably exploit when fighting in a hostile sea. The factor of space becomes critical if an adversary effectively employs mines to achieve sea denial. Conceivably, through the organic MCM concept, the effect of mines on the operational factors of time and force can be mitigated. In practical terms, this means that organic countermine instruments can decrease the impact of mines on the tempo of operations and maneuverability of a battle force, thereby dramatically reducing the effectiveness of mines as a sea denial instrument. Proponents of the organic MCM argue that this can be achieved without a substantial increase in dedicated countermine forces.⁸

The development of an organic MCM concept is the result of the combination of advances in technology and the recognized need to dramatically improve the timeliness and effectiveness of mine clearance operations. The organic MCM concept is viewed by many as a logical extension to, and key element of, the Navy and Marine Corps' "Forward.....From the Sea," and "Operational Maneuver From The Sea" (OMFTS) strategies.

The current Naval Mine Warfare Plan developed by the Director of Expeditionary Warfare describes the organic MCM concept. This concept is built around three key timelines: The Near-Term (1999-2000), Mid-Term (2001-2005), and Far-Term (2006-2016). The fielding of fleet organic MCM systems begins in the Mid-Term with the goal of deploying a fully-capable organic MCM systems package with a carrier battle group (CVBG) by 2005.⁹ The organic MCM concept calls the organic systems described in Appendix B to conduct mine reconnaissance, mine hunting, minesweeping, and mine

clearance in order to support the full spectrum of maneuver in mined littoral waters. The ultimate objective is to field organic systems that will allow CVBGs and amphibious ready groups (ARGs) to operate unencumbered in order to support land forces in such an environment.¹⁰ While not specifically addressed in the Navy's Mine Warfare Plan, this most likely includes ensuring littoral access for Army and Air Force pre-positioned ships as well.

Since 1992, the Navy has invested roughly \$1.2 billion in RDT&E funds to improve its counter mine capabilities and will spend an additional \$1.5 billion through 2004.¹¹ Though no organic device has been operationally fielded as of this writing, a number of new organic MCM systems, such as the AN/WLD-1(V)1 Remote Mine Hunting Vehicle, the AN/AQS-20X advanced AMCM Sonar and the Airborne Mine Neutralization System are in late developmental and testing phases. These systems and others are a critical first step in the organic MCM concept and will soon be deployed from helicopters, ships, and submarines. They will provide the first operational test of the organic MCM concept and provide the framework for follow-on capabilities. It is important to examine how these systems will functionally translate into operational applications.

Airborne Mine Counter Measure (AMCM) operations have been a linchpin in the Navy's countermine strategy since the late 1950's. The current fleet AMCM workhorse is the MH-53E helicopter. These helicopters can be forward-deployed or surged via the *U.S.S. Inchon*, the Navy's sole dedicated AMCM ship. Though this combination provides a potent MCM capability, both the *Inchon* and the MH-53Es will be decommissioned by 2005.

As part of the Navy's Helicopter Master Plan, the CH-60 will replace the aging CH-46 currently flown and supported by the Helicopter Combat Support (HCS) community. The CH-60 will also replace the MH-53E as the Navy's only AMCM aircraft and provide an aerial platform for most of the next generation organic airborne MCM systems.¹² The AN/AQ-20X Airborne Mine Neutralization Sonar, the Airborne Mine Neutralization System (AMNS), the Organic Airborne and Surface Influence Sweep System (OASIS), and the Rapid Airborne Mine Clearance System (RAMICS), will all be fitted to the CH-60.

It is expected that surface combatants, such as DDG-51 class destroyers, will be able to perform MCM by deploying the self-contained AN/WLD-1(V) Remote Mine Hunting Vehicle. This sensor will be remotely deployed, operate untethered from the host ship for up to forty-eight hours, and will feed underwater reconnaissance information into the AN/SQQ-89(V)15 Undersea Warfare Combat System (an advanced sonar integration suite). The synthesis of these two systems, along with support from battle group AMCM CH-60s, will theoretically neutralize mines encountered in a given operating area.¹³ This concept is a key MCM component to facilitate complete freedom of maneuver, enabling surface combatants to operate unencumbered in mined waters.

The mid-term undersea organic MCM effort centers around two devices, the Near-Term Mine Reconnaissance and Long-Term Reconnaissance systems (NMRS/LMRS). These are unmanned, underwater vehicles (UUVs) that are designed to be compatible with SSN-68 and the new NSSN class attack submarines. Like the Remote Mine Hunting Vehicle deployed from surface ships, MCM UUVs are being developed to provide submarines the ability to detect and classify various types of bottom

and moored mines in deep through very shallow water.¹⁴ Future concepts call for submarine-launched UUVs that will not only detect and classify mines, but will also destroy them.

Though the final mix of organic and dedicated MCM forces is still to be determined, the Navy is betting heavily on the success of organic designs. Before the Navy is completely seduced by the promise of a “technological fix” to the naval mine challenge, it is prudent to examine the functional limitations of the organic concept from an operational perspective. If the Navy fails to critically address the limitations to its organic countermine strategy, costly failures of the past may soon be repeated.

Organic MCM Limitations

Operational considerations. It is probable that organic MCM systems will enable naval units to tactically operate more effectively in a mined environment. However, the real issue is just how well this concept will translate into significant operational advantages. In view of the considerable expense and risk associated with the organic MCM concept, key questions and issues should be examined and resolved before the Navy fully incorporates an MCM strategy dependent upon organic systems.

There are essentially four general ways a naval commander can neutralize the naval mine threat:

- Prevent the enemy from laying mines (limited by Rules of Engagement)
- Avoid mines all together (operationally dependent).
- Clear the mines (from an essential operating area).
- “Press on” despite some risk (balance risks verses rewards).¹⁵

The organic MCM concept is best suited to provide a limited capability to avoid or clear a small number of localized and unsophisticated mines. Some will argue that the operational commander will be able to depend on new, sophisticated, and organic MCM reconnaissance and neutralization systems, coupled with superior strategic and operational intelligence, to provide clear avenues of approach to reach objectives. This argument is flawed in that it fails to adequately consider the operational and practical limitations of the organic MCM concept. It also overestimates U.S. intelligence capabilities and underestimates the complexity of many of the environments where U.S. naval forces may be tasked to operate in the future.

Organic MCM sensors should provide operational commanders with improved situational awareness. A self-contained mine neutralization capability should also improve the mobility of some units. Nonetheless, these are tactical improvements and will do little to provide sufficient access and freedom of maneuver through a sophisticated mine defense for the bulk of a commander's critical naval forces.

It is also increasingly difficult to predict the next place U.S. forces will conduct opposed naval operations. However, it should be assumed that future adversaries will possess detailed knowledge of their home waters and will be well suited to exploit this knowledge. Countering the myriad of mine deployment options primarily through organic MCM measures is unrealistic. Finally, considering that mines will likely be used as part of a larger, multi-faceted coastal defense system, a commander may not have the option to avoid heavily mined operating areas to reach an objective.

AMCM operational shortfalls. Even if the new AMCM systems perform as planned, it is improbable that the CH-60 will provide adequate airborne mine detection,

classification, and neutralization coverage. While the CH-60 should prove a dependable and robust replacement for the aging CH-46, the HCS community will have a difficult time supporting all of its newly assigned missions. This will greatly impact the effectiveness of the CH-60 as the Navy's sole AMCM platform.

The HCS role is rapidly evolving from providing "bullets and beans" to the fleet, to that and much more. By mid 2001, the Navy's Helicopter Master Plan calls for the HCS mission to significantly expand beyond airborne logistics delivery. The CH-60 will soon support search and rescue, combat search and rescue, and naval special warfare. The Master Plan expands the HCS mission even further to include airborne mine detection and counter-measures.¹⁶ Even with the best technology, mastering the complex art of airborne mine warfare requires a tremendous amount of training and practice. A dedicated helicopter community currently performs the AMCM mission as a "full time job". Considering the increased number of new missions, and the complexity of the AMCM requirement, the HCS community may find their plate too full to proficiently conduct aerial mine warfare. This may ultimately result in a reduced operational AMCM capability.

Even if the HSC community can overcome their training and expansion challenges and gain proficiency in AMCM, the actual number of AMCM CH-60s available to an operational commander will be very limited. Since the typical battle group deploys with only one HCS detachment consisting of two helicopters, organic AMCM resources will always be spread very thin. In order to provide meaningful AMCM coverage, these two helicopters will not only need to remain fully mission capable (improbable), but will also be required to shed their other missions to support

actual MCM operations. This may prove an unacceptable trade-off for an operational commander. Even in a best-case scenario, the few available CH-60s will be hard pressed to provide a robust AMCM capability for large combinations of ships needing to rapidly access a mined region. Also, since Surface Action Groups (SAGs) typically operate independent of carrier battle groups, they will rarely have the support of these helicopters.

Surface ship restrictions. Surface combatants deploying organic MCM systems will face significant challenges stemming from the sheer number of complex warfare disciplines they are currently tasked to conduct. While envisioned to increase their overall lethality, the addition of organic MCM devices on warships may actually decrease their overall operational effectiveness.

For example, DDG-51 class destroyers are designed to counter air, land, surface, and sub-surface threats, often simultaneously. This requires a high degree of flexibility, coordination, and maneuverability. Despite impressive and proven technology, task saturation remains a limiting factor for these ships. Combat success during a multi-axis attack (especially in the littorals) is a daunting task even for the most technically advanced and best trained warships. Adding a MCM requirement to these multi-tasked ships will inadvertently hinder a naval commander's ability to achieve sea control.

A warship operating in a mined environment of even limited scope and sophistication will have to significantly slow its operational tempo and narrow its focus. Surprise will be lost and initiative will be squandered. The ship will be constrained by its ability to maneuver and conduct parallel operations required to achieve combat objectives. Essentially, while prosecuting mines, a warship's overall effectiveness will

decrease while its vulnerability increases. Even with advanced organic systems, a destroyer will need to slowly, methodically, and deliberately identify, avoid or destroy a conceivably large number of mines, often without AMCM support. This is a difficult task under the best circumstances. Though individual warships may retain some capability to "feel" their way around a minefield, they will be hard pressed to provide MCM support for ships without an organic capability, especially aircraft carriers, amphibious, and maritime pre-positioned ships (MPS). The end result is a very limited and local tactical MCM capability for some individual units, but severe operational restrictions for the bulk of the battle force.

Implementation considerations. Despite the millions of dollars already spent on the organic MCM concept, almost all systems are still in the development stage. The transition from concept to capability depends on continued advances in technology, maturing systems, and robust expenditures. None of these are a given. Even though significant resources have already been expended in developing organic MCM, history shows that mine related programs stand a good chance of losing steam in future budget battles.¹⁷ Even if proven organic systems make their way to the fleet, it is questionable as to whether or not they will arrive in adequate numbers and with a reliable logistical tail. For the organic MCM concept to have a real impact on an operational commander's ability to neutralize a mine threat, the systems have to be reliable, rugged, and available. This is a standard difficult to attain in an austere budget climate. If organic systems are to be an integral component of a warfighter's MCM package, the individual organic devices need to be easily replaceable or repairable. If one system goes down or is lost

through attrition, another will have to quickly step in and replace it. It is doubtful the operational commander will be afforded such a redundant capability.

Though the sophistication of MCM systems is rapidly improving, so is the lethality of the mine threat. The majority of organic MCM systems are being engineered to counter relatively unsophisticated moored contact or influence mines.¹⁸ An operational commander may very well face far more complex underwater weapons to include buried influence mines, rising contact mines, camouflaged mines, (designed to blend in with the topography of the bottom), and mines containing an anti-mine hunter capability.¹⁹ Many mines will also contain advanced countermeasure systems. In a sophisticated, layered minefield, organic MCM systems will probably never be able to provide a full-spectrum countermine capability thereby limiting their overall usefulness.

A cautionary prelude. A recent example of a new MCM system that failed to translate into real-world operational advantages (despite eight years of R&D and the expenditure of over \$40 million dollars) was the Shallow Water Breaching System (SABRE, described in Appendix B).²⁰ Though SABRE was innovative, somewhat organic, and appeared to solve a particularly difficult part of the sea mine problem, its success was hampered by key operational and logistical weaknesses. These shortcomings severely decreased its overall effectiveness and resulted in termination of the program.

SABRE was conceived to neutralize the Very Shallow Water (VSW, which is water depth less than ten feet to the beach) mine threat. The system was designed to deploy from an air cushion landing craft (LCAC) and provide a breaching capability for marines as they moved ashore through the surf zone. The major pitfall of SABRE was that it was large, heavy, and difficult to deploy. This significantly increased the on-

station time and vulnerability of LCACs as they maneuvered to their landing areas.²¹ Though SABRE provided a desperately needed capability, its complexity and portability problems rendered it ineffective in facilitating the rapid deployment of ground forces. SABRE's technological capabilities did not translate into operational utility. This failed countermine endeavor articulates some of the practical and operational risks associated with the organic MCM concept.

The thriving arms export market will ensure many variations of more advanced mines are available to a wide range of potential enemies of the United States. It is unlikely that any organic system will adequately cope with such a wide array of weapons. Though technological improvements are critical to counter this evolving and multi-faceted threat, it is highly improbable that new technology alone will radically simplify the complexities of mine warfare.

Conclusions

If a commander is going to prevail over naval mines, a realistic, robust, and reliable operational mine clearance capability must be an integral component of his scheme of maneuver. It is naïve to assume that organic MCM systems will significantly impact the operational factors of space, time, and force against this threat. Despite advances in technology, for the conceivable future, mine warfare will remain a difficult, slow, complex problem. A true "in-stride" MCM capability may never be possible. However, MCM responsiveness and effectiveness can be greatly improved.

In order to gain access and exploit mined seas, it will take a dedicated and sustained effort to coordinate a network of organic and dedicated MCM assets. This is the only way to provide a commander a credible countermine enabling force. If an

operational commander relies too heavily on organic MCM capabilities to open the door to a disputed sea, he may very well find the door locked and barricaded.

Pragmatic solutions

In order to provide a commander the capability to significantly decrease the impact of mines on his scheme of maneuver, an organic MCM concept should augment and enhance, not replace, dedicated MCM forces. A synthesis of both dedicated and organic MCM assets will optimally leverage the operational factors of force and time to achieve access and maneuverability in a given battle space. The first two recommendations below focus on operational considerations. The second two recommendations delve into the force-planning realm. Though force planning is outside the scope of this paper, they are included because they offer realistic solutions that can significantly impact the operational factors of force and time while having minimal impact on resource allocations. In order to achieve an optimal balance between organic and dedicated MCM concepts, the following recommendations should be considered:

- a. Improve the integration of CVBGs and ARGs with dedicated countermine surface platforms. This would mean moving the *Avenger* class MCM ships presently home ported in Corpus Christi, Texas to major fleet concentrations such as San Diego and Norfolk. Establish a Mine Warfare Type Commander in San Diego or Norfolk to optimize integration and "mainstreaming" of MCM forces. This would better facilitate the conduct of realistic littoral exercises and enhance MCM capabilities through fully integrated battle group operations.
- b. Enhance the ability to surge forward-deployed surface MCM forces. Only four MCM ships are currently based overseas. Two in the Arabian Gulf and two in

Sasebo, Japan.²² The number of forward-deployed MCM ships should be increased. Diego Garcia, Naples Italy, and Darwin Australia are among the possible overseas ports of choice. The availability of more-forward deployed minesweepers would significantly improve MCM response times, a significant limiting operational factor.

- c. Since the Navy is adopting the H-60 as a common airframe for all helicopter operations, expand HS (carrier-based helicopters) and HSL (cruiser/destroyer based helicopters) mission areas to include AMCM. This will provide a far more robust AMCM capability providing aircraft carriers, amphibious ships, and surface combatants (as well as combat support and pre-positioned ships) a viable AMCM capability. This would increase a battle force's overall operational effectiveness by dramatically increasing an operational commander's AMCM coverage and reliability.
- d. Utilize a core group of the *Oliver Hazard Perry* class guided missile frigates (FFGs) to serve as battle force MCM platforms.²³ Since these ships are to be phased out over the next ten years, some could be reserved for an MCM role. These extremely capable ships would be a logical and affordable host for the wide array of AMCM, and surface organic MCM assets. The FFGs would provide a very fast, flexible, and robust capability to escort many types of force packages through a wide range of mined environments.

APPENDIX A

This appendix provides a cross-section (Sweden, Russia, China, Iran, and Italy) of five mine producing countries' latest developments in mine technology. These mines are currently in production and are available for export.²⁴

Sweden. ROCKAN bottom-influence mine. Incorporates a wedge shape design and is enclosed in a non-corrosive fiberglass casing. The ROCKAN mine is difficult to detect as its non-ferrous construction and anechoic coating significantly reduces the weapon's magnetic and acoustic signatures. The lethality of the mine can be further enhanced by close-tethering it or by deploying it in deep waters, where it will be less vulnerable to mechanical minesweeping efforts.

Russia. UDM bottom-influence mine. Widely exported and can be purchased or back fitted with a remote control capability. The SMDM mobile mine is an efficient, highly sweep resistant weapon for use against surface vessels and submarines in constrained coastal waters. The SMDM combines a bottom influence mine with a torpedo to provide a considerable standoff capability. These systems represent a portion of Russia's mine stockpile estimated to be in excess of 100,000.

China. EM55. A straight rising, rocket propelled warhead mine used against surface ships and submarines. Propelled warhead mines use either buoyancy or a propulsion system to transport the warhead to the target. This weapon has a far greater range capability than conventional mines and exploits its capability to limit its target's reaction time and ability to deploy countermeasures. Buoyancy propelled mines are most effective in shallow waters against slow moving targets, whereas rocket-propelled mines travel three times faster and can be used in waters as deep as 650 feet.

Italy. Manufactures a wide-range of mines, including the MP-80, Manta bottom mines and several types of anti-invasion mines. Buyers of these weapons include Iraq, Iran and North Korea.

Iran. Aggressively procures mines from various sources as a key part of its naval development program. Iran's mine program is a critical component of an over-arching strategy of controlling access to the Strait of Hormuz.

APPENDIX B

This appendix provides an overview of a number of organic mine-countermeasure systems currently under development.²⁵

AN/WLD-1(V)1 Remote Minehunting System (RMS). A remotely operated, surface ship launched and recovered semi-submersible vehicle towing mine reconnaissance sonar. The system will conduct bottom reconnaissance for bottom and moored mines from the deep-water region to the 30-foot contour of the Very Shallow Water region. The RMS will determine the presence of mine-like objects and safe routes or operating areas around minefields.

Near-term Mine Reconnaissance System (NMRS). The NMRS will be launched and recovered from a *Los Angeles* (SNN-688) class submarine. The system will be capable of limited mine detection, classification, and localization and provide an inherent low risk to the host platform. The NMRS will be deployed through standard SSN-688 torpedo tubes and will consist of two reusable UUVs; launch and recovery equipment; and shipboard control, processing, and monitoring equipment. Operators will control the vehicle via a fiber-optic cable connected to the launch platform.

AN/AQS-20X Advanced AMCM Sonar. The AN/AQS-20X will be a helicopter-towed minehunting sonar system containing an integrated Electro-Optic Identification (EOID) device. Follow-on to the AN/AQS-20 minehunting program, the AQS-20X will be compatible with the MCM variant of the H-60 helicopter. This system will provide an organic capability for rapid detection, neutralization, localization, and classification of bottom and close-tethered mines. This capability is envisioned to enable CVBGs and ARGs to transit or avoid mined areas in choke points and littoral areas with a high degree of self-protection.

Airborne Mine Neutralization System (AMNS). AMNS is an expendable, remotely operated device that will be employed by CH-60 helicopters to explosively neutralize bottom (unburied) close-tethered and volume mines that are impractical or unsafe to defeat using existing minesweeping techniques. The system will have a day or night, shallow to deep-water capability. Prior to the neutralization mission, a minehunting sonar or electro-optic system will be required for mine detection, localization, and classification.

Organic Airborne and Surface Influence Sweep System (OASIS). An improved organic influence sweep system planned for the CH-60 as part of the organic AMCM suite of systems. OASIS consists of a towed magnetic and acoustic source, a tow/power cable, a power conditioning and control subsystem, and an external power supply. OASIS will incorporate the most recent magnetic and acoustic countermeasure technology in one towed body to achieve an increased depth capability.

APPENDIX B, continued

Rapid Airborne Mine Clearance System (RAMICS). A helicopter-borne weapon system that will fire a 20mm projectiles from a modified Gatling gun controlled by a blue-green Laser Detection and Ranging (LIDAR) sensor. A supercavitating 20mm projectile drives a chemical initiator through a casing into the mine. The LIDAR locates and targets the mine and provides aiming coordinates to the gun's fire control system. Rounds are fired in bursts to neutralize the mine.

Shallow-water Assault Breaching System (SABRE). A discontinuous line charge system delivered by two MK 22 rocket motors and deployed from an LCAC. SABRE is designed to accomplish wide area neutralization of anti-invasion mines in the surf zone by deploying a 180-by180-foot explosive net system from a 200-foot standoff range.

NOTES

¹ Director Expeditionary Warfare, United States Naval Mine Warfare Plan (Washington, DC: N85, 1999), 1.

² Admiral Allan Smith, quoted in Dwight Lyons and others, The Mine Threat: Show Stoppers of Speed Bumps? (Alexandria, VA: Center for Naval Analyses, 1993), 1.

³ United States General Accounting Office, Navy Mine Warfare, Plans to Improve Countermeasures Capabilities Unclear (Washington, DC: GAO, June 1998), 1.

⁴ Admiral Allan Smith, quoted in Tamara Melia, Damn the Torpedoes (Washington, DC: Naval Historical Center, 1991), 57-58.

⁵ Malcolm Cagle and Frank Manson, The Sea War in Korea (Annapolis: Naval Institute Press, 1957), 142.

⁶ Director Expeditionary Warfare, 1.

⁷ Milan Vego, On Operational Art (Newport, RI: Naval War College Press, 1999), 53.

⁸ Director Expeditionary Warfare, 1.

⁹ *Ibid.*, 3.

¹¹ United States General Accounting Office, 5.

¹² Director Air Warfare, Helicopter Master Plan (Washington, DC: N88, 1996), Briefing Slides.

¹³ Ken Haas, "The Remote Minehunting System," Surface Warfare, (May/June 1999): 24-25.

¹⁴ Malcolm Fages, "The Submarine Force: A Century of Excellence and the Challenge of the Future," Undersea Warfare, (Summer 2000): 5.

¹⁵ Lyons, et al, 15.

¹⁶ Director Air Warfare, Briefing slides.

¹⁷ Lyons et al, 2.

¹⁸ United States General Accounting Office, 14-19.

¹⁹ Watts, Anthony, Jane's Underwater Warfare Systems, 1999-2000 (Surrey, UK: Sentinel House, 1999), 259.

²⁰ United States General Accounting Office, 16.

²¹ L.H. Rosenberg and R.T. Anderson, "Stopped by Mines," U.S. Naval Institute Proceedings, (January 2001): 67.

²² Director Expeditionary Warfare, Appendix D-1.

²³ Robert E. McCabe III (Captain USN), Military Chair of Mine Warfare, Naval War College, Newport, R.I., interview by author, 27 November 2000.

²⁴ Director Expeditionary Warfare, Appendix A.

²⁵ *Ibid.*, Appendix C.

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