Protecting Naval Vessels
Threats, Concepts and Systems

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In October 2016, an attack on the UAE high-speed logistics vessel SWIFT by anti-ship missiles (assessed as C-801 or C-802 types) inflicted severe damage on the vessel. A similar attack on a Saudi Arabian AL MADINAH Class frigate in January 2017 killed several crew and damaged the ship.

These attacks are a reminder of the continuing requirement for navies to develop concepts and deploy systems that protect their vessels from attacks in an increasingly lethal naval security environment. That environment challenges the defence of ships and forces with a spectrum of threats ranging from new generation anti-ship cruise and ballistic missiles to missiles such as those that hit the SWIFT. Adding to the challenge of protecting naval vessels are constrained budgets, smaller force structures and, as a result, fewer ships available to operate for most navies around the world. This strategic setting induces trade-offs between offensive and defensive systems, as well as hard decisions about what kinds of threats are the most pressing, and therefore which defensive small groups, they are less able to draw on the proven principles of protecting naval vessels: stand-off distance, safety in numbers and layered defence. This article will review contemporary naval vessel protection concepts and systems. It begins with a look at the threat environment, then presents a conceptual framework for naval vessel protection that helps assess the strategic choices available for high speed jet aircraft. Ships must also protect themselves from the "simpler" but more numerous threats posed by high speed small craft armed with crew-served weapons and grenade launchers, low speed and low visibility manned and unmanned aircraft, shore-based artillery as well as the older generation anti-ship systems will have the highest priority in allocating resources. Indeed, the US Navy's "Distributed Lethality" operating concept now guiding the surface forces is a response to the critique that modern warships have become so focused on defending themselves against the whole spectrum of threats that they are underinvested in offensive capabilities that historically defined most fleet and ship designs for the last century.

And as these fewer surface ships operate in coastal or constrained waters such as the Arabian Gulf, North Arabian and South China Seas, often as single ships or in very naval design, operation, and acquisition. It closes with a comparative review of how US, European and especially other navies are choosing to protect their newest frigates and destroyers - those recently built or currently under construction. That review will use proprietary data drawn from AMI International's naval market and technical databases. While the article considers concepts and systems that apply to protecting all types of naval vessels - from aircraft carriers to submarines to patrol craft - it focuses mostly on the general purpose surface combatant. Destroyers and frigates represent the main

The hybrid catamaran HSV-2 SWIFT was originally built for the United States Navy Military Sealift Command, primarily for mine countermeasures and as a sea basing test platform. Then it was leased by the United Arab Emirates' National Marine Dredging Company in 2015, where it was attacked by Houthi fighters in October 2016.

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body of most navies today and a significant part of planned shipbuilding investments globally over the next 20 years. They are also the types of ships most often operating “in harm’s way” and are the ships most likely to be found operating alone in high threat environments, and so provide insight into how navies are prioritising their investments to protect naval vessels.

Threats

Threats to naval vessels come from all directions. The subsurface, surface, air, space and increasingly the electronic/cyber domains all represent threat axes when planning ship or force defence. As described in our recent article on contemporary anti-submarine warfare challenges, investments in modern, and increasingly missile-armed, submarines are drawing increased attention to the lack of modern ASW capabilities (systems and trained personnel).

Judging from defensive systems equipping frigates and destroyers being built now, the threat from the air – missiles and aircraft – remains the priority driving ship protection concepts and investments. The resources devoted to radars, other sensors, combat management systems and weapons that are optimised for air and missile defence outstrip those for anti-submarine and anti-surface defence systems.

The Air Threat Matrix

Conventional short range weapons include airborne weapons typically used in direct attacks at short range – bullets and bombs from helicopters and manned fixed wing aircraft. Attacking platforms gain stand-off advantages with tactical missiles such as the laser-guided BRIMSTONE missile at a range of about 8 nautical miles. Longer-range precision anti-ship missiles such as EXOCET and HARPOON (maximum ranges 75-100 NM) are being superseded by the newer generation of weapons such as Indian-Russian joint venture BRAHMOS missile – claimed to be the fastest ASCM (Anti-Ship Cruise Missile) currently in service at an operational range of up to 250 NM.

As more navies add to the numbers and sizes of ships in their fleet structures, the once firm dividing line between ASCM and LACM (Land-Attack Cruise Missile) is blurring. A mission kill or even sinking of an adversary’s ship – even those as small as corvettes – can have a dramatic political effect, as shown in the attacks on UAE and Saudi Arabian ships, along with a similar attack on the INS HANIT off Lebanon in 2006.

The Russian KLUB series of missiles (NATO designation SS-N-27/SS-N-30) is one example of this increasingly complex missile threat confronting the next generation of air and missile defence systems. KLUB uses a common missile design for long range (up to 600 NM for some variants) land attack and anti-ship variants. KLUB is widely exported (India, Algeria, Vietnam, China, possibly Iran) and can be launched on short notice from a wide variety of platforms. Recent marketing literature on the system promotes its ability to be adapted to commercial shipping containers for sea, road or rail launch, as well as conventional submarine tube and surface ship vertical launch systems.

Missiles like the KLUB series will be increasingly difficult to identify, locate and destroy prior to launch, making post-launch neutralisation by sea-based air/missile defence systems the main line of missile defence – for the fleet or the homeland.

Conceptual Framework: Active and Passive, Kinetic and Non-Kinetic

In reviewing the difficult strategic choice of what systems to acquire to protect the vessels, two general categories can be seen. Active measures reach out to deter
or destroy the threatening platform (aircraft, ship, boat, submarine, land-based launcher) prior to the employment of the weapon (shell, projectile, missile, torpedo) that will damage the ship. And in the event of an attack, active systems neutralise or destroy the weapon that is directed at the ship. Active naval protection is mainly performed by guns (especially small calibre, high rate of fire close-in weapons systems) and missiles.

Passive means that contribute to force or ship defence have traditionally been intelligence, long range sensors, communications and command/control systems that provide the location, classification, posture and, finally, notification of the attack of a threatening platform. These systems enable ship countermeasures such as manoeuvre and emissions control that enhance the protection of the threatened platforms. On the ship itself, systems such as chaff, flares, decoys (physical and electronic), noisemakers and the like that aim to counter the attack system's guidance and control prior to the weapon reaching its effective engagement range.

Another related way of categorising naval protection systems is whether they are kinetic or non-kinetic. Kinetic systems protect by physical impact or destruction of the threatening platform and/or weapon. Non-kinetic protection, heretofore mostly electronic warfare and related systems, counter the threat by directing energy in ways that neutralise critical elements of the threat platform or system without its complete physical destruction.

For the purposes of this article, this framework serves as a "menu" to evaluate how navies, ship and system designers are allocating resources for protecting naval vessels.

Directed Energy systems, however, blur some of the distinctions above and offer the prospect of "changing the game" on ship protection in which guns and missiles remain the predominant technologies. As noted by Congressional Research Service naval expert Ron O'Rourke: "The (US) Navy is currently developing three potential new weapons that could improve the ability of its surface ships to defend themselves against enemy missiles — solid state lasers (SSL), the electromagnetic railgun (EMRG), and the hypervelocity projectile (HVP) (...). Rarely has the Navy had so many potential new types of surface-ship missile-defence weapons simultaneously available for development and potential deployment (...). Although the Navy in recent years has made considerable progress in developing..."
SSLs, EMRG, and HVP, a number of significant development challenges remain."

**Current Ship Protection Systems – The Balancing Act**

AMI forecasts of new large surface combatants construction over the next 20 years include 438 new destroyer and frigate hulls at a total acquisition cost of US$346Bn. This represents about 34% of all new naval construction spending on all types of naval ships and craft through 2037.

That the navies of the world plan to spend about 1/3 of their new ship acquisition resources over the coming two decades on destroyers and frigates is largely explained by an expanding range of threats in the naval domain detailed above. The most expensive defensive system being acquired for these frigates and destroyers are air defence missiles and related radars. While virtually all the frigates and destroyers forecast to be built over the next 20 years will be equipped with small calibre guns, and most with medium calibre (57 mm-127 mm), the cost of the gun systems being acquired is generally lower than that of missile systems. The same can be said of ASW systems (sonars and torpedoes) compared to air defence radars and missiles.

The reference points for integrated air and missile defence for frigates and destroyers will continue to be the AEGIS systems – still the "state of the art" for ship-based fleet and national air/missile defence. The AEGIS combat system on US BURKE class destroyers are an example of successful evolution in both ship and system design to manage high-end ballistic missile defence (BMD) as well as general naval missions.

However, most navies are not resourced to invest in AEGIS-level integrated air and missile defence. Rather, most of the world’s frigates in service or under construction rely on short-range air defence missiles for air defence. A representative sample of air defence missile systems equipping smaller frigate programs (3,000 tons or below) under construction is provided on the left. The gun and ASW defensive armament on the same set of ships (shown left) demonstrate that navies are investing to provide anti-surface and even ASW defense capabilities on even these smaller hulls, where "real estate” available to add systems is even more limited than is the case for frigates and destroyers 4000 tons and larger.

**Conclusion**

Torpedoes, suicide boats, and mines are all threats to naval vessels. All are capable of crippling or sinking ships, and all have done so in the post-World War II era. Yet a review of the systems being selected to protect frigates and destroyers today signal that navies continue to see air and missile attack as the most likely and most difficult to counter among the array of threats to naval vessels, and are investing accordingly. This is not to say that ASW and anti-surface defence systems are neglected. As seen above, even the smaller frigates now being built for non-NATO navies around the world are being fitted with small calibre guns, sonars and torpedoes to counter a broad range of potential threats. But it remains the case that naval investment continues to be weighted toward kinetic systems for air and missile defence onboard frigates and destroyers.

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