Solutions

Open Architecture fosters lower-cost, interoperable systems that provide sailors with better capabilities in an era of scarce funding

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Locked In

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- Open Architecture nurtures competition and modularized systems.
- Keys to success: the disclosure of designs to all players and the reuse of software and hardware across the naval enterprise.
- Needed: a repository for enterprise assets to cultivate the sharing of products and ideas.
- But genuine sharing will be possible only if the Navy insists on contracts to acquire the most flexible intellectual property rights available.

Imagine standing on the flight deck of the USS *Ronald Reagan* on a clear sunny day, off the coast of San Diego, when all of a sudden a Type-093 Chinese nuclear-attack submarine emerges on the horizon.

In the mid-1990s, this was the scenario the U.S. Navy found itself facing when new classes of Russian submarines emerged with acoustic superiority after a period of decreased U.S. funding for undersea warfare.

However, the Navy has substantially improved its performance. How did the Navy do it? Through the adoption of Open Architecture (OA) — a multifaceted business and technical strategy for acquiring and maintaining weapon systems and other hardware that is standardized, transferable to other platforms and able to accommodate a variety of software applications. This led to the creation of interoperable systems that adopt and exploit open-system design principles and architectures, a sharp departure from the Navy's former practice of purchasing stove-piped systems built for single uses that were not designed to work in a networked environment.

To deliver improved capabilities to Navy sailors when funding was scarce, new acquisition strategies were implemented that rapidly increased performance while decreasing costs. Consequently, the submarine force sonar program increased performance seven-fold, cut real processing costs 60-fold and fielded four major improvements within five years.

Today's environment presents the same challenges. Navy leadership is faced with building future combat systems and a fleet capable of meeting emerging threats and evolving national security requirements while controlling the rising costs of weapon systems and aging platforms.

In most cases, the technologies needed to counter emerging threats already exist, but their introduction to the fleet is still stymied by outdated acquisition models that lock the Navy into a limited vendor base, despite the prior acquisition improvements. Further changing the way the Navy does business today is imperative if we are to gain the added flexibility required to capitalize on these technologies.

The OA principles that will help us foster this change include increasing competition and collaboration, modularizing systems and disclosing designs to all players, fielding interoperable joint warfighting applications and securing information exchange, reusing software and hardware assets, and ensuring life-cycle affordability.

Modular combat systems are an especially important element of OA. Individual components of a modular system can be taken out and rapidly replaced with upgraded versions. The modular approach fosters increased competition, reduced cycle times and rapid upgrades. The days of end-to-end upgrades of an entire combat system to achieve improved performance are rapidly coming to a close.

For example, the Naval Air Systems Command office responsible for the E-2C Hawkeye command-and-control aircraft faced delays in enhancing capabilities for its mission computing system and obsolescence by the time it

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was to be fielded. The office adopted OA principles and integrated the new capabilities within 24 months. The acquisition cycle time was reduced from seven years to two-and-a-half.

A second benefit of OA, increased operator and system performance, is achieved by integrating components into an appropriately designed and OA-compliant system.

For example, the Navy's program executive office for Command, Control, Communications, Computers and Intelligence rapidly developed and deployed a new capability to assist ship operators to better manage the tracking of merchant ships. This was accomplished by installing the Automatic Identification System (AIS) on each ship.

A commercial shipboard broadcast system that performs much like a transponder, the AIS enables users to track and communicate with all other ships within range. This system reused previously developed software components, enabling the program executive office to field the system within two months from the initiation of the effort. Ship operators were able to see twice as many merchant tracks in their Common Operational Picture than before AIS was installed.

OA also fosters improved system interoperability, meaning that all potential developers understand the standards and interfaces in use and validate that systems work together as expected. To reap the benefits of improved system interoperability, standards and interfaces for major combat systems — and the components that comprise them — must be published and available to all qualified vendors.

The H-53 Heavy Lift Helicopters Program Office needed a lightweight, survivable monitoring system to detect impending failure of critical components on helicopters. It contracted for an open, modular system design and required the prime contractor to publish key interface specifications and prove the system was open and could be modified by other vendors. The availability of the published interfaces enabled modules from different vendors to interchange without affecting performance. The Integrated Mechanical Diagnostics System is now widely used in the helicopter community.

The cost avoidance stemming from OA is possible because of the widespread adoption of commercial-off-the-shelf (COTS) and government-off-the-shelf products and the reuse of government-owned assets, such as software and hardware. OA enables the Navy to develop or buy the software applications once and use them repeatedly across the enterprise, thus minimizing duplicate investments in the same capability.

With respect to hardware, OA fosters greater investment in COTS at optimum price points when the hardware is separated from the applications that ride on it. For example, the Air Combat Electronics Program Office changed its design and acquisition strategy to find ways to continually provide aircraft with high performance computer processing to handle correlation, fusion and the presentation of high volumes of data to generate information relevant to warfighters.

To develop the Advanced Mission Computer and Displays, the program office focused on building a modular architecture utilizing COTS. The office shunned military standards and insisted on a performance-based specification. The program office is now able to reuse software and hardware to varying levels on the F/A-18, T-45 and AV-8B tactical aircraft, avoiding the costs that would be incurred if the Navy had developed different applications and hardware for the various platforms.

The application of OA standards and processes leads to similar reductions in the costs of training systems for the Navy's ships and planes. OA also fosters cost restraint by supporting diagnostic software and relying on innovative life-cycle support approaches such as distance support, a web-based tool that enables experts ashore to advise and collaborate on maintenance tasks, reducing the maintenance burden on sailors at sea.

Experts responsible for the BQQ-10 Submarine Sonar System Maintenance Free Operating Period Program found that the addition of diagnostic software helped cut man-hours expended, travel costs, operational down-time and hardware replacement costs. The software identified corrective actions needed in response to detected faults and, when directed by the operator, executed the required "reconfiguration" commands to redirect processing as needed to maintain system performance at design levels. Thus, they eliminated 100 percent of open cabinet maintenance for modules within the program boundary. This enabled operators to focus more on operating the system rather than maintaining it.

Becoming leaders of change and innovation requires increasing competition, collaboration and sharing across the naval enterprise. In the 1990s, "OA" meant maximizing the use of commercial standards and commodity COTS products as the preferred alternative to monolithic combat system development. Government program managers demanded modular designs consisting of components that are self-contained elements with well-defined interfaces. That was a good start.

Today, program managers need more flexible acquisition strategies and contracts that allow systems to be upgraded more easily without vendor lock-in. Government and industry need to collaborate more — a key feature of contemporary innovation and integration of technologies and business models. The Navy can foster collaboration with contracts that contain incentives for collaboration and cooperation among industry partners.

OA promotes sharing through greater collaboration by adopting peer reviews, conducting joint end-to-end system engineering experimentation, and promoting reuse and sharing of common solutions. Peer reviews comprising government and industry subject matter experts facilitate the identification of innovative solutions the Navy should consider when upgrading and building systems. By bringing the Navy together with a variety of industry partners, peer reviews increase competition, which lowers costs and fosters the delivery of superior capabilities to warfighters.

In addition, collaboration through end-to-end experimentation across multiple testing facilities provides access to more stakeholders, thereby helping to harmonize standards and guidance and reducing the risk of delivering products that are not interoperable. The sharing of common system components and assets across the enterprise will leverage the Navy's considerable portfolio of intellectual property.

However, additional steps are needed if the Navy is to fully harness the potential of OA. For example, a repository for enterprise assets must be created to enable the sharing of products, knowledge and ideas through communities of interest.

The Navy must find ways to share government-owned intellectual property and data. This is possible only if the government enters into contracts to acquire the most flexible intellectual property rights available — and establishes collaborative capabilities and toolsets to support sharing.

The government also must be vigilant in protecting these rights. Deliverables with correct markings and attribution statements are essential. The government will benefit from its investments only by protecting the rights for which it has negotiated.

When the combat systems of tomorrow are built correctly from the outset — "born open"— the Navy will be able to keep pace with emerging threats and maximize systems' performance in an affordable manner. We should never have to encounter a scenario in which our adversaries cruise the coastline of our nation without our prior knowledge.

If we are to succeed in this transformation, organizations across the enterprise, from fleet requirements to procurement to testing, must share in the OA vision. Engineering and program management personnel must implement OA through technical and business practices. Our partners in academia must promote it in the classroom and through continuing education. And, finally, industry must embrace the Navy's new way of doing business and become proponents of open architecture. ■

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