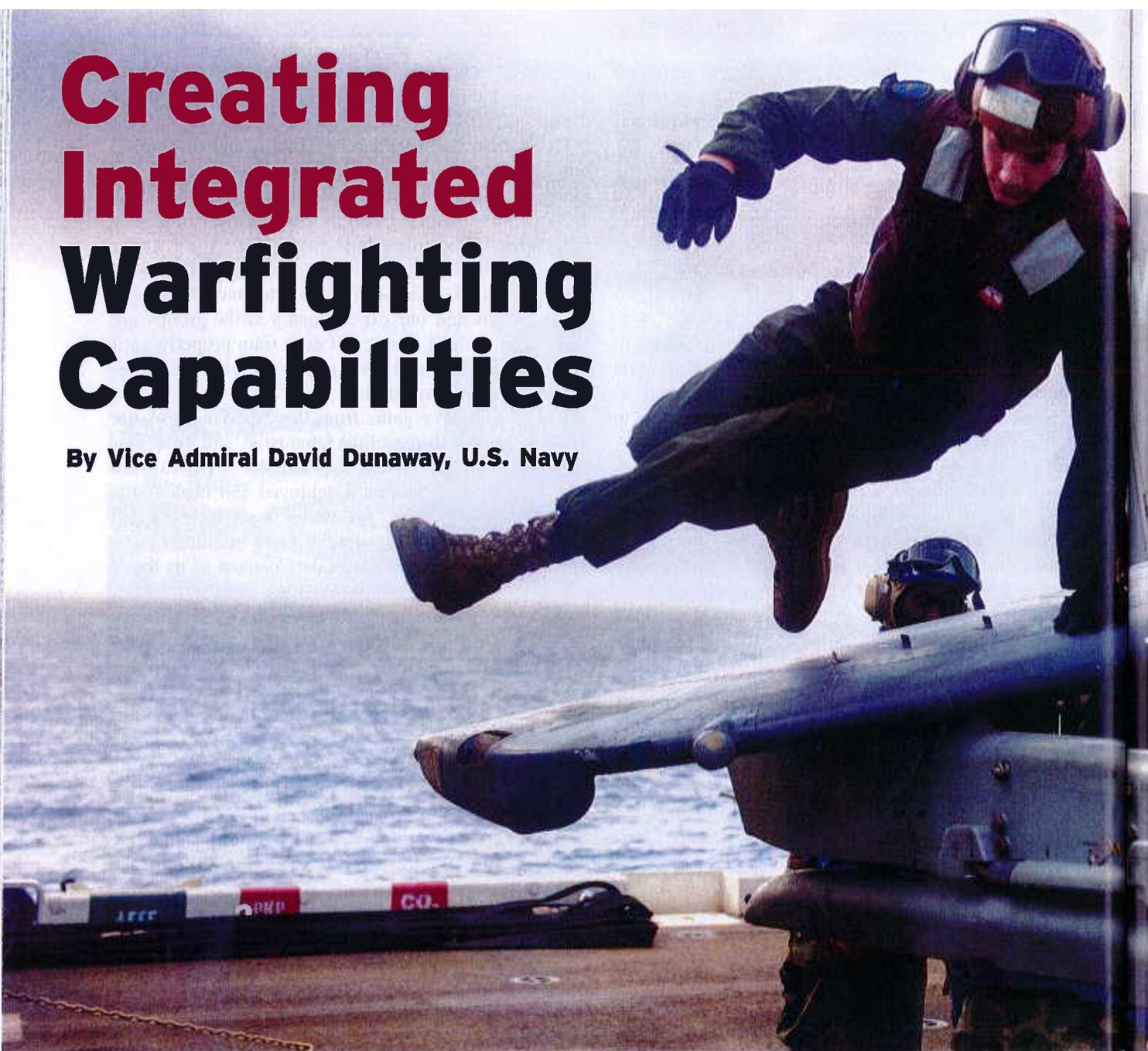


Creating Integrated Warfighting Capabilities

By Vice Admiral David Dunaway, U.S. Navy



To meet increasing demands with decreasing budgets, 'integration and interoperability' become words for the Navy to live by.

The United States has the greatest navy in the world. Free passage over the high seas is largely due to substantial taxpayer investment and the blood, sweat, and tears of extraordinary sailors and Marines. In the face of decreasing budgets, rapidly evolving threats, and a shift in national defense strategy that de-

mands more than ever from our naval forces, it's imperative that every dollar spent increases warfighting capability.

I believe that a view of the outcomes really helps us understand where best to invest resources. With a fixed Department of Defense budget, the only way we will afford our future without stripping away force structure is to consistently deliver integrated warfighting capabilities (networked platforms, sensors, and weapons that can operate seamlessly in a systems-of-systems [SoS] environment) to create desired mission-level effects.

This concept of integrated warfighting capabilities (IWC) is often referred to as "integration and interoperability" or I&I. This makes perfect sense, because integration and interoperability are fundamental components of the IWC end state. IWC encompasses the combined

Corporal Ben Hudson, assigned to the 31st Marine Expeditionary Unit, climbs off the wing of an AV-8B Harrier after moving it aboard the USS *Bonhomme Richard* (LHD-6) in the East China Sea on 26 June. With “a shift in national defense strategy that demands more than ever from our naval forces, it’s imperative that every dollar spent increases warfighting capability,” remarks the author. “The concept of integrated warfighting capabilities . . . encompasses the combined interaction of people, equipment, and training.”

interaction of people, equipment, and training, and the effects can be kinetic or non-kinetic. These capabilities must be available at adequate speed and capacity, as well as be affordable, in order for our forces to dominate the battlespace.

No More Stovepiping

Current trends in test results and feedback from deployed assets indicate inadequacies in integration and interoperability. Over the years, a number of contributing factors have been identified in countless reports, studies, and evaluations. Unstable requirements, stovepiped funding, poor program execution, inadequate technical maturation, and increased systems-integration complexity are all contributors.

Despite a host of efforts to correct these deficiencies, including the Goldwater/Nichols Act, Interoperability as a Key Performance Parameter (KPP), and Net-

Ready KPP, the problem will never be solved until our systems commands (SYSCOMs) assume responsibility for developing, delivering, and supporting integrated mission-level capabilities, just as they do for the performance of individual platforms, weapons, networks, and sensors (PWNSs).

A recent update to the Defense Acquisition Guidance emphasizes the importance of considering SoS in the development of individual systems: “From the Joint Capabilities Integration and Development System (JCIDS) Capabilities-Based Assessment (CBA) through sustainment activities, it is important to recognize how the system context influences system requirements.”

This is why I’m focusing Naval Air Systems Command’s (NAVAIR’s) considerable talent, experience, and

tools on *up-front* SoS integration, interoperability, and sustainment considerations *at the capability level*. This focus will reduce the overall acquisition cost of capability by eliminating the complex and costly post-fielding investment required to properly integrate unique, point-to-point, proprietary, platform-centric solutions. Most important, it will increase mission-level warfighting effectiveness by ensuring tactically relevant systems that operate as intended—right out of the gate.

Albert Einstein’s definition of insanity is doing the same thing the same way and expecting a different result. Organizations that suffer this type of futile madness are destined for rough times if not complete failure. In a harsh world where threats are agile and capable, funding is receding, and technology is advancing at breakneck speed, the only way to stay relevant and outpace all threats is to be increasingly innovative, adaptable, and efficient. These attributes have been and will continue to be the essence of naval aviation.

Root Cause

As mentioned, many factors contribute to poor and expensive integrations. Radios that don’t connect, data links that don’t communicate, weapons that miss targets, and radars that interfere with other systems are the byproducts of harsh physical realities and our feeble initial attempts to integrate individual systems in an SoS environment. From what I’ve seen in more than 23 years of designing, developing, verifying, validating, and sustaining our combat systems, the root causes of poor integration and interoperability are clear.

First, we do not have a technical standard for integrated warfighting capability. Second, we do not sufficiently test our systems within the SoS environment when we develop them; and third, we have not developed a workforce skilled in the area of SoS integration.

Demand for new warfighting capabilities is initiated through the Joint Capabilities Integration and Development System process, which ultimately results in development of a capability-development document (CDD). It is at this point that the complex SoS gets reduced to an individual PWNS, which is funded as the program of record. The linkage between each CDD and the SoS is handled through specific requirements called Key Performance Parameters (KPPs) and Key System Attributes (KSAs). In theory, it makes perfect sense. In execution, KPPs and KSAs are very necessary, but wholly inadequate to ensure that our systems ultimately work within an SoS.

Along with the CDD, program managers are typically given an overly optimistic budget (in terms of cost and risk) with which to execute the program. They are given boundaries that define program scope and a few technical parameters on how they will interface within the greater SoS. In the past, our ability to manage these interfaces was a byproduct of good systems engineering and simpler mission threads. Future success will require

a broader SoS application of these technical disciplines across mission areas and at the air-campaign-integration level so proper trades and balances can be made. No one is better poised to take on this challenge than the naval aviation enterprise.

Corrective Action

To create desired outcomes at the mission level, we must develop clear technical standards for warfighting capability, create an environment and process to exercise capability-oriented technical standards, and enforce those

progressive-thinking engineers, testers, and logisticians at NAVAIR, Naval Sea Systems Command (NAVSEA), and Space and Naval Warfare Systems Command (SPAWAR) are doggedly pursuing development of technical standards or “Mission Technical Baselines” for all warfare mission areas (including antisubmarine, antisurface, air, and strike warfare).

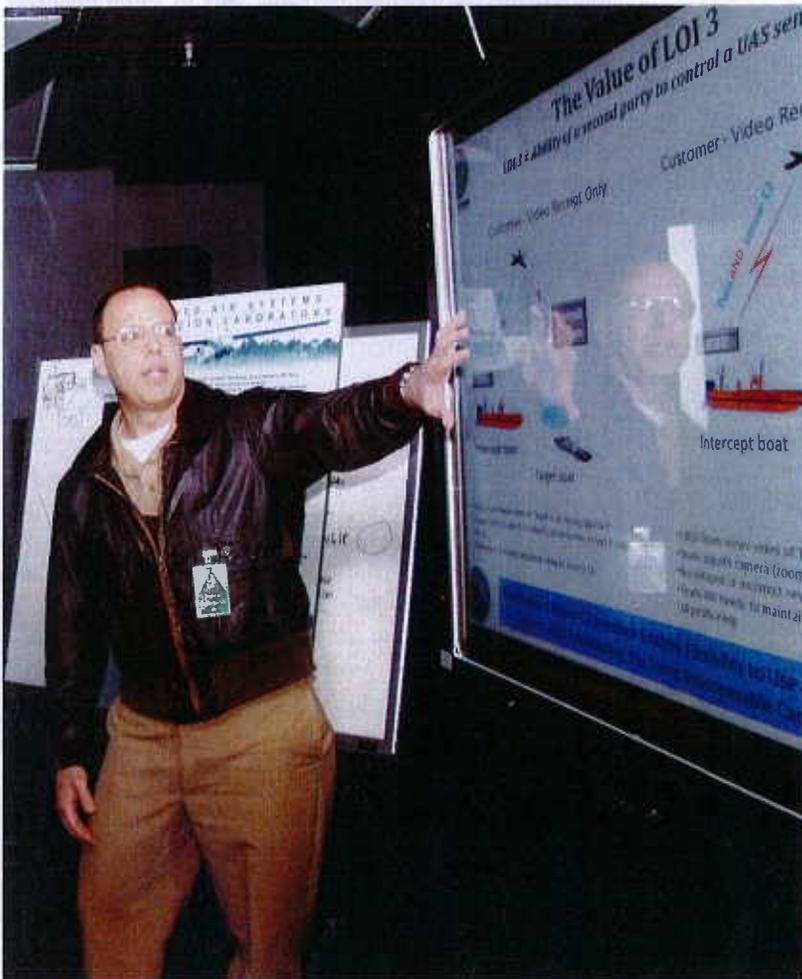
The government must take control of the critical inter-system interfaces and dictate the design specifics, similar to how the smart-phone business controls its interoperability.

This involves standardizing critical interface requirements, implementing government-defined and -controlled interface reference designs, and directing industry to build them to open-architecture standards. We will be selective and work these interfaces in collaboration with industry. Using the government as a lead-capability integrator for certain architectures is a critical component and will allow the essential technical interaction required to create a more open, less expensive, and more thorough SoS approach.

With select government-controlled interface reference designs, we can move away from today’s pair-wise integration schemes that require costly re-engineering and additional flight-testing each time a weapon is married to a platform. When the government controls the interface, we pay for it once and reuse engineering and test results to reduce acquisition time lines and cost. These common interfaces will allow modular software to “plug ‘n’ play” so we can rapidly configure and adapt our capabilities to changing conditions.

As any good engineer knows, technical standards in and of themselves are inadequate to ensure the fielding of IWC. The challenge is creating integrated live, virtual, and constructive (LVC) environments where we can pull complex SoS together at critical times and in relevant operational environments to ensure they perform as intended. Fortunately, LVC capabilities have been systematically improved every year. We are now poised to take on the full, end-to-end expanse of LVC environments that will become the testing, training, and proving ground for development of future capabilities.

Finally, we must develop tech-savvy professionals who have the ability to evaluate a system under development in terms of its place in the larger mission-execution context. These highly skilled “systems architects” can look across a complex SoS and recommend cross-program trades that will result in desired warfighting effects. This



Captain Don Zwick, Common Standards and Interoperability program manager for Naval Air Systems Command (NAVAIR), details the technical implications and operational significance of the Standard Command-and-Control Interface Module during a February lab demonstration. Management of the interface, the author notes, “promotes interoperability, reduces contractor costs, and accelerates development efforts.”

standards through the knowledge of our technical workforce.

Creating such standards around complex warfighting capabilities is a daunting task. Many view it as far too difficult and unmanageable. This mentality leads to unique integrations across a complex mission thread where each is handled in partial isolation, without consideration of the impacts on the entire thread. This approach increases cost and fails to perform. Fortunately, a small group of

rare and critical skill is emerging as NAVAIR's next great technical competence. Many of our contractor partners are joining the trend and matching the government momentum.

In time, we will have the technical standards, LVC environments, and workforce necessary to deliver mission- and campaign-level warfighting capabilities just as effectively as we have platforms and weapons.

Benefits That Accrue

Venturing further into the world of mission technical baselines, we will build a technical foundation that produces more capability with the available dollars. Savings will manifest in multiple forms when we execute this new standard properly.

By extracting much of the latent capability that resides in our considerable infrastructure, we can reduce new program starts, saving billions. Many examples are coming to light in which the SoS view has allowed us to solve critical warfighter needs by integrating existing systems (perhaps in a different way) to provide vital information or battlefield outcomes. This work can be incorporated within the acquisition process with major PWNS upgrades or outside the acquisition process with rapid warfighter-responsiveness efforts.

By applying the SoS approach in the proper LVC environment early on as a program progresses, we can ensure that the new products we procure are well integrated and effectively perform when fielded. Technology integration is the responsibility of the SYSCOMs and we do a great job on integrating individual PWNS. Now is the time to apply our rigorous systems-engineering, test-and-evaluation, and logistics processes to the broader SoS context so we get it right the first time and avoid costly, corrective efforts.

We're making encouraging progress in a number of initiatives that move away from a pair-wise systems-integration approach with contractor-proprietary interfaces toward government-developed and -controlled interfaces that will enhance systems interoperability and affordability:

- The *Future Airborne Capability Environment* reference architecture describes a standardized, hardware agnostic, and software common-operating environment for avionics integration.

- The *Sensor/Platform Interface and Engineering Standardization* describes a reference architecture for sensor/platform integration and interoperability.

- *Network Enabled Weapon Controller Interface Module* is a role-based interface reference design. It is a complete implementation of the standards and is government developed and owned.

- NAVAIR in-house capability is being leveraged to develop the communication suite for the *VXX Presidential Helicopter*. Our clear understanding of subsystem interfaces and government control of data rights for mission-systems architecture and software will enable us to achieve the best value solution.

- NAVAIR's *Common Standards and Interoperability* group, in collaboration with the Army, has validated a government-developed command-and-control interface for inclusion into future unmanned aircraft systems. Organic ownership and management of the interface promotes interoperability, reduces contractor costs, and accelerates development efforts.

- We've designed and documented a standard process for developing the required *Reliability, Availability, Maintainability, and Cost* report for each acquisition phase and milestone, as well as an *Integrated Logistics-Support Analysis-of-Alternatives Assessment* process to define the logistics related deliverables during NAVAIR-conducted analyses of alternatives.



U.S. MARINE CORPS (ALEX C. SAMUELO)

The MV-22 Osprey, overseen by NAVAIR's V-22 Joint Program Office (PMA-275), provides troop-and-supply transport for the Marines—and great savings for the public: NAVAIR's 2008–2012 procurement contract for the Osprey program saved taxpayers \$427 million and reduced risk to the government by establishing cost ceilings.

• Through the *Naval Research/Development Test & Evaluation Infrastructure, and Capability* survey effort, we are pulling together existing NAVAIR and joint lab-testing mission-level capabilities.

A Construct for Success

Warfighters fight like they train. In the world of DOD acquisition, we build like we're organized. If the missing links are clear traceability back to the original warfighting capability and the inclusion of SoS engineering, test and evaluation, and logistics in the acquisition process, the question is how to best incorporate them into that process. Executed poorly, the outcome could easily be the same level of performance we observe today at increased cost and delay.

As is required by law, the funding and incentive structure in the current process is vertically aligned to develop an individual system. That important alignment is neces-

cal level. Second, we must manage solutions for doctrine, organization, training, matériel, leadership, personnel, and facilities from a capability-portfolio management perspective as well as a program-of-record perspective (one is not exclusive of the other). Finally, we must establish a methodology for our senior leaders to govern the process.

The establishment of the N9 and the N2/N6 within the Office of the Chief of Naval Operations and the "Readiness Kill Chain" at U.S. Fleet Forces provides the governance backbone for how capability will be overseen. Successful governance will require the best information possible in a transparent form.

NAVAIR's Role

NAVAIR is well positioned to support delivery of IWC. With dual reporting responsibility to the CNO and the Commandant of the Marine Corps (for logistics sustain-



The venerable E-2C Hawkeye, whose mission-readiness is overseen by NAVAIR's E-2/C-2 Tactical Data System Program Office (PMA-231), is the Navy's all-weather, carrier-based tactical battle-management airborne early-warning command-and-control aircraft. Here, a Hawkeye flies over the Atlantic during a July air-power demonstration by Carrier Air Wing 7.

sary and must continue to be executed vigorously. However, we must also implement a new process that includes a horizontally integrated view of how that system will work in the SoS.

A group of stakeholders (U.S. Fleet Forces Command, Commander Pacific Fleet, Warfare Centers of Excellence, the SYSCOMs and their Warfare Centers, OPNAV staff and Commander Operational Test Force) has been working this challenge at the behest of the Chief of Naval Operations for some time, and the outcome is emerging.

The group identified three tenets of the path forward. The first is to keep an independently developed baseline of warfighting capabilities and gaps at a detailed techni-

ment and in-service support) and to the Assistant Secretary of the Navy for Research, Development, & Acquisition (ASN/RDA), we have considerable insight into operational needs and available technologies across the entire naval-aviation acquisition portfolio.

Our strong technical foundation will help define, test, and support the standard interfaces needed to enable interoperability among systems in the battlespace. We are ready to expand our technical experience in platform-level systems engineering, test and evaluation, and logistics to the broader SoS environment. This will provide analysis and decision support for cost/schedule/performance trades across program or system boundaries to achieve holistic "mission area" outcomes for the Navy.

Our Warfare Centers have the in-house expertise, facilities, and tools to ensure platforms, weapons, and sensors are effectively integrated and interoperable prior to delivery to the Fleet. We've gained significant experience by supporting interoperability and the Net-Ready Key Performance Parameters through use of our open-air ranges, specialized laboratory facilities, and modeling and simulation capabilities.

We're working closely with Commander Operational Test Force in applying capabilities-based test and evaluation (CBTE), which moves identification of capability and supportability gaps to the left, prior to transition into operational test. This practice of identifying deficiencies "up front" will significantly shorten developmental time lines and cost, and mitigate integration challenges.

CBTE provides the necessary breadth to examine systems under testing in an SoS and family-of-systems construct, in relevant operational environments. We're using our already considerable infrastructure in modeling and simulation, hardware-in-the-loop, installed systems testing, and statistical methods to address operational effectiveness and suitability through live, virtual, and constructive (LVC) test and evaluation. This approach is key to ensuring SoS mission-effects are a deliberate consideration in early program planning. As we strive to pass a final exam that includes SoS capability, our program decisions will naturally drive to that goal.

In the proverbial words of boxer Mike Tyson, "Everyone has a plan 'til they get punched in the mouth." Test and evaluation is our first punch in the mouth, and CBTE ensures the developmental world blocks that punch from hitting the operators. It's our duty, and anything else is unacceptable.

Creating an Integration Culture

I am committed to making IWC a fundamental competence within NAVAIR. By this I mean providing the people, skills, methods, and tools required to successfully execute mission-level SoS engineering, test and evaluation, and logistics—and ensuring all of these important elements are just as tightly integrated as the capabilities we're delivering to the Fleet.

We're partnering with NAVSEA and SPAWAR to maximize our collective capability and mitigate any technical seams that exist across commands. This will allow us to provide enhanced decision support at a reduced cost.

Efforts include integrating our internal pockets of technical process and product excellence, such as the Naval Aviation Enterprise Capabilities-Based Assessment Integrated Process and the Warfighting Capabilities Baseline that are already providing support to our customers, and aligning them and others with external activities such as the Portfolio Health Assessment Process at SPAWAR.

Bringing these technical disciplines together in common integrated environments will allow us to capitalize on best practices and uniformly exercise a capability-foc-

used technical standard. Our capability-level engineers, testers, and logisticians will develop and maintain standard, government-owned interfaces and technical standards for acquisition program managers to use and reuse to ensure all systems work seamlessly within an SoS.

NAVAIR's IWC vision has three distinct event horizons:

1. *Near-term*: better integrating our considerable infrastructure to solve immediate capability gaps and execute rapid-response requirements for our deploying carrier strike groups and expeditionary strike groups;
2. *Mid-term*: enabling our programs of record to satisfy both program requirements as well as integration and interoperability requirements necessary for the system to fit within the system of systems; and
3. *Far-term*: building knowledge and standards that will allow all future systems to operate in a much more flexible and open architecture—dramatically reducing integration and interoperability costs, increasing speed to the Fleet, and extracting the maximum warfighting capability.

In order to deliver IWC, the SYSCOM must organize, train, and equip accordingly. At NAVAIR, we recently stood up an IWC Enterprise Team (ET) to provide external visibility and a clear point of entry for mission-based resources. The ET includes representatives from each of our technical disciplines (engineering, test and evaluation, and logistics) who apply their technical authority to ensure the integrity and consistent application of capability-area technical standards across programs.

The IWC ET is NAVAIR's "integration agent," and as such, has a direct reporting responsibility to the NAVAIR Commander. The team's task is to work with our counterparts at NAVSEA and SPAWAR and pull together the technical and analytical expertise, tools, processes, and secure environments necessary to support Navy requirements—with the goal of delivering the greatest return on investment.

The DOD acquisition-and-decision support system is structured to advocate a platform-centric viewpoint. Limited dollars, dynamic threats, disruptive technologies, and operational needs call for a corresponding methodology to address the interaction of platforms, weapons, sensors, and networks that form mission-area kill chains in a system-of-systems construct. The Navy must balance platforms, sensors, and weapons development and delivery with a corresponding, comprehensive, *capabilities-centric* focus and methodology.

Maturing this focus will vastly improve integration and interoperability, speed the delivery of rapid-response and irregular-warfare solutions, and reduce development and life-cycle support costs—making it possible for our naval forces to deter any threat and if needed, fight and win. ✨

Vice Admiral Dunaway is Commander, Naval Air Systems Command.