



# Partnering with Carderock

Areas of Opportunity - 2024

## Overview

The main intention of establishing this document is to foster discussions with potential collaboration partners by sharing areas of interest across the entire Carderock Division.

The needs for all six Naval Surface Warfare Center Carderock Division (NSWCCD) departments (three business and three technical) are itemized in this document. An overall description is provided for each department followed by a list of the needs that exist for them at this time to establish and maintain foundational knowledge and/or capabilities to build upon for the future.

## Business Department Needs & Opportunities

### Code 01: Comptroller Department

*The Comptroller Department (Code 01) provides fiduciary oversight of fiscal operations for the NSWC Carderock Division. Our mission: provide timely, reliable and accurate financial management support to all elements of the command, while ensuring fiscal responsibility as trusted stewards of taxpayer dollars. The Department's full spectrum of financial services include budget formulation/execution, corporate and managerial accounting and employee services, while maintaining audit readiness and adherence to fiscal policy and regulations.*

- **Budget:** performs all aspects of the Planning, Programming, Budget and Execution (PPBE) cycle the Command level; receiving and controlling funds; issuing advice and guidance on the appropriate uses of all funds by following statutory, regulatory, and procedural requirements.
- **Accounting:** certifies the accuracy and integrity of the command's financial statements and ensures financial transactions are recorded in accordance with Generally Accepted Accounting Principles (GAAP). Accounting disciplines include: accounts receivable, accounts payable, accrued expenses, general ledger management and asset accounting, DAR-Q (dormant account review).
- **Employee Services:** manages and oversees all payroll, labor and travel support for the command. Payroll/labor services - administration of the command time and attendance (T&A) policy, new hire processing, prior pay adjustments, employee indebtedness, labor accruals, and leave liability reporting; labor/non-labor cost transfers; travel – utilization of the Defense Travel System (DTS) and management of the Government Travel Charge Card (GTCC) program.
- **Data Analytics:** designs and conducts qualitative and quantitative studies and analyses of command financial, accounting and budget data. Develops and employs mathematical and statistical models in support of prediction/forecasting/trending of "big financial data" analysis and activities.



- **Financial Improvement and Audit Readiness (FIAR):** interprets Navy Working Capital Fund audit readiness policies, instructions, and procedures from higher echelons, and disseminates and proposes implementation strategies; plans, organizes and executes audit readiness projects.

### Code 02: Contracting and Acquisition Department

*The mission of the Contracting and Acquisition Department enable the NSWCCD mission through continuous improvement of our contracting process at all levels, cultivation of quality communications between technical departments and procurement teams, and a commitment to innovative business strategies, affordability, and buying power. Code 02 strives to deliver high quality acquisition products and services that meet or exceed customer expectations while maintaining public trust and fulfilling public policy requirements.*

- **Business Process Analysis and Solutions:** Analysis of contracting business with a goal to improve efficiency and effectiveness of operations. Identification of business units that are prime for optimization, either through process improvement, utilization of tools and technology, and/or resource adjustments.
- **Data Analytics:** Analysis and modeling of diverse data sets from various systems of record in order to assess both performance and compliance metrics. Development of improved reporting mechanisms to aid informed decision-making.
- **Process Automation:** Development and delivery of tools and technology that minimize or eliminate manual touch time throughout the contracting process. Connect and integrate with procurement systems to limit administrative burden on repetitive tasking.

### Code 10: Corporate Operations

*The Corporate Operations Department provides efficient and effective business solutions to facilitate and enable the Naval Surface Warfare Center, Carderock Division in achieving its strategic direction and technical mission while maintaining the public trust at the lowest cost. Our vision is to achieve a diverse, highly motivated professional workforce that delivers on-time, quality business solutions and service excellence to our customers through partnering and continuous process improvement.*

- **Information Technology Support Services:** The Enterprise Solutions Section maintains the Carderock Division Intranet (CDI), which is a repository of Division knowledge and computing resources that provides authorized access to web-based information, tools and applications relevant to Carderock Division personnel supporting communication, collaboration and workflow throughout the Division.
- **Enterprise Solutions Support:** Support areas includes Network Operation and Maintenance Services, Server / System Administration, High Performance Computing (HPC), Design / Installation of Network Infrastructure Extensions and Enhancements, Help Desk / User Support, Video Telecommunications (VTC) / Audio Visual (AV), Media Transfer Support, Cybersecurity Support, and Navy Marine Corps Intranet (NMCI) Support.
- **Material and Asset Management Support:** Includes support to the Operating Materials & Supplies (OM&S) branch, Purchase Requisition (PR) branch, and Plant Property & Equipment (PP&E) programs.



- **Business Office Support:** Includes business and administrative support services to aid the support Departments at Carderock in meeting our mission.

## Technical Department S&T Needs & Opportunities

### Code 60 - Platform Integrity Department

*The Platform Integrity Department focuses on the overall design and integrity of naval platforms and components, as well as environmental, energy storage, and weapon systems and systems safety. This includes full spectrum research, development, testing, and in-service engineering concerning: survivability, structures, materials, and environmental quality.*

- **Hypersonics:** Hypersonic flight occurs at speeds above Mach 5; a speed where dissociation of air begins to become significant and high heat loads exist. The Department of Defense (DoD) is developing hypersonic cruise missiles and boost-glide vehicles because of their unique warfighting aspects of range, speed, maneuverability, survivability, and lethality. Support of these hypersonic systems requires the following efforts:
  - Development, testing, evaluations of high temperature materials to include but not limited to: ceramics, composites, and refractory metals across a broad range of hypersonic flight regimes
  - Vulnerability and lethality M&S, as well as testing of hypersonic projectiles and weapons against maritime assets
- **Additive Manufacturing:** Additive manufacturing (AM) is a rapidly growing and changing discipline. AM technology began as a convenient way to make sturdy plastic objects from 3-D printers, and now military personnel at all levels have been pushing its limits. Support of the integrity of AM utilization requires the following efforts:
  - Understanding the relationships between processing, microstructure, and material properties, including M&S of these associations
  - Assessment of new processes and new application of existing technologies
- **Industrial Base Support:** Support the sustainment and growth of the shipbuilding industrial base through: acquisition support to minimize complications and ambiguities of material procurement requirements and criteria, qualification of components and certification of material systems, In-house development of alloys, advancement in automation and manufacturing for transition, and engagement and qualification of new and existing vendors.
- **Power and Energy:** The United States military is shifting towards a more resilient and distributed operational energy strategy that will increase operational flexibility and effectiveness. Emerging weapons systems require greater power & energy availability and density, and the ability of the DoD to provide energy to warfighters and weapon systems in austere and distant environments will increasingly be critical. Advanced battery technologies are a critical enabler to help the DoD achieve this strategy. Support of this operational energy strategy requires continued development of advanced batteries in the following areas:
  - Lithium Ion (Li-ion) battery test capabilities, with associated analysis tools, equipment, facilities, and staffing



- Battery failure M&S and prediction with thermal monitoring
- Enhanced battery safety and performance characteristics
- Improved charging capabilities including wireless recharge, fast charging, and improved battery management
- **Environmental Engineering, S&T:** Navy ships generate a variety of wastes, both solid and liquid, including bilgewater containing oil, blackwater, graywater, ballast water, shipboard “industrial” waste, solid residuals from existing treatment systems, and traditional wastes such as paper, metal, plastic, and cardboard. The need for shipboard waste treatment for military vessels is driven by existing and anticipated regulations. Support to comply with these regulations requires the following:
  - Understanding of water chemistry, alternative water treatment methods, filtration science spanning nano- and ultra-filtration to large particle removal, biological digestion, liquid and solid disinfection, emulsions and their impacts on oily waste treatment systems, environmental signatures, solid waste systems and technologies, pollution prevention principles and methods, ship-to-shore technology integration, and marine environmental system designs.
  - Understanding of biostabilized sediments and advanced active level sensors for liquid systems
  - Understanding of in-service engineering requirements and principles for life cycle sustainment
  - Understanding of thermal destruction concepts, system operations, and impacts of byproducts
- **Sustainment Technologies:** DoD platform sustainment is an incredibly complex, multifaceted problem with systems expected to last almost half a century or more. Decision-makers must not only create sustainment plans to support aging equipment but also navigate the decades of budget battles and changing requirements that may threaten to undermine these plans. Support for these decision-makers requires the following efforts:
  - Corrosion-control, thermal-barriers, anti-fouling coatings & hull grooming.
  - Novel repair methodologies and nondestructive evaluation.
  - Platform environmental and radiation detection programs.
  - In-situ monitoring and assessment of platform and material conditions.
- **Enabling Technologies:** Military enabling technologies build on more than three decades of increasingly rapid evolutions in science are the foundation for almost daily changes. These new and evolving technologies impact every area of military operations. Knowledge and application of enabling technologies needs to be developed through the following efforts:
  - Machine learning applied to platform integrity areas such as corrosion, welding, battery failure, material development, fatigue, vulnerability assessments, and ballistics.
  - Digital Twin applied to structural health monitoring and development of structural decision-making tools for repair, inspection, high fidelity vulnerability assessments, materials, manufacturing, fabrication, in-service engineering, and bio-fouling.



- **Modeling & Simulation Tools:** M&S provides a powerful and cost-effective tool that can be used to promote innovation, to test capability, to facilitate preparation, and to support training. M&S is intended to provide readily available, operationally valid environments to explore concepts and refine capability requirements in preparation for field experimentation. Development of these tools is needed in the following efforts:
  - Structural design of strength, buckling, fatigue life, loads, wave impacts and other secondary and tertiary loadings for both ships and submarines.
  - Principal unit failure predictions due to shock, vulnerability, survivability, recoverability, ballistics, weapons effects and subsequent interactions.
  - Material aspects involving manufacturing and fabrication; including properties, residual stress, microstructure, corrosion and failure mechanisms.
  - Modeling of the AM process, whether wire fed, powder based or filament.
  - Li-ion battery design and operation aspects, such as failure, thermal management, and charging.
  - Fluid mechanics of liquid waste and ballast water management systems.
  - Biocide diffusion gradients from anti-fouling coatings.
- **Fabrication Support:** Support for limited production, prototyping jigs, fixtures in support of all technical fields in a research, development, test, and engineering (RDT&E) environment. Production includes subtractive machining, additive design and fabrication, sheet metal and welded structures. Specialization in pressure vessel production.
- **Quality Control - Dimensional Metrology:** Support include all aspects of dimensional inspections from hand tools to laser trackers, coordinate measurement technology, broad area scanners among others.

### Code 70 - Ship Signatures Department

*The mission of the Ship Signatures Department is to assure that surface ships, submarines and other navy vehicles have signature characteristics which will ensure their operational superiority over other navies. The Department conducts research and development in the fields of underwater acoustics and non-acoustic signature control, hydro-acoustics, structural acoustics, mechanical vibrations, target strength reduction, radar cross section reduction, infrared reduction, electro-optical detection, and advanced signal processing.*

- **Real-time Tactical Decision Aids and Trainers:** Combining real world physics modeling, real-time high-performance computing, leading edge software design, and sophisticated simulations to produce immersive training and tactical systems. In the world of simulations, getting a system to act as close to authentic as the real-world situations it represents is always the main goal. Supporting decision makers and the fleet's training need the following efforts:
  - Developing Live, Virtual, And Constructive-Training Environments (LVC T&E) and training
  - Real-time ocean environment modeling
  - Signature management simulations and assessments
  - Digital twin M&S developments



- **Signatures Assessment:** The signature of a naval platform is crucial for both its operational performance and its survivability. Proper assessment supports the Fleet by providing awareness of signature deficiencies and capabilities, aiding in the resolution of deficiencies, and providing and maintaining reference systems for ships' signatures.
  - Digital transformation of sea trials
  - Provide validated data to tactical decision aids
  - AI/ML technology
  - Signatures environment propagation modeling
- **Advanced Signature Technologies:** The reduction and control of signatures enhance the operational performance and survivability of the platform, because low signatures make it more difficult to be detected, identified, and targeted. It also increases the effectiveness of own platform's countermeasures against incoming threats.
  - Develop technologies to meet future requirements
  - Explore physics of stealth
  - Computational design tools
  - Full-scale, laboratory, and scaled prototype experimentation
- **Signatures Measurement:** Verification of future signature requirements requires proper development of applicable sensors, facilities, and subsequent signal processing capabilities. Keeping up with the state-of-the-art technologies provides validated signature levels, supporting the previous aforementioned needs.

### Code 80 - Naval Architecture and Engineering Department

*The mission of the Naval Architecture and Engineering Department is to ensure that the Navy's surface ships, submarines, combatant craft, and uncrewed systems (UxS) maintain their maritime mobility superiority. In support of this mission, the Department conducts research, testing, engineering, systems integration, and technology development in the areas of ship and maritime systems design and hydromechanics across the full acquisition spectrum, from exploratory to detailed design to in-service modernization.*

- **Early-stage ship design:** Increasingly informed ship design decisions are enabled by providing high-end toolsets integrating ship and submarine design generation tools with physics-based analysis tools.
  - Improved ship, submarine, UxS design and analysis tools
  - Multi-hull and non-body of revolution design tools
- **Uncrewed systems and autonomy:** The DoD has made substantial progress in the deployment of more capable sensors, uncrewed aircraft systems (UAS), and other UxS, however, to provide effective capabilities in more demanding missions and environments, UxS require the appropriate level of autonomous capabilities. Continued efforts in UxS design, development, testing, fielding, and sustaining require the following:
  - Control, autonomy, sensing, and perception capabilities in general and for multi-domain interfaces



- Hydrodynamics and vehicle design for enhanced performance and multi-body dynamics
- **Computational fluid dynamics (CFD) hydrodynamic support:** Numerical models of a wide range of problems are becoming possible with CFD, significantly driving up demand signal for support and requires in-depth knowledge in a broad range of areas. Development and application of state-of-the-art computational tools to solve challenging Navy problems requires understanding of complex hydrodynamic issues in the following areas:
  - Boundary layer interactions, such as multi-body dynamics, near-bottom/near-surface operations, and precision maneuvering
  - Fluid-air-structure interactions, such as bubbly wakes, cavitation inception, and wave impact or water on deck issues
  - Multi-physics (signatures, etc.)
- **Extreme Motions and Loads:** Power projection requires operating ships in severe weather conditions, where large-amplitude ship motions have the potential to cause capsize or structural damage to the hull. The assessment of operational data and data analytics is needed in exploring the use of long-term ship monitoring data (ship motion, structural data, weather data, wave radar, etc.) to tune models or determine uncertainties. In addition, the following capabilities are required:
  - Multi-fidelity modeling of large motion and load data sets to define tail distribution of motion/load statistics along with benchmark-quality test data to validate numerical tools
  - Extreme-Value Analysis to accurately define the tail distribution
- **Future Undersea Platforms:** New and unique missions lead to advanced requirements and challenges designing future undersea platforms. Support is needed in the following areas:
  - Low speed precision maneuvering development at large flow angles, including larger-scale model experiments
  - Multi-Body dynamics for all platform and payload interactions
  - Next-generation (novel) ship control methodologies to handle advanced capabilities
- **Core competency modernization and sustainment:** Maintaining and keeping current with state-of-the-art knowledge competencies, especially in between acquisition ship programs, is needed to ensure the necessary personnel and skill sets to support a broad range of tool development and testing needs. This support is required in the following areas:
  - Cavitation research moving from visual detection of cavitation inception to acoustic approach and modernizing numerical tools
  - Resistance and powering for submarines where future operating envelopes are likely to exceed the limit of traditional testing and thus requires exploration into alternative evaluation capabilities
  - Hydrodynamics testing
- **Workforce Development:** Development and retention of a dynamic and flexible workforce that can engineer solutions for current and future Naval requires support in the following areas:
  - Training and mentorship encouraged across all expertise levels as well as cross-training among different expertise areas.



- Higher education of Naval-related research leading to higher academic degrees and more university engagement.
- External engagement/exposure with direct S&T sponsors, conference attendance, and cross-organization collaboration.
- **Facility Modernization:** Advanced hydrodynamic research for the DON requires modernized facilities, tools, and instruments. UxS laboratory research support requires the following:
  - UAS Lab Aloft provides controlled flight space and motion capture, rotor testing
  - Autonomy Lab and Integration Center (ALICe) provides multiple lab afloat platforms and cloud-based lab ashore capabilities
  - Uncrewed undersea vehicles (UUV) Lab Undersea provides capabilities in-house as well as an external test site
  - Subsonic Wind Tunnel (SWT) capability upgrade for state-of-the-art measurement techniques: particle-image velocimetry (PIV), surface-flow visualization, pressure and shear stress measurement, etc.
  - Maneuvering and Seakeeping Basin (MASK) capability upgrade for air/surface/subsurface UxS experimentation with directional wave spectrum and wave topology