



# Partnering With Carderock: Areas of Opportunity

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## 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.

Needs for all six Naval Surface Warfare Center Carderock Division (NSWCCD) departments (3 Business and 3 Technical) are itemized in this document. An overall description is provided for each department followed by a list of the needs (Business or Science and Technology) that exist for them at this time to establish and maintain foundational knowledge and/or capabilities to build upon for the future.



# Naval Surface Warfare Center Carderock Division (NSWCCD) Departmental Needs

## Business Department Needs

### Code 01 – Comptroller Department

The Comptroller Department (Code 01) provides fiduciary oversight of fiscal operations for the NSWCCD 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.

#### Business Needs:

- **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 delivery high quality acquisition products and services that meet or exceed customer expectations while maintaining public trust and fulfilling public policy requirements.

### **Business Needs:**

- **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 and Use of Artificial Intelligence:** 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.

### **Business Needs:**

- **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 Science & Technology Needs

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### 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.

#### Science & Technology needs:

- **Hypersonics:** Hypersonic flight occurs through the atmosphere below 90 km 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 strike systems 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, ceramics, and composites across a broad range of hypersonic flight regimes
  - Vulnerability and Lethality Modeling and Simulation (M&S), as well as testing of hypersonic 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.
- **Power & Energy:** The United States military is shifting towards a more resilient and malleable energy strategy that will increase operational flexibility and success. Emerging technologies require greater energy generation and density, therefore the DoD needs methods to provide this vital resource to warfighters in austere and distant environments. Support of this resilient energy strategy requires Modeling and Simulation (M&S) and continued development of the following:
  - Li-ion battery test methodology with associated analysis tools and equipment.
  - Battery failure prediction with thermal monitoring.
  - Enhanced safety and performance of novel electrolytes
  - Charging capabilities including wireless, fast charging, and overall battery management.
- **Liquid Waste:** Navy ships generate a variety of wastes, including bilgewater containing oil, blackwater, graywater, ballast water, shipboard "industrial" waste, and solid residuals from existing treatment systems. The need for shipboard wastewater treatment for military vessels is driven by existing and anticipated regulations. Support to comply with these regulations requires the following:



- Understanding emulsions, and their impacts on oily waste treatment systems.
- Understanding biostabilized sediments and advanced active level sensors in ballast water tanks
- **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, ISEA, and bio-fouling.
- **Modeling & Simulation Tools:** Modeling and Simulation (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 Additive Manufacturing 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.

## 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.

**Science & Technology needs:**

- **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 for the US Navy. 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
- **Signature Management Technology:** 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 naval architecture and naval systems engineering. The Department undertakes surface ship, small craft and boat, and submarine research, engineering, systems integration, and technology development and integration in the areas of design integration and management, conceptual design, preliminary & contract design, analysis of alternatives, naval architecture design and analysis, general arrangements design and analysis, RMA, specifications development, hydromechanics design, analysis, model testing and other experimentation, developmental and operational testing, technical information systems, sailor support systems, design and analysis tools and methods, and other naval engineering. The Department also provides cradle to grave full engineering and lifecycle support for small craft and boats.

**Science & Technology needs:**



- **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. Efforts in this area continue to develop the workforce through the Center for Innovation in Ship Design (CISD). Support of this area requires the development of the following tools:
  - Set-based design tools such as Rapid Ship Design Environment (RSDE) need integration of key technical areas including stability (for both intact and damaged conditions) and hydrodynamic performance (resistance, seakeeping, maneuvering, etc)
  - Improved ship, submarine, unmanned systems design & analysis tools for both multi-hull and non-body of revolution designs.
- **Unmanned systems and autonomy:** The DoD has made substantial progress in the deployment of more capable sensors, unmanned aircraft systems (UAS), and other unmanned systems (UxS), however, to provide effective capabilities in more demanding missions and environments, UxS require more autonomous capabilities. Continued efforts in UxS design, development, testing, fielding, and sustaining require the following:
  - Control, Autonomy, and Sensing 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 submarine precision maneuvering involving payload handling.
  - Fluid-Air-Structure interactions, such as bubbly wakes, Cavitation inception, and wave impact or water on deck issues.
  - Multi-physics (signature, 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.
- **Tactical Submarine Evolution Plan (TSEP):** Novel ship control methodologies are needed to handle new missions and requirements to meet new and unique mission requirements for future submarines. Support for TSEP is needed in the following areas:
  - Precision Maneuvering development for operations in very low speed ranges with hydrodynamics involving large flow angles require whole-boat larger-scale model experiments.
  - Multi-Body Dynamics evaluations for the launch and recovery of UUVs as well as cables and tray / payload handling.
  - Next-Generation (novel) Ship Control methodologies are needed to handle new missions and requirements.





- **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 Navy 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 Navy-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 Navy 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 capability
  - 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 unmanned system experimentation with directional wave spectrum and wave topology.