Technology Investment Plan FY26

NATIONAL SHIPBUILDING RESEARCH PROGRAM™
Taking Shipbuilding and Repair to the Next Level

MISSION

- Employ a unique collaborative framework to research, develop, mature, and implement industry-relevant shipbuilding as well as sustainment technologies and processes, improving efficiency and throughput across the U.S. shipyard industrial base to meet demand.

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1. INTRODUCTION

The National Shipbuilding Research Program's mission is to employ a unique collaborative framework to research, develop, mature, and implement industry-relevant shipbuilding as well as sustainment technologies and processes, improving efficiency and throughput across the U.S. shipyard industrial base to meet demand. The NSRP's Government impact is primarily on Navy ships, but the program is also intended to benefit other Government organizations such as the U.S. Coast Guard (USCG), National Oceanic and Atmospheric Administration (NOAA), Maritime Administration (MARAD), Military Sealift Command (MSC), and Army Corps of Engineers (ACoE). The NSRP considers unmanned and optionally-manned vessels to be types of ships fully within the mission scope. The NSRP's mission equally includes reducing the total ownership costs of U. S.-flag commercial ships.

The NSRP team typically considers a wide range of national, Navy, and Naval Sea Systems Command strategies and plans (see Strategic Investment Plan Section 10, Bibliography) to determine the NSRP's role within the higher level strategies. The NSRP's role is to support the Nation's plan to increase its maritime capability by increasing the overall number of vessels, improving the combat capability of military vessels, increasing the operational availability of all vessels, and improving the ability to rapidly upgrade mission systems, all while reducing the total ownership costs of these vessels. The NSRP mission statement was updated by the Executive Control Board (ECB) in January 2026 to emphasize increased industry throughput as a desired program outcome, in order to meet current demand.

NSRP conducted a Technology Investment Plan (TIP) workshop on 28-29 January 2026 to identify high priority issues and current industry challenges where research proposals would be of particular interest to the program. The workshop attendees included a cross-section of highly experienced shipbuilders and repairers from the member shipyards, along with senior government representatives from the Navy's Program Executive Offices, the Naval Sea Systems Command (NAVSEA) NSRP Program Office, Maritime Industrial Base, and NAVSEA headquarters and field unit staffs.

2. RESEARCH AND DEVELOPMENT AREAS OF PARTICULAR INTEREST

Readers are encouraged to review the NSRP Strategic Investment Plan (SIP) for discussion of the program and the three Major Initiatives. Proposals addressing these topics will receive strongest consideration by the Executive Control Board (ECB). However, the ECB wishes to clearly emphasize that this list should not be viewed as excluding any other ideas. Also, readers should understand that the list is not rank-ordered; all the topics are considered to be equally important. The ECB will continue to consider those proposals which best further the mission of the collaboration.

3. MAJOR INITIATIVES

The Definitions and Sub-Initiatives of each Major Initiative in this TIP are taken directly from the SIP. In fact, the numbering from the SIP is carried forward into the TIP. The TIP provides specific project interest areas, which are directly aligned to a particular sub-Initiative of a particular Major Initiative. The program seeks proposals that provide **research, development, and implementation** for these interest areas.

Information, Design, & Integration (ID&I) (SIP 7.1)

Definition (SIP 7.1.1)

The Information, Design, & Integration (ID&I) Major Initiative focuses on the research of emerging technology, and the management of information to design and develop advanced solutions that support the full product lifecycle.

The ID&I Major Initiative consists of three Panels as follows:

- Business Technologies (BT)
    - The Business Technologies Panel focuses on emerging digital capabilities, blending process and information to develop advanced solutions that support product lifecycles of ships and their components from concept to disposal.
- Ship Design and Material Technologies (SDMT)
    - The Ship Design and Material Technologies Panel focuses on providing increased capabilities and cost reduction initiatives across the complete spectrum of design processes and the identification of materials and technologies to support rapid and efficient development, construction, sustainment, and disposal of ships and their components.
- Ship Warfare Systems Integration (SWSI)
    - The Ship Warfare Systems Integration Panel focuses on the cost of integration and test for warfare and communication systems in ship construction and maintenance/modernization. The Panel improves coordination across programs, warfare and communication integrators, ship designers, and shipbuilders.

ID&I Sub-Initiatives (SIP 7.1.2)

1. Reduce time for qualification and application of systems, materials, components and manufacturing technologies
2. Advance and leverage digital shipbuilding and Industrial Internet of Things (IIoT)/Internet of Things (IoT) in shipyard processes
3. Identify and implement flexibility, modularity, and scalability across platforms to increase throughput
4. Investigate and apply solutions and best practices for the digital ecosystem to support enterprise business processes and information management
5. Develop design guidance to support, maintain and sustain manned and robotic/autonomous surface, underwater, and aerial unmanned platforms
6. Advance design, materials and processes that increase throughput and reduce

sustainment/modernization costs and schedule

7. Integrate advanced autonomous technologies to accelerate and enhance the decision process, enabling faster design, analysis, and operational insights
8. Define, integrate and implement innovative approaches to cybersecurity compliance, solutions, education & awareness
9. Implementation, integration, management, and governance of Artificial Intelligence and Machine Learning (AI/ML) in shipbuilding, ship design, and ship repair processes

7.1.2.1 Reduce time for qualification and application of systems, materials, components and manufacturing technologies:

1. Additive manufacturing (AM) to include cladding and 3D printing
2. Non-metallic materials for shipboard application
3. Materials needing low heat/no heat welding or pre-heat, including mechanically attached fittings, for new construction and repair
4. Advanced structural and non-structural materials
5. Application and impact of battery chemistries
6. Sources, generation, and application of Alternative Energies
7. Approach for approval of energy storage systems (e.g. capacitor)
8. Approach for the approval of new/updated specifications and standards (e.g. material procurement, build process or component/system performance)
9. Develop a streamlined approach for reuseable logistics packages as contractor deliverables/CDRLs for Virtual Shelf items

7.1.2.2 Advance and leverage digital shipbuilding and Industrial Internet of Things (IIoT)/Internet of Things (IoT) in shipyard processes:

1. Integrate Enterprise Processes and Tools to support digital shipbuilding and repair including:
   a. Internal and External Product Lifecycle Management (PLM)
   b. Manufacturing Execution Systems (MES)
   c. Enterprise Resource Planning (ERP) and Material Resource Planning (MRP)
   d. Application of Artificial Intelligence and Machine Learning (AI/ML)
   e. Modeling and Simulation
   f. Data management, exchange, and reuse
   g. Digital Twin
   h. Augmented Reality/Virtual Reality/Mixed Reality
   i. Knowledge management and retention
2. Enable the Digital Thread by integrating Computer-Aided tools, analysis, manufacturing, and sustainment technologies (CAx) into the enterprise environment
3. Develop a fully integrated and collaborative Model-Based Enterprise (MBE)
4. Approach to create improvements to requirements and digital data for shipbuilding processes
5. Develop information systems to progress from batch processes to integrated, autonomous,

and continuous information flows

6. Utilize the Digital Twin technology for virtual ship modeling for optimization, interoperability and data reuse

7.1.2.3 Identify and implement flexibility, modularity, and scalability across platforms to increase throughput:

1. Access and removal routes
2. Align equipment with design and production for just-in-time delivery
3. Common space design
4. Standard physical interfaces
5. Standard system interfaces
6. Hull, Mechanical & Electrical (HM&E) equipment packages
7. Advanced shipboard networking technology
8. Common electronic equipment and racks
9. Power Control and Management Systems

7.1.2.4 Investigate and apply solutions and best practices for the digital ecosystem (shipyards, customers, suppliers) to support enterprise business processes and information management for:

1. Data configuration management and governance
2. Data exchange and delivery
3. Data inter-operability and intra-operability between internal/external systems
4. Shipbuilding informatics (data analytics, business intelligence, and reporting)
5. Improving knowledge and implementation of Navy standards with vendors
6. Application of artificial intelligence and machine learning (AI/ML)

7.1.2.5 Develop design guidance to support, maintain, and sustain manned and robotic/autonomous surface, underwater, and aerial unmanned platforms:

1. Physical integration
2. Platform interoperability
3. Physical and data security
4. Power architecture
5. Mission Systems
6. Standards and interfaces for UxV (robotic/autonomous surface, underwater, and aerial vehicles) such as Unmanned Maritime Autonomy Architecture (UMAA)
7. Evolving battery chemistry and energy storage
8. To support unmanned inspections such as autonomous underwater vehicles for hull inspection submersibles, drone-based inspection for structural surveys, and robotic tank inspection for confined space condition assessments.

7.1.2.6 Advance design, materials and processes that increase throughput and reduce sustainment/modernization costs and schedule for:

1. Impact of environmentally resistant materials and surface treatment techniques

2. In-situ monitoring technologies and methods including real-time sustainment monitoring for sensor-based health tracking
3. Customizable techniques for assessing localized material properties
4. Application of digital data acquisition tools
5. Expanding re-use of product model data
6. Damage-tolerant design methods
7. Exploring cold spray additive technologies
8. Fiber optic material and technology for installation and test
9. Increase performance and commonality of novel fastener alloys

7.1.2.7 Integrate advanced autonomous technologies to accelerate and enhance the decision process, enabling faster design, analysis, and operational insights for:

1. Design for Autonomous Manufacturing (DfAM) rules and optimization
2. Modular construction
3. Design for Production (DfP) rules and optimization
4. Design for Sustainment (DfS) rules and optimization
5. Large scale additive manufacturing
6. Inspections & Repair (e.g., tank, weld quality)
7. Application of Artificial Intelligence and Machine Learning (AI/ML)
8. Leverage sensing technologies (machine/computer vision, scanning, etc.)

7.1.2.8 Define, integrate and implement innovative approaches to cybersecurity compliance, solutions, education & awareness:

1. Increase awareness of cybersecurity best practices for enterprise processes, technologies, and tools
2. Ensure secure, compliant data exchange and collaboration throughout the shipbuilding digital ecosystem.
3. Investigate solutions for Navy-compliant Artificial Intelligence and Machine Learning (AI/ML) for the shipbuilding enterprise delivered through protected, Zero-Trust cloud infrastructure that ensures that all data and models are protected through hardened cloud environments with continuous cybersecurity monitoring

7.1.2.9 Implementation, integration, management, and governance of Artificial Intelligence and Machine Learning (AI/ML) in shipbuilding, ship design, and ship repair processes:

1. Bi-directional integration of shipyard enterprise solutions into the complete shipbuilding digital thread (design, build, sustain) for maritime industry Standardize Artificial Intelligence (AI) and large language model (LLM) frameworks to enable seamless cross-domain interoperability across platforms and workflows
2. Improvements to shipyard operations, visibility into system performance, and workflow management by enabling real-time monitoring, predictive maintenance, and optimization of shipyard operations
3. Identify shortcomings within the current information technology (IT) infrastructure that inhibit flow of digital information to shop floor/field for fabrication, including information needed for expanded automation of processes
4. Identify large language models (LLMs) and their supporting tooling that can be used to create both an opportunity and reduce challenge for maritime organizations seeking to adopt generative AI (GenAI) and Physics AI tools

5. Develop AI-driven predictive maintenance based on ship design and cost-effective sensors to create algorithms capable of forecasting equipment and system failures across naval shipbuilding and fleet operations that facilitate data interoperability

Ship Production Technologies (SPT) (SIP 7.2)

Definition (SIP 7.2.1)

The Ship Production Technologies (SPT) Major Initiative addresses the fabrication, assembly, and testing phases of ship production, and the disassembly, repair/conversion, reassembly and testing phases of maintenance and modernization activities.

The SPT Major Initiative consists of the following four panels:

- Electrical Technologies (ET)
    - Research, develop and implement technologies and processes focused on improvements to installation, testing and operation of shipboard electrical systems.
- Planning, Production Processes, and Facilities (PPPF)
    - Discover and disseminate best practices focused on the principal manufacturing processes, equipment, planning, and facilities required to support the fabrication, assembly, and testing phases of ship production, repair and maintenance.
- Surface Preparation and Coatings (SPC)
    - Research, evaluate, and develop new and existing technologies in surface prep, coatings, corrosion control, and inspection that will reduce cost and improve quality in shipbuilding and repair applications.
- Welding Technology (WT)
    - Research, develop and implement the technologies and efficiencies focused on welding and allied processes, including weld joint preparation, forming, post weld heat treatment and inspection methods.

SPT Sub-Initiatives (SIP 7.2.2)

1. Develop and implement Manufacturing Processes for construction, fabrication and assembly
2. Develop and implement Manufacturing Processes for outfitting, installation and testing
3. Improve shipyard sub-tier supplier performance with respect to quality, cost and schedule
4. Develop and implement Automation, Robotics and Mechanization in manufacturing and inspection processes
5. Increase knowledge and proficiency of overall workforce
6. Develop and qualify emerging technologies
7. Develop and implement digital shipbuilding tools for improved construction and sustainment activities
8. Investigate improvements to standardization, commonality and modularity
9. Improve quality, level of detail, and automation of job planning and work instructions

10. Develop and implement Additive Manufacturing (AM) into shipbuilding and repair
11. Develop solutions to improve installation, maintenance and efficiency of shipboard networks
12. Develop warehousing and logistics improvements to facilitate equipment delivery

7.2.2.1 Develop and implement Manufacturing Processes for construction, fabrication and assembly:

1. Technologies that improve the quality, efficiency and user friendliness of existing manufacturing processes
2. Solutions that increase throughput and capacity
3. Technologies that improve current inspection processes
4. Technologies and processes that move work off hull to more efficient work environments
5. Optimize construction strategy to support coating processes
6. Increase utilization of accuracy control technologies
7. Tools and automation to improve planning process
8. Facility and infrastructure improvements to support construction, fabrication and assembly

7.2.2.2 Develop and implement Manufacturing Processes for outfitting, installation and testing:

1. Technologies and processes that move work off hull and upstream in the manufacturing process to more efficient work environments
2. Solutions that increase throughput and capacity
3. Methods to improve cable installation and termination processes, to include, but not limited to the following areas:
   a. Improve cableway designs
   b. Improve cable segregation for required circuits
   c. Facilitate rapid cable identification following a casualty event
   d. Improve First Time Yield
   e. Installation of Medium Voltage systems
4. Processes and tools which facilitate efficient load-out of equipment and increase use of plug and play components
5. Design, develop, and gain approval for more efficient outfitting processes, e.g., common foundations and modularity
6. Increase utilization of accuracy control technologies
7. Tools to automate testing processes
8. Tools to improve preventative maintenance (PM) processes for shipboard equipment (e.g. AI-driven failure prediction tools)
9. Facility and infrastructure improvements to support outfitting, installation and testing

7.2.2.3 Improve shipyard sub-tier supplier performance with respect to quality, cost, and schedule:

1. Increase supply base knowledge, awareness and proficiency to ensure satisfactory execution of work
2. Improve inspection, quality and remediation at sub-tier suppliers
3. Develop supplier curriculum for transitioning to MILSPEC requirements by discipline

4. Facility improvements to increase throughput and output
5. Improve collaboration and integration with prime shipyard operations
6. Resilient solutions to supply chain disruptions

7.2.2.4 Develop and implement Automation, Robotics and Mechanization in manufacturing and inspection processes:

1. Strategies to determine candidate manufacturing processes for automated solutions
2. Strategies for accelerated insertion and scalability of automation, robotics and mechanization for all processes, to include, but not limited to the following areas:
   a. Platform agnostic solutions
   b. Retrofitting legacy equipment/platforms with automation integration capabilities
   c. Modularity and flexibility
   d. Automated nondestructive testing or material evaluation
   e. Autonomous underwater vehicles for hull inspection
3. Equipment, strategies and requirements to facilitate the implementation of COBOTs
4. Mechanical aids for fitting and fixturing to support robotic processing
5. Automated solutions for fitting and fixturing
6. Sensor technologies and control algorithms that enable adaptive automation to reduce or eliminate off-line robotic programming
7. Applications that utilize drones/Remotely Operated Vehicles (ROVs) during the inspection process
8. Workforce training program to minimize equipment startup
9. Design requirements for efficient use of Automation, Robotics and Mechanization
10. Tools to automate inspection processes

7.2.2.5 Increase knowledge and proficiency of overall workforce:

1. Improve deployment method of industry standards and training, e.g., Electrical (fiber optic, medium voltage), Welding, and SPC (blasting and coating)
2. Develop and implement tools/processes to build shipbuilding skills that lead to documented proficiency improvements
3. Develop and implement modern tools and methods to reduce training timeline

7.2.2.6 Develop and qualify emerging technologies:

1. New electrical technologies to improve:
   a. Energy efficiency
   b. Energy storage
   c. Distribution and protection for medium voltage (e.g., bus pipe, MVDC)
   d. New solutions for topside and bulkhead electrical penetrations
2. Advanced welding processes, consumables, and materials to improve deposition rates and/or quality
3. Enhanced Surface Preparation & Coatings (SPC)solutions, to include:
   a. Paint removal methods
   b. Enhanced universal corrosion control system across programs

   c. Environmentally friendly coating systems
   d. Resilient solutions to supply chain disruptions
4. Condition based monitoring and corrosion detection solutions
5. Enhanced inspection methods (e.g., Digital radiography, Phased-array Ultrasonic Testing, Terahertz sensing)
6. Enhanced fire control and protection methods for hot work
7. Improved methods for outfitting trades (e.g., HVAC, sheet metal, machining, piping)
8. New materials not traditionally applied in ship construction (e.g., composites or nanotechnologies)

7.2.2.7 Develop and implement digital shipbuilding tools for improved construction and sustainment activities:

1. Technologies to address:
   a. A network of sensors, Internet of Things (IoT), and Industry 4.0 for shipyard facilities use
   b. Digital twin concepts for facilities and project management
   c. Effective means of information transfer to trade workforce (such as digital work instruction at the point of execution)
   d. More efficient communication between engineering, planning, production and procurement
   e. Applications for Extended Reality (XR)
   f. Efficient addition of design data to the product model to enable automation/robotic processes (e.g. weld size and type)
2. Encourage acceptance and use of mobile and wearable advanced technologies for shipyard applications
3. Artificial Intelligence (AI) and Machine Learning (ML) applications from procurement through ship production
4. Expand data capture and records management systems to identify and eliminate bottlenecks and inefficiencies in production
5. Increase utilization of material/equipment tracking and health monitoring systems
6. Develop data capture network to support rapid identification of workplace hazards (e.g. shipyard locations prone to long term sprain/sprain hotspots)

7.2.2.8 Investigate improvements to standardization, commonality and modularity:

1. Reduce or eliminate unique part numbers for same items
   a. Raw materials
   b. Discrete parts
2. Develop and implement standardized tools and processes for fitting and assembly
3. Standardize and implement methods for intermediate lifts (such as bulkheads/webs/frames)
4. Align distributed systems with construction zones to facilitate modular construction techniques
5. Utilize modularity during ship construction to optimize installation sequences and reduce equipment care and protection efforts

7.2.2.9 Improve quality, level of detail, and automation of job planning and work instructions:

1. Implement technologies and processes that move work upstream to more efficient work environments
2. Utilize tools to better estimate work content, duration and cost
3. Utilize tools to simulate the build and validate the plan before production
4. Develop and implement digital twin and simulation modeling concepts for:
   a. Shop floor planning and tactical re-planning
   b. Production training

7.2.2.10 Develop and implement Additive Manufacturing (AM) into shipbuilding and repair:

1. Accelerated insertion of Additive Manufacturing that includes considerations for infrastructure, capital procurement assessment, applications, design for AM, robust/flexible system designs, control of upstream production process, and workforce training
2. Strategies and requirements for conventional weld installation and repair procedures of AM parts
3. Strategies for on-demand 3D printed parts

7.2.2.11 Develop solutions to improve installation, maintenance and efficiency of shipboard networks:

1. Reduce distributed system congestion and weight
2. Improve installation efficiency and facilitate efficient maintenance/overhaul activities:
   a. Signal testing techniques (compartmentalize sub-system level techniques)
   b. Connector installation processes
3. Improve throughput capacity (e.g. blown optical fiber, signal density)
4. Improve temporary data connectivity during construction phase in shop and in ship
5. Develop and implement methods for protecting sensitive cable media

7.2.2.12 Develop warehousing and logistics improvements to facilitate equipment delivery:

1. Weather protection for sensitive components at pre-installation stage
2. Improve methods to optimize shelf life and preservation of sensitive components and materials
3. Develop digital twin concepts for material movement and storage within the shipyard
4. Streamline methods to determine that delivered product is as expected
5. Improve methods for material kitting and delivery
6. Improve methods for Work in Progress (WIP) storage and tracking
7. Explore production planning and logistic techniques that deliver the right quantity of material, in the right place, at the right time to minimize the impact to warehousing, handling and potential damage

Infrastructure, Logistics and Sustainment (IL&S) (SIP 7.3)

Definition (SIP 7.3.1)

The Infrastructure, Logistics and Sustainment (IL&S) Major Initiative focuses on improving shipbuilding and sustainment processes for manned and unmanned vessels. This includes attracting and developing a skilled workforce, while maintaining and advancing shipbuilding, modernization and repair capabilities. A

focus remains on compliance with environmental, occupational safety and health requirements. It also includes logistics and sustainment processes associated with post-delivery, life cycle support of Navy, other Federal government agency, and commercial vessels.

The IL&S Major Initiative consists of the following two Panels:

- Workforce & Compliance
    - The Workforce & Compliance Panel will focus on improving the industry's workforce development ecosystem, recruiting, maximizing training efficiency and effectiveness, reducing time to proficiency, and developing technologies to solve workforce challenges while maintaining workforce safety. It also includes researching and addressing current and emerging environmental, health and safety issues to ensure stewardship of industry and communities.
- Sustainment
    - The Sustainment Panel has the mission of reducing the cost of ship logistics and sustainment activities to include repair, maintenance and modernization while increasing operational availability for manned and unmanned vessels. Panel focus will be placed on advancing technologies, materials, processes and procedures that realize greater efficiencies in lifecycle sustainment. The Panel also includes researching and evaluating opportunities for implementation of digital tools, new technology, and processes to increase fleet readiness.

IL&S Sub Initiatives (SIP 7.3.2)

1. Recruit, retain and continually develop a skilled and motivated workforce
2. Improve the effectiveness of training content and delivery to reduce the training time for knowledge capture, dissemination, and retention
3. Develop and leverage technologies, methodologies, and programs to enhance occupational health, safety, and environmental factors
4. Explore opportunities to leverage artificial intelligence/machine learning (AI/ML), and emerging technology for shipyard planning, operations, and execution
5. Incorporate sustainment considerations in the design phase of vessels and components to support ship maintenance and modernization
6. Develop and implement new technologies, processes, and infrastructure to support minimal time in availabilities
7. Explore, develop, and implement processes to address supply chain limitations
8. Improve early condition assessments and prognostic monitoring tools to support condition- based maintenance and structural health

7.3.2.1 Recruit, retain and continually develop a skilled and motivated workforce:

1. Develop an innovative approach for career pathways (K+) for shipbuilding and repair
2. Develop innovative outreach programs and talent management solutions to identify and recruit critical/specialty skill sets
3. Develop or enhance pathways for skills development through standardized curricula and nationally recognized portable credentials, qualifications and certifications
4. Identify best practices of involving employee experiences which encourage retention of

the workforce
5. Develop and improve knowledge retention, time to proficiency, and succession/workforce planning solutions for the shipbuilding and repair industry
6. Implement standardization of Navy specification training for supplier technical personnel
7. Explore/investigate emerging skill sets specific to shipbuilding and repair
8. Attract the next generation of workforce by leveraging modern technology to address and fill workforce gaps related to skilled and high technology positions.

7.3.2.2 Improve the effectiveness of training content and delivery to reduce time for knowledge capture, dissemination, and retention:

1. Improve training delivery, ideology, and techniques to ensure effective retention and dissemination of knowledge and skills
2. Identify and develop innovative interactive training targeting all aspects of the workforce focusing on both hard and soft skills
3. Identify, develop, and implement simulated training environments for the "next generation" workforce – examples: gaming app, extended reality (XR), training videos, streaming, computer based training and high velocity learning
4. Develop training methods to improve literacy, fluency, interpretation of Navy standards such as standard items, ship specification, and General Specifications of Overhaul of Surface Ships (GSO)
5. Develop new programs or tools which capture pre-existing, historic workforce knowledge or techniques, while transferring it to the incoming workforce

7.3.2.3 Develop and leverage technologies to enhance occupational health, safety, and environmental factors:

1. Develop data analytics to review historical data during different stages of ship construction and repair to eliminate reoccurrence and costs associated with safety mishaps to include fire prevention
2. Develop technologies to identify, process and reduce exposure to pollutants, hazardous materials/waste, and hazards to personnel health generated during shipbuilding and sustainment processes
3. Implement training tools to educate and identify workplace hazards to reduce injuries and improve safety
4. Identify and implement robotics and automate/assisted processes to replace inherently high risk/dangerous jobs (e.g. human augmentation, real-time health monitoring, and remote-controlled systems)
5. Evaluate materials and methods that are fire resistant for replacement of current materials in use during new construction and repair availabilities
6. Investigate and develop technologies for the identification, mitigation, and suppression of hazards such as fire and welding during ship building overhaul and maintenance
7. Develop tools and methods to reduce injury rates, exposure to hazards, property damage and costs associated with compliance
8. Investigate the impact of mobile work centers for workforce development and EH&S

compliance

7.3.2.4 Explore opportunities to leverage artificial intelligence/machine learning (AI/ML), and emerging technology for shipyard planning, operations, and execution:

1. Promote, adapt, and develop AI/ML tools bridging technology gaps between design, planning, and execution, and budgeting activities
2. Identify, adapt, and develop AI/ML tools to optimize shipyard operations and/or execution through the identification and reduction of process inefficiencies, excessive waste, and unnecessary risk
3. Identify and introduce technologies enhancing the first-time quality of data-gathering, data visualization, and design processes informing availability execution
4. Promote integration of mobile and digital devices aimed at accelerating the execution of procedures by providing technical guidance at the point of need. Examples include mobile 3D work instructions, advanced imaging (LiDAR, Photogrammetry), XR devices, wireless pier-side connectivity, instant communication technologies, and local tooling/material locators, etc.

7.3.2.5 Incorporate sustainment considerations in the design phase of vessels and components to support ship maintenance and modernization of hull, mechanical, and electrical as well as mission system infrastructure:

1. Develop improved design tools to standardize shipbuilding design practices across shipyards that facilitate sustainment
2. Develop innovative methods to leverage the use of existing equipment and components in modernization design efforts to minimize cost and in-service availability time
3. Identify and pursue advanced materials and processes that reduce the burdens associated with cost and longevity
4. Improve accuracy of engineering and design products supporting ship modernization and upgrades
5. Evaluate existing commercial advanced technologies for application in shipbuilding, modernization and repair
6. Develop and advance technologies and processes supporting the development and advancement of Digital Twin tools aligning with the Navy's Model Based future state, and targeted towards the reduction of time in availability planning and execution
7. Leverage advanced technologies to improve shipboard interference detection during the maintenance and modernization design phase
8. Increase efficiency by leveraging best practices and technologies against material waste and unnecessary duplication during the planning and execution phases
9. Identify and account for common repair and common replacement parts within the design process

7.3.2.6 Develop and implement new technologies, processes, and infrastructure to support minimal time in availabilities:

1. Incorporate emerging technologies to advance inspection, sustainment and improved reliability

2. Develop capability to automate detection, non-destructive inspection, and assessment of corrosion and delamination on vessels
3. Develop and mature capabilities for problem identification and rapid repair of shipboard systems to include modular overhaul kits for pre-packaged repair solutions
4. Adapt comprehensive production planning systems to develop an integrated plan tailored to short duration availabilities
5. Develop extended reality (XR) capabilities that can enhance sustainment efforts such as ship checks, planning processes, and pre-avail risk mitigation

7.3.2.7 Explore, develop, and implement processes to address supply chain limitations:

1. Investigate alternative advanced and additive manufacturing technologies, processes and materials to mitigate issues with parts obsolescence and/or long lead time materials
2. Identify methods to discover and prevent supply chain limitations using data analytics and predictive modeling methods, assessing available supply chain demands and limitations, and implementing technologies such as AI/ML to identify alternative supply chain resources.
3. Leverage advancing technologies such as AI/ML to identify alternative supply chain resources and support early identification of supply chain issues with the intent of relieving bottlenecks during execution

7.3.2.8 Improve early condition assessments and prognostic monitoring tools to support condition-based maintenance and structural health:

1. Develop data analytic and visualization methods supporting early identification and communication of potential system failures
2. Explore emerging technologies such as robotics or AI/ML methods to improve condition inspections of hulls, tanks, and other systems
3. Explore condition-based preventative maintenance and structural health monitoring capabilities from other industries such as aerospace, oil & gas, etc.

4. CONCLUSION

NSRP is committed to supporting the national defense and maritime strategy by providing a collaborative framework and performing research and development on shipbuilding and ship repair processes and technologies that will reduce the total ownership cost of United States Government and U. S.-flag commercial ships, and enhance the capacity of the U.S. maritime industrial base to meet future demand. NSRP will collaborate with other organizations to execute the strategy described in this TIP to support the nation's plan to increase its maritime capability by increasing the overall number of vessels, increasing the combat capability of military vessels, increasing the operational availability of all vessels, and improving the ability to rapidly upgrade mission systems.

The strategic objectives that promote the NSRP mission consist of funding R&D projects that affect total ownership cost as follows:

- Insertion of relevant technologies that reduce design, acquisition, testing or delivered ship operations and sustainment (maintenance/repair/conversion) costs
- Development of improved processes that reduce design, acquisition, testing or delivered ship operations and sustainment (maintenance/repair/conversion) costs