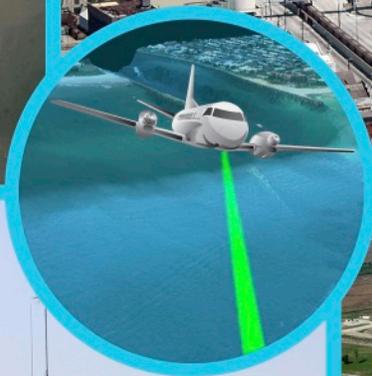


Navigation Research, Development and Technology Strategic Needs and Priorities

Engineer Research and Development Center
US Army Corps of Engineers



BUILDING STRONG

March 2012

**Navigation Research, Development and Technology
Strategic Needs and Priorities**

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U.S. Army Corps of Engineers**

Contents

Executive Summary..... 2

Introduction..... 3

Background..... 3

The Corps’s Navigation RD&T Program..... 7

 Navigation RD&T at a Glance..... 7

 Navigation RD&T Assets..... 9

Navigation RD&T Strategic Needs and Priorities.....11

 Top RD&T Priorities.....12

 Short Term Priorities.....12

 Long Term Priorities.....12

 Implementation.....13

Summary.....13

Table 1: Navigation RD&T Programs

Table 2: Navigation RD&T Needs

**Navigation Research, Development and Technology
Strategic Needs and Priorities**

**Engineering Research and Development Center
U.S. Army Corps of Engineers**

Executive Summary

The U.S. Army Corps of Engineers provides Navigation infrastructure that is reliable, efficient, and resilient. This is important because this infrastructure enables American goods to compete in the Global marketplace.

This report identifies strategic research, development and technology (RD&T) needs and priorities for the U.S. Army Corps of Engineers Navigation mission. It summarizes the Corps' Navigation vision and links it and this RD&T plan with the Corps Civil Works priorities and the National Marine Transportation System vision and priorities. Information is provided on each Navigation RD&T program to show how they are unique, each with a clear focus and how, when combined or leveraged across programs they produce even greater capability through a strong mix of research, development, and technology expertise. This mix of technical expertise and organizational breadth is key to the success of the portfolio.

The Navigation RD&T needs and priorities are divided into five primary topics:

1. Extend the useful life of existing navigation infrastructure.
2. Operate and manage national waterborne transportation assets as an integrated system
3. Optimize and prioritize channel availability for commercial freight movement.
4. Engineering With Nature to enhance ecosystem and navigation processes, benefits and services.
5. Implement eNavigation throughout the national MTS.

The report identifies immediate needs covering these topics and lists the 25 top priority short-term and long-term Navigation RD&T needs.

Navigation Research, Development and Technology Strategic Needs and Priorities

Engineering Research and Development Center U.S. Army Corps of Engineers

Introduction

The U.S. national Marine Transportation System (MTS) consists of ocean, coastal, and inland waterways, ports, intermodal connections, vessels, and commercial, military, and recreational users. It is the largest national MTS in the world and functions as a joint private- and public-sector enterprise. This system connects the very heartland of America to the rest of the world and is vital to the nation's economy, security and quality of life. Disruptions to ports and waterways threaten the continuity of operations and have adverse ripple effects to the U.S. economy. The most critical public sector responsibility - maintaining the availability and continuity of the system - is entrusted to the U.S. Army Corps of Engineers (USACE or Corps).

The purpose of this report is to identify the Corps' strategic research, development and technology (RD&T) navigation needs and priorities. It is intended as an aid to the Corps Navigation Program, Corps science and technology organization, and the national MTS to provide a succinct guide to Navigation RD&T needs and priorities.

Over the past few years the Corps and MTS community have produced sound strategies and visions that provide direction and identify national needs. The following documents were used in the formulation of this Navigation RD&T Plan:

- U.S. Army Corps of Engineers Campaign Plan, July 2010.
- Sustainable Solutions to America's Water Resource Needs, Civil Works Strategic Plan 2011-2015, Sep 2011.
- Navigation Strategic Vision, U.S. Army Corps of Engineers, February 2011.
- Advancing Science & Technology in support of Sustainable Solutions to America's Water Resource Needs, USACE Civil Works R&D Strategy, 2012.
- National Strategy for the Marine Transportation System: *A Framework for Action*, by the Committee on the Marine Transportation System, July 2008.
- Strategic Action Plan for Research and Development in the Marine Transportation System, by the U.S. Committee on the Marine Transportation System, January 2011.

Background

Hundreds of Corps Navigation projects including tens of thousands of miles of channels are in operation along the coast and on 27 river systems. Navigation RD&T supports all phases of the project life cycle: planning, engineering, construction, operations, management, rehabilitation, and retirement. Currently, the navigation assets entrusted to the Corps are:

- 1,067 coastal navigation projects
- 13,000 miles of coastal navigation channels
- 27 inland river systems with 12,000 miles of channels
- 236 lock chambers at 192 lock sites
- 929 navigation structures
- 844 bridges

In its stewardship of these national assets, the Corps' Navigation mission is to provide safe, reliable, efficient, effective and environmentally sustainable waterborne transportation systems for movement of commerce, national security needs, and recreation, which enables American goods to compete in the Global marketplace.

This mission is a great responsibility shared by all Corps Districts and Divisions offices, with each managing specific watersheds within the nation. The USACE Campaign Plan recognizes this responsibly and sets 3 of its 4 strategic goals applicable to the navigation mission.

- Goal 1 – Deliver USACE support to combat, stability, and disaster operations through forward deployed and reach back capabilities
- Goal 2 – Deliver enduring and essential water resource solutions through collaboration with partners and stakeholders;
- Goal 3 – Deliver innovative, resilient, sustainable solutions to the Armed Forces and the Nation;
- Goal 4 – Build and cultivate a competent, disciplined, and resilient team equipped to deliver high quality solutions

Navigation is embodied in Corps' Civil Works Strategic Plan, "Sustainable Solutions to America's Water Resources Needs" to: "Contribute to the strength of the Nation through innovative and environmentally sustainable solutions to the Nation's water resources challenges."

The goals established by this strategy are to:

1. Assist in providing for safe and resilient communities and infrastructure.
2. Help facilitate commercial navigation in an environmentally and economically sustainable fashion.
3. Restore degraded aquatic ecosystems and prevent future environmental losses.
4. Implement effective, reliable, and adaptive life-cycle performance management of infrastructure.
5. Build and sustain a high quality, highly dedicated workforce.

The overarching strategy for achieving these goals is Integrated Water Resources Management, which is defined as "A holistic focus on water resource challenges and opportunities that reflects coordinated development and management of water, land and related resources. IWRM maximizes economic services and environmental quality and ensures public safety, while providing for the sustainability of vital ecosystems."

The crosscutting strategies identified by the Civil Works Strategic Plan are:

1. Systems Approach
2. Collaboration and Partnering
3. Risk-Informed Decision Making and Communication
4. Innovative Financing
5. Adaptive Management
6. State-of-the-Art Technology

The Corps *Navigation Strategic Vision 2010* (February, 2011) envisions in the future a reliable, sustainable national waterborne transportation system, managed using risk-informed life-cycle

asset management principles and concepts. Three simple performance indicators will measure the success of this vision:

- The availability of navigation channels will increase;
- Scheduled and unscheduled lock closures will trend downward;
- Navigation system risks will be expressed in terms of economic impacts.

The vision identifies four focus areas for the next decade and key concepts in each area.

- **Communicate the value of the Navigation Program.** Navigation provides proven economic benefits and the value of the navigation program must be better defined, proactively communicated and well publicized to multiple audiences. The marine transportation industry creates jobs and provides a less costly means of transporting goods, while consuming less energy to move the freight. In some locations, navigation projects provide a refuge from perilous sea conditions or may be the only means of livelihood for a community. Some of the nation's most critical defenses depend upon safe navigation to accomplish their mission.
- **Improve Business Processes.** In order to ensure mission accomplishment with a proactive, systematic approach that considers both short and long-term goals for the Corps Navigation Program, improvement to existing business processes must be identified, developed and implemented. Successful business processes will seek to maximize the reliability and sustainability of the navigation program and therefore ensure customer satisfaction, quality projects and a good return on investment.
- **Manage the Marine Transportation System as a System.** Because the MTS is essential to the United States' economy, it must be considered as part of the larger freight transportation system, including rail, highway, pipeline and airfreight. We must manage our navigation projects and systems to support this broader view. The MTS supplies a less expensive means of shipping materials that produces less impact on the environment and reduces volume on the highway system. We must deliver reliable marine transportation using a risk-informed asset management business model in order to operate our coastal and inland assets of the Navigation Program.
- **Develop a Human Capital Management Strategy for Navigation.** The ability of the Corps to lead and fulfill its navigation mission depends on a strong workforce composed of dedicated experts to perform the needed functions while growing the knowledge and skills of the professional and support team members.

The USACE Civil Works Research & Development Strategy calls for advancing Science and Technology in support of sustainable solutions to America's water resources needs, with goals to:

- ***Anticipate*** and address research and development to improve the scientific understanding and delivery of exceptional engineering technologies
- ***Create*** sustainable, adaptive, cost-effective and integrated solutions
- ***Deliver*** new science and engineering technologies into practice
- ***Maintain*** scientific and technological resources through training, guidance and technical support

The overarching strategy is to provide state of the art technology through innovative science and strategic collaboration and partnering in support of Integrated Water Resources Management with Cross-cutting strategies of:

- Ready access to state-of-the-art technology
- Adaptive solutions
- Research for tomorrow
- Multidisciplinary and integrated teams
- Innovation
- Technology transfer

Changing engineering, environmental, and economic trends will challenge the ability of the national MTS to provide the needed levels of reliable, safe transport of commercial, recreational, and defense waterborne traffic. In *The National Strategy for the Marine Transportation System: A Framework for Action* (July, 2008) the Committee on Marine Transportation (CMTS) discusses the most pressing, present-day challenges to marine transportation and identifies five priority areas: capacity, safety and security, environmental stewardship, resilience and reliability, and finance and economics. The CMTS represents the 27 Departments and Agencies that have jurisdiction over the MTS and thus the *Framework for Action* is a holistic national view of marine transportation challenges.

Among the many actions recommended in the *Framework for Action* is to “encourage, coordinate, and support navigation technology research and development to enhance navigation safety.” Toward this action the CMTS established an R&D Interagency Action Team. An early product of the team’s work, in collaboration with the CMTS and the Marine Transportation Research Board, is the “Strategic Action Plan for Research and Development in the Marine Transportation System” (January 2011), a comprehensive national perspective on research and development themes. Specific needs identified by the Strategic Action Plan are:

- Integrate the MTS with other modes of transportation in the U.S. and with other MTS systems globally.
- Modify the MTS to be more adaptable to change on short- and long-term time scales.
- Increase access for MTS research opportunities, programs, and research results.
- Provide real-time operational information associated with MTS use.
- Standardize MTS performance metrics that assess the national freight movement system.

The salient drivers from the broader integrated water resources and national freight movement perspectives that affect the Corps’ Navigation role may be summarized as:

1. Aging inland navigation infrastructure (locks & dams).
2. Diminishing navigation channel availability.
3. Limited context for regional decision-making.
4. Larger ships / New Panama Canal locks.
5. Administration goals to double exports in 5 years.
6. Environmental and economic constraints to dredge material placement and vessel transit.
7. Climate change and associated uncertainty.

The Corps’ navigation RD&T addresses these drivers through an integrated portfolio that links ERDC programs, leverages other Corps expertise, and partners with many Federal agencies and academia.

The Corps' Navigation RD&T Program

Navigation RD&T at a Glance: The Corps recognizes that meeting the navigation mission, realizing the vision, reaching the Campaign Goals & Civil Works Goals, and supporting national MTS requirements require a long-term strategic investment in research, development and technology (RD&T). The Corps makes this investment and manages it with a robust portfolio of programs, supporting teams and centers.

A responsive, productive research investment strategy balances basic research, applied research, technology development and demonstration, technology transfer and operational adoption. It has a deliberate process for determining what to invest in and addresses short and long-term needs. It integrates and leverages resources from many sources and most importantly it is tightly coupled to the intended users of the products from the research investment. The Corps Navigation RD&T portfolio meets these criteria.

Table 1: Navigation RD&T Programs

Focus	Program	Purpose
R&D	Dredging Operations and Environmental Research (DOER)	Meet complex engineering, environmental, and economic challenges of dredging and placement
R&D	Coastal Inlets Research Program (CIRP)	Improve management and design of coastal inlets, ports, harbors, and channels; increase reliability and reduce operation and maintenance costs
R&D	Navigation Systems Research Program (NavSys)	Coastal and inland navigation channel design, sedimentation, structure evaluation and design, economics, risk, and asset management
R&D	Navigation Structures	Long-term engineering to extend the useful life of infrastructure and improve reliability
D&T	Regional Sediment Management (RSM)	Systems-based approach for collaboratively addressing sediment related issues within a regional context
D&T	Monitoring Completed Navigation Projects (MCNP)	Improve design, repair and operations capabilities by monitoring navigation project performance; transfer lessons learned to Corps offices
D&T	Dredging Operations Technical Support (DOTS)	Provides direct environmental and engineering technical support to the Corps navigation mission
OPS	Inland Electronic Navigation Charts (IENC)	Provide standard, frequently updated electronic navigation charts of the inland system and ENC data for coastal charts
OPS	National Coastal Mapping Program (NCMP)	Provide high-resolution engineering, environmental and economic conditions of the U.S. shorelines on a recurring basis

The individual program budgets vary by annual appropriation, but the approximate percentage

these programs invest among research, development, technology and operations fluctuates less. The graph below illustrates the proportion of the individual programs devoted to these phases of the research investment cycle. Notice that a high percentage of annual funding in DOER goes to research and a low percentage to technology. Conversely, a high percentage of RSM goes to technology and a low percentage to research. This variation provides strength to the navigation RD&T portfolio allowing each program to leverage the others for a given RD&T need.

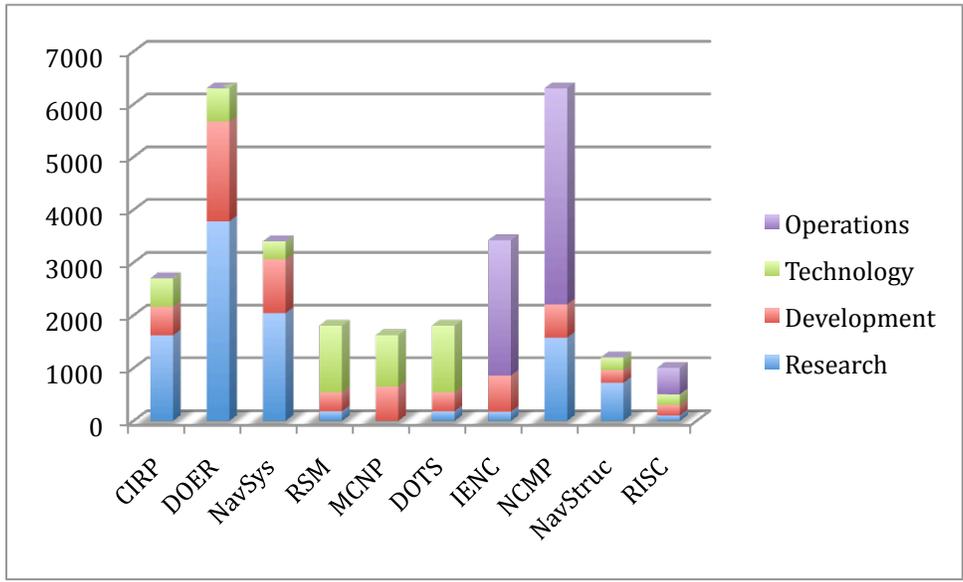


Figure 1 Approximate Proportion of RD&T by Program (Y-axis \$1,000/yr)

DOER, NavSys, CIRP and Nav Structures are core research and development programs. They are dominated by applied research to meet recognized and specific needs and by advanced technology development that integrates research results into product prototypes for field experiments or tests in simulated environments. The research priorities in these core programs are determined through a rigorous process that originates with the submission of Statements of Need (SoN) by Corps Field Offices. The Corps' Navigation Research Area Review Group (RARG) meets annually to review ongoing research and identify and rank future short-term and long-term needs.

RSM, MCNP, and DOTS are development and technology programs. They are dominated by joint District-ERDC projects that transfer tools and technology developed in the core R&D programs into District use. These programs test and validate research products in a realistic District operating environment. They provide a strong technology transfer bridge. This tight coupling to Districts sets up a continuous feedback loop to evolve the technology as well as the underlying science and engineering.

IENC and NCMP are operational programs with unique built-in RD&T components. The operational components of IENC and NCMP are world-renowned mapping and charting programs centered in a District. Both programs produce operational-ready data used by Districts in navigation and other mission areas. These same operational data are used by RD&T to develop new theories and increase our knowledge using field measurements. An imbedded research component in each program provides continuous technology development support to operations and in turn exploits their data to create new products and inform other core R&D programs.

The R&D programs, D&T programs and Operational programs work collaboratively to address multidisciplinary problems. The synergy between programs provides an added dimension to Navigation RD&T support to Districts and addresses the more challenging problems. Examples are:

Unexpected Channel Shoaling. MCNP is monitoring Galveston Ship Channel, TX, to determine why shoaling rates following channel deepening and widening are much higher than predicted during the feasibility study. This is a collaborative study with the RSM and CIRP programs to develop a comprehensive regional understanding and utilize the CIRP program's Coastal Modeling System and technical transfer expertise to deliver improved prediction tools Corps-wide for future navigation deepening and widening studies.

Establishing Nautical Depth. DOER has teamed with MCNP to measure and monitor fluid mud in the Gulfport, MS, ship channel and develop tools, technology and guidance to establish nautical depth based on new measurement technology. Use of nautical depth is common in Europe, but this is the first time it will be established in the U.S. and has the potential to save considerably on maintenance dredging of this channel. The research can then form the scientific basis to inform policy.

Operational Condition Assessment. The NCMP has teamed with NavSys to provide operational surveys to support coastal structures asset management. New standard NCMP products are being developed and procedures established to survey all coastal navigation structures and populate each District's navigation and coastal databank and analysis tools to aid in producing operational condition assessments. This will produce a variety of products with standard formats.

Multi-use Data Collection. IENC produces operational data for electronic navigation charts used on the inland MTS, but are also used in a range of new tools and applications from ERDC, AGC, IWR, and Districts. These new products are enabling the Corps on river information services (NavSys), the channel portfolio tool (CIRP), and Dredging Quality Management (DOER) to name a few.

Navigation RD&T Assets: In addition to the RD&T programs, the Navigation Portfolio links and leverages other operational technical and planning centers of expertise, Communities of Practice (CoP) and sub-CoPs, and teams across the Corps and outside. These interactions inject a broad perspective into the RD&T strategic planning, execution and technology transfer. These highly leveraged resources are:

Navigation Data Center – Located at the IWR, the Center provides annual MTS use statistics and access to operational data needed to execute the daily Navigation mission. The NDC is the repository and source for a range of data that support engineering applications and decision support tools for planning, engineering and operations. They are a key leader in the emerging RIS technologies and capabilities and in linking related data between other agencies for access and use in the Corps' Navigation business line.

Coastal Working Group – They augment the Navigation community with coastal engineering and planning expertise and a strong, active network for technical transfer and identifying statements of need for research. This is a working group under the H,H&C sub-Community of Practice.

Inland Electronic Navigation Chart Production Office, Louisville District – The operational component of the IENC program, which creates the actual charts and keeps them up-to-date, is run through the Louisville District. This produces standardized data and navigation charts while identifying future needs which are addressed through the AGC RD&T portion of the IENC program. This coupling ensures a direct bridge between the IENC and evolution of the product to meet the needs of the Corps and industry.

River Information Services Center, Pittsburgh District – The new River Information Services Center is being established with the Pittsburgh District to leverage a number of existing research and operational programs both within the Corps and with industry to encompass the entire inland waterway system. The RIS Center will be a joint enterprise with ERDC, the Navigation Data Center, Districts, other Federal agencies (USCG, NOAA), and industry to provide real time information services for inland MTS users throughout the U.S.

Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX), Mobile District – JALBTCX is a partnership in airborne coastal mapping and charting between the U.S. Navy, National Oceanic and Atmospheric Administration, U.S. Geological Survey, and the Corps. The NCMP, an operational program funded by HQ with the Mobile District and implemented through JALBTCX, includes research funds used to develop new sensors, evolve related technology, and produce new science and products that support a range of Corps missions.

Inland Navigation Design Team - Composed of representatives from across the Districts in ENC, the IENC provides the core technical competency for lock design and major rehabilitation. They are a Corps-wide asset with hundreds of years of experience, which is being leveraged to identify new RD&T needs and priorities by participating in the RARG and SoN annual review. They also provide a conduit for testing and transferring emerging technologies from the Navigation RD&T programs to the Districts.

At-Large Navigation Safety Program Manager – This position was created to ensure a strong technology bridge between the Navigation RD&T programs and the inland waterway operators. Navigation's High Priority Performance Goal is to reduce unscheduled lock closure times and this Program Manager position focuses on transferring relevant technology from across ERDC, Civil and Military programs, to solve inland Navigation problems. The focus is on bringing Engineering and Operations personnel together with INDT, ERDC, and Navigation RD&T experts to rapidly address problems and develop optimum solutions.

National Dredging Center – New in 2012, being established to provide improved dredging technical support and research capabilities as the Corps confronts a considerable maintenance backlog, deteriorated channel conditions, and reduced levels of service. With high rates of workforce retirements in recent years, much institutional knowledge and expertise has been lost. The NDC aims to develop subject matter expertise within the Corps and infuse knowledge and technologies in to Corps practice.

Civil Works and Military Engineering RD&T – There are opportunities to leverage and collaborate with Military funded programs at ERDC to provide Civil Works solutions. Already being leveraged are technologies for non-destructive testing, but there are others that should provide great value to the Navigation RD&T portfolio. Currently, the focus is on our inland navigation structures. The Flood Risk Management and

Environmental business lines also participate in leveraging, collaborating and partnering on many RD&T projects and studies. These relationships significantly improve Navigation products by leveraging expertise and perspective.

Committee on the Marine Transportation System – The CMTS represents 27 Federal agencies that play a role in the U.S. MTS. In 2009 the CMTS formed a Research & Development Interagency Action Team (R&D IAT) to provide the CMTS with a strategic capability to identify, develop, and implement innovative research and technology to address the pressing challenges identified in the National Strategy. The R&D IAT serves not only to re-establish previous collaborative interagency activities, but help develop a robust research agenda to improve the MTS. The primary product of the IAT is a marine transportation research plan and implementation strategy that includes a framework for research investments out to 2030. The R&D Plan is built on collaboration, leveraging multiagency programs, and execution of multi-party studies, projects, and demonstrations.

These programs, organization, and people make up an extended team that cross cuts the Navigation Business Line and conventional organizations of Planning, Engineering, and Operations, and Program Management, to include the broader navigation community focused on solving our most challenging navigation problems of today and tomorrow. Each Navigation RD&T program is unique with clear focus and is leveraged across programs to produce even greater capability though a strong mix of research, development, and technology expertise. This mix of technical expertise and organizational breadth is a key to the portfolio's success.

Navigation R D & T Strategic Needs and Priorities

The Navigation Research Area Review Group (RARG) plays a key role in identifying and prioritizing Navigation RD&T to support District and project needs through the rigorous process developed by the Headquarters Civil Works Research and Development Steering Committee and specified in EC 70-2-37 (draft). The RARG considers both inland and coastal navigation needs as well as both short-term and long-term needs. This is achieved primarily through submittal of Statements of Need on the Navigation Gateway, at <http://operations.usace.army.mil/ideas/index.cfm?CoP=nav>, combined with an annual RARG meeting to review, discuss and rank needs. A representative from every Navigation organization in the Corps is invited to participate in the annual meeting, which includes specific discussion on long-term, strategic needs to ensure they too are being identified and incorporated into the Navigation RD&T program.

Over the past several RARG reviews, along with input from the Headquarters Navigation Business Line Manager and other senior Navigation leaders throughout the Corps, over 100 needs have been identified, discussed, ranked and vetted, and are organized into five high-level strategic RD&T priority areas:

1. **Extend the useful life of existing navigation infrastructure.** Determine the condition, extend the life, and enable rapid repair of aging infrastructure, such as locks, dams, jetties, and breakwaters.
2. **Operate and manage national waterborne transportation assets as an integrated system,** including using life cycle and supply-chain concepts and principles. Create new capabilities to look beyond channels, locks and docks to quantify the supply chain and better design an integrated MTS.

3. **Optimize and prioritize channel availability for commercial freight movement.** Extend dredging capabilities with improved science and engineering tools to calculate channel shoaling, morphological and regional responses and impacts.
4. **Engineering With Nature to enhance ecosystem and navigation processes, benefits and services.** Develop new science and engineering tools that intentionally align natural and engineering processes to efficiently and sustainably deliver economic, environmental and social benefits.
5. **Implement eNavigation throughout the national MTS.** Share, access, and manage navigation data and information in a framework that supports inter-Corps and intra-Corps requirements, such as river information services.

Top RD&T Priorities

The priorities were established through discussion and ranking by the RARG, reviewed and approved by the Navigation Business Line Manager and discussed with the R&D Gang. Additional review of needs and priorities was performed through a Red Team process and the annual ERDC Board of Directors review before final approval by the CW R&D Steering Committee. The short-term time horizon is identified as 0-3 years and long-term as 3-10 years.

Short-Term Priorities.

1. Initiate Engineering With Nature concepts and introduce these concepts to the Corps and Nation.
2. Develop marine transportation system optimization methods for enhanced operation and decision support.
3. Establish River Information Services to increase safety and waterway reliability.
4. Update existing navigation infrastructure repair, evaluation, maintenance, and rehabilitation technologies.
5. Identify sealing techniques for quoin blocks backing materials.
6. Identify position-measuring device for directly connected hydraulic cylinders.
7. Identify and verify new repair designs that reduce miter gate cracking.
8. Create repair and replacement guidance for lock culvert valves.
9. Identify and evaluate rapid repair using composite materials.
10. Evaluate methods and procedures to replace post-tension trunion rods.
11. Improve prediction of shallow water transport and fate of dredged material.
12. Identify and quantify the cost of dredging windows.
13. Identify and quantify environmental benefits and services resulting from the use of dredged material.
14. Develop GIS suitability model for identifying and ranking beneficial use sites.
15. Design an evaluation tool for nearshore berm placement of multi-grain sized material.

Long-Term Priorities.

1. Research, develop, adapt, and test composite material for rapid repairs.
2. Transition from expert elicitation condition index assessments to science and engineering based analysis, capabilities and tools.
3. Develop science, engineering and economic tools to evaluate the intricate marine transportation system and guide the Corps to ensure rational and transparent maintenance investment decisions.
4. Develop knowledge and tools to consider impacts in other business lines that share these multi-use projects.
5. Quantify what is a minimum caretaker status and how to best monitor navigation systems.

6. Create integrated tools, models and data that provide decision support for multi-purpose systems.
7. Improve science and engineering tools describing cohesive and mixed grain transport at deep draft navigation projects.
8. Develop concepts, principles, and practices associated with Engineering With Nature to support the development of navigation infrastructure by maximizing the use of natural processes and the generation of environmental benefits.
9. Develop new river information services.
10. Conduct challenging pilot efforts that integrate applications, data, and business processes.

Portfolio Framework. In addition to the short-term and long-term RD&T technical priorities there are framework improvements needed to support the Navigation RD&T portfolio:

1. Continue to seek, build, and sustain collaboration and partnerships to leverage authorities, funding, talent, data and research and expertise from other agencies and organizations.
2. Seek funding beyond traditional appropriations and innovative relationships such as public-private partnerships.
3. Link and connect technologies and expertise from Military RD&T programs and across the Corps to bring the best solutions forward quickly.
4. Seek to find a good balance between tools for Districts and capabilities and expertise in the Navigation RD&T program.

Implementation. These needs will be addressed through the Navigation RD&T programs described above, following the process established by the Civil Works R&D Steering Committee (EC 70-2-37) with annual input and prioritization from the RARG. Work units will be created and where appropriate, efforts will be connected between the core research programs and the technology programs to maximize District connections and technology transfer. Also, other Federal agencies will be leveraged and academia will be engaged. As needed, Focus Areas will adjust to meet the long-term needs to address future challenges. This will ensure that the Navigation RD&T remains focused on District needs while advancing the science and engineering capabilities of the Corps.

Summary

The primary value of this plan is to provide a succinct summary to foster discussion and transparency. The goal of this plan is to identify strategic research, development and technology needs for the U.S. Army Corps of Engineers Navigation mission. It also serves to communicate these needs and priorities throughout the Corps and Marine Transportation Community. The Navigation Research Area Review Group and input from others have defined short-term and long-term research, development and technology needs for a National program and they are being used to focus of the Navigation RD&T portfolio. These priorities will change over time and this document will be periodically updated to reflect those changes.



Navigation Research, Development and Technology Portfolio

- Dredging Operations and Environmental Research (DOER)
- Coastal Inlets Research Program (CIRP)
- Navigation Systems Research Program (NavSys)
- Regional Sediment Management (RSM)
- Monitoring Completed Navigation Projects (MCNP)
- Dredging Operations Technical Support (DOTS)
- Inland Electronic Navigation Charts (IENC)
- National Coastal Mapping Program
- Navigation Structures