

The Future of Navigation: e-Navigation Innovations

Take-Away Points

Moderator: Captain Scott Smith, USCG

- Standards for navigation technology are vital to ensure safety of MTS and maritime users across the spectrum. Development of those standards needs to keep pace with the speed of technology.
- Multiple delivery methods are required to: (1) meet the vast array of technologies users exploit to receive navigation services/portfolio data, (2) meet the time requirements /criticality of the data, and (3) meet geographic restrictions on communication methods available.
- Reliable positioning and navigation information is critical to safe navigation. GPS, other GNSS, and other users of PNT may be vulnerable to exploitation. Alternative PNT should be explored at the national level.
- USCG/USCAE/NOAA Listening Session Feedback Form is available at <http://www.navcen.uscg.gov/>



U.S. Committee on the Marine Transportation System

Innovative Technologies for a Resilient MTS: 3rd Biennial R&D Conference



System Performance Take-Away Points

Moderator: Jim Walker

- Maximize administrative & operational efficiencies before building more
 - Security enhancements *can* improve efficiency, ex by Shipmoves.org
- Users need varying time-scale and geographic-scale data, how to dis/aggregate appropriately? Clarify context a bit?
 - Ongoing challenge: data collection, standardization
- Optimizing use of crowdsourcing to supplement data, ex real-time water levels
- Accounting for different physical characteristics of waterways when measuring performance
- Improve data fidelity to support system performance analysis
 - Discrepancies in Vessel Characterization db for Vessel Age and Vessel Rebuilt
 - Reasons for lock closures can have improved descriptions/coding
- FILS: need to communicate successes, use as roadmap for other data collaboration and collection, ensure continued collaboration
- Demonstrating importance of facilities in dimensions beyond tonnage/value of cargo
 - “Industry critical” ports and cargoes



MTS Resilience

Take-Away Points

Moderator: Todd Bridges

- We need to translate knowledge about resilience into action.
- We need to prepare for uncertain future conditions and hazards.
- We need to increase collaboration, sharing best practices and lessons learned.
- We need to account for the human element – how different mental models, values and perspectives influence decisions.



Engineering with Nature Take-Away Points

Moderator: Bill Hanson

- Innovative waterways management practices are being implemented at many locations of the U.S. as part of dredging practices although most efforts are not well published or communicated.
- It is important to develop robust partnerships, increase communication between public and private partners, and to share best techniques/practices and lessons learned.
- Innovative changes can be made to hardened structures to incorporate green elements into grey infrastructure and increase ecological habitat. There is no one size fits all solution.
- Metrics are necessary to assess the success of hybrid grey/green infrastructure.
- Innovative thinking has been underway for a long time and we need to share our successes and lessons learned in order to further the practice.



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1E: Innovative Technology Take-Away Points

Moderator: Hota GangaRao

Speakers: Dr. Hota GangaRao, Dr. Hai Fang, Dr. Ray Liang, and Mr. Dustin Troutman

- **There are new infrastructure technologies applicable to a variety of MTS uses -- these technologies can increase resilience by decreasing maintenance costs and repair time, by maximizing cost efficiencies, and by increasing the strength and longevity of infrastructure with minimal user inconvenience.**
- **Fiber reinforced polymers (FRP) composites are one of these key new technologies:**
 - FRPs are a heterogeneous combination of two or more materials –1) reinforcing elements such as fibers, fillers and (2) binders such as resins or polymers.
 - FRPs have a high strength/weight ratio and durability; can be manufactured as bars, shapes, and wraps; are lightweight; and can act a protective membranes to inhibit corrosion.
 - FRPs are already in use in marine, aviation, and automobile industries.
 - FRPs have been tested in numerous projects/studies.
 - FRPs are easy to install with minimal training.
- **FRPs have enormous potential for use within the MTS as:**
 - Strengthening wraps to repair corroding steel pilings (e.g. East Lynn Lake Bridge in WV)
 - Allision bumpers for bridge pilings (e.g. on multiple bridges in China)
 - Pultruded fiberglass reinforced polymer pipe pilings (e.g. Statue of Liberty dock repair post Hurricane Sandy)
 - Lift gate rollers (e.g. Bankhead Lock & Dam, AL)
 - Blocks for miter gates (e.g. Washington Lake Canal, WA)
 - Bridge fender systems (e.g. Twigg Bridge, VA)
 - Abrasion-resistant overlays (e.g. Tainter Gates at Heflin Dam, AL)
 - Replacement for other materials in general (i.e. wood & concrete)



East Lynn Bridge (WV) Repair Process



Pultruded piling in San Francisco



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2A: System Performance Take-Away Points

Moderator: John Quinn

- **Mr. Matt Chambers (Seaports)**
 - Seaport data (i.e. exports/imports and trade imbalances) can be a useful metric for assessing the resilience of ports following disturbances; however, to ensure accurate understanding of port capabilities, sensitivity to choosing the right metric (i.e. cargo value, tonnage, TEU) for the question is critical.
- **Mr. Jim Taylor (Federal and Industry Logistics Standards - FILS)**
 - Use of common descriptors of MTS elements (i.e. locations, bridges, and vessels) is critical to effective information-sharing among MTS stakeholders (e.g. government, industry). The FILS effort is providing these common descriptors in a format that is common, non-proprietary, and open -- they should be used.
- **Ms. Marin Kress (MTS Performance Measures)**
 - To build a robust and current picture of MTS system performance, we must have data that is available and interoperable as to be automatically retrieved without human intervention. Support for this resource can only be developed through active communication and education regarding its value to MTS stakeholders.
- **Mr. Michael Hilliard (Predicting Vessel Arrival Times Using AIS)**
 - AIS based predictions of vessel arrival times can enable more efficient lock management, port infrastructure and manpower use as well as allow vessel energy savings when slower travel speeds can accommodate acceptable arrival times.



SECURITY

Take-Away Points

Moderator: Captain Michael Bee, USCG

- Cross-Cutting Theme: Cyber Threats and Security
- Paradox: Reliance on Automated Everything, But Any Connected Thing is Not Secure Without Effort
- Needs: Threat Intelligence, Systematic Risk Assessment, Coordinated Application of Standards, & System Monitoring, Augmented by Public-Private and Private-Private Information Sharing
- Solutions Start with Proactive, Unified Effort of Mission/ Business Line Owners, IT and Security Managers, Manufacturers/Developers and End Users



Environmental Stewardship Take-Away Points

Moderator: Ben Steinberg

- Regulations involving maritime traffic that are intended to benefit the environment can have unintended consequences on maritime safety and can be both difficult and cost prohibitive to implement by vessel owners. These negative impacts can be minimized through researching best practices on how to respond to and implement the regulations and by working closely with the vessel owners, captain, and crew.
- An increase in the modal share of freight by the marine transportation system will result in a reduction in freight-related CO₂ emissions. This can be demonstrated through analysis of available multi-modal data.
- National Automatic Identification System data can be mined to analyze vessel movements, vessel travel paths, including vessel origins and destinations, and vessel travel times, for many applications including environmental studies.
- Readily biodegradable products used as lubricants for ship maintenance perform as good or better than traditional lubricants. In addition, by computing life cycle costs, and not just initial purchase costs, the lower cost of these products can be demonstrated.



Innovative Technologies

Take-Away Points

Moderator: Eddie Wiggins

- Closing the gap of knowing and tracking vessels and having (near) real-time situational awareness particularly in the Arctic, ex MONALISA and MICE programs
 - Need a way to provide notice of deviations from designated shipping lanes
- Need a sensor suite to monitor a ship moving towards a bridge, notify the mariner, stop bridge traffic in all conditions
- Physical oceanographic information is foundational for MTS resiliency planning; infusion of technology necessary to continually evolve observing systems cost effectively.
 - Large geospatial gaps & challenges in the Arctic region
- Aerial topo and bathy lidar, photogrammetry, hyperspectral imagery
 - Investigate new derivative products for decision support

Data Management and Sharing Take-Away Points

Moderator: Brian Tetreault

- Data collected (and funded) for a specific purpose is useful for many other users to improve MTS decision making
- Implementation of e-Navigation will require development of interoperable communications technologies
- Data collectors and information providers are shifting from delivering products through single purpose portals to providing web and map services that can be used on many applications
- Managing waterways after natural disasters requires planning for data management pre-disaster and structured baseline data collection



Asset and Maintenance Management Take-Away Points

Moderator: Bob Leitch

- Lots of data and many models exist for various parts of overall Life Cycle Assessment approach; what is needed is a comprehensive integration that leverages the entire process
- A means of relating the value of investment choices between different infrastructure or parts of a system would enable prioritization and lead to greater resilience through optimal risk reduction
- Analysis depends on the quality of data-- and finding improved methods of gathering quality data or improving quality of existing data
- Enterprise development and integration of data systems, or improved data sharing is another major challenge and should be an active goal



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MTS Resilience Take-Away Points

Moderator: Tom Wakeman

- Stakeholder-shared processes lead to decisions regardless of available technologies, infrastructure or political agenda
 - Ex. Pilots and other mariners provide local knowledge and cohesion among users of ports and harbors during crises.
- Trust is the glue that holds their recovery process together through adaptive-driven responses
- Resilience management strategy for the MTS depends on trust, shared culture, and co-production among public-private stakeholders to accelerate decision-making.
- Economic aspects (e.g., profit, business continuity) must be recognized as the functional objective of the private sector
- Resiliency is based in human factors; if the labor force is distracted by events (home destroyed, family at risk, etc.), recovery will be delayed causing further disruptions.

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CATALYZING QUESTIONS FOR CLOSING SESSION

1. What promising new and emerging technologies/methodologies were presented during the conference?
2. What gaps were identified in R&D?
3. What are the current and future primary disturbances to the MTS?
4. How can R&D contribute to these primary areas of resilience
 1. Prepare/plan
 2. Resist/withstand
 3. Recover
 4. Adapt
5. What are the opportunities now and in the future to "co-produce"?
6. What contributions or role can we make as co-producers from our respective positions in private-sector, government, NGOs and academia?

What gaps were identified in R&D?

- Communication science– data gap to decision makers so that they understand the cost of inaction
- Involvement of private sector
- Free the data!
- How to build machine-readable data export capabilities into existing data collection/reporting processes (this might also be an “R&D personnel gap”)
- Smartphone application (smart technology) to facilitate communication with industry/system users
- Need to understand the barriers in sharing data & coproducing
- Geographic gaps in communication systems
- Resiliency from the perspective of the vessels
- Understanding a baseline for resilience (quantification)

What are the current and future primary disturbances to the MTS?

- Multiple users and competing demands on the waterway/landside
- Inefficient environmental regulation
- Cascading impacts (ex. Drinking water and nav controlled by dams)
- Operating in a carbon constrained environment
- Planning with uncertainty (ex. climate change)
- Cascading impacts of technological advances (ex. landside vehicle technology)
- Institutional barriers to systems planning (ex. Modal silos)
- Changing workforce and budget constraints
- Increasing interaction with the urban environment (ex. land use, water quality, traffic)
- Creating a physical internet of things (long-term disturbance to the MTS), demand for increased situational awareness and accompanying communication and computing technologies
- Change in operating/ownership conditions of physical assets due to increased 'sharing economy' principles and standardization of physical structures
- Defining system bottlenecks and choke points
- MTS capacity – new paradigms to meet demand on waterway/landside
- Demographic shifts driving increased demand, or changes in freight patterns

What are the opportunities to "co-produce"?

- What is the appraisal value of the MTS? Not just physical assets.
- Conceptual framework to relate technologies to resilience
- Public stewardship vs private efficiency/costs
- R&D can contribute quality checks to crowd sourced data
- ensure ground truth of proprietary data
- Understand common threats, objectives, interdependencies among stakeholders
- Elevating technology as an infrastructure
- Assessment of administrative, legal, regulatory hurdles to advance coproduction (Procedures Act, use existing frameworks, BMPs)

What contributions or role as co-producers from our respective positions in private-sector, government, NGOs and academia?

- Bring cutting-edge entrepreneurs, young academics to share work and ideas
- Communicating federal research needs to academia to translate to funding
- Outreach to academia, industry to communicate value of MTS
- Outreach to programs that provide fellows and interns to MTS
- Advertise/Outreach with student/professional associations such as the Marine Technology Society, IEEE, Coastal & Estuarine Research Foundation (CERF), American Association of Geographers (AAG)

<http://senseplatypus.com/About/about.html>

<http://www.auvsifoundation.org/foundation/competitions/roboboat/>

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