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Inland Navigation Technology '09 - Digital Technology Impact on Safety and Efficiency

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Summary Report
Inland Navigation Technology '09
“Digital Technology’s Impact on Safety and Efficiency”

3-4 February 2009

US Army Engineer Research and Development Center
Coastal & Hydraulic Laboratory, Vicksburg, MS

Background

This workshop discussed the impact of digital technology on inland navigation safety and efficiency from the combined perspective government agencies and waterway operators. The US Army Corps of Engineers (USACE) described inland navigation Research & Development (R&D), related demonstration efforts, and Headquarters initiatives for safer, more reliable waterways and infrastructure. The US Coast Guard (USCG) addressed the latest developments in e-Navigation (e.g., electronic charts, AIS, and aids-to-navigation), and how these developments might affect inland waterways operations. The National Oceanic and Atmospheric Administration (NOAA) discussed *PORTS* (Physical Oceanographic Real-Time System) and other activities. Representatives from the Towing Industry, led by the American Waterways Operators Technology Steering Group, described current/future needs, as well as on-going/planned initiatives to meet challenges associated with projected future increases in inland commerce.

e-Navigation is a new concept that aims to integrate existing/new vessel and shore-based navigational tools in an “all embracing” system. It has been defined by the International Association of Marine Aids-to-Navigation and Lighthouse Authorities (IALA) as:

... the harmonized collection, integration, exchange, presentation and analysis of maritime information onboard and ashore by electronic means to enhance berth to berth navigation and related services, for safety and security at sea and protection of the marine environment”

Major components include electronic charts, radar, AIS, and precise positioning from satellite and/or land-based navigation systems. To go from concept to implementation, there are two main challenges:

- 1) Ensuring the availability of all system components and using them effectively to simplify the display of crucial navigation-related information.
- 2) Incorporating new technologies in a structured way while ensuring that their use is compliant with the existing navigational communication technologies and services.

While most would agree on the goal of e-Navigation, making it happen will be challenge. A major factor is that there are two main groups, each with a different perspective: those responsible for providing e-Navigation services, and those who will use and rely on them.

Four break-out groups used the e-Navigation concepts to address the following Workshop goals:

- 1) Create a vision of the future of inland waterway navigation (for year 2013 and 2020) to include:
 - Components of the vision;
 - How the vision would be put into practice;
 - R&D needed to meet the vision;
 - Technical obstacles the vision.; and
- 2) Identify potential demonstrations/initiatives.

Several breakout groups identified the assumptions they used:

- Vessel traffic will increase by 10-20%; rail and highway at or near capacity.
- Demands of commerce may change implementation timeline, but not the basic needs.
- Technology will continue to advance
- Entire inland waterways network will be viewed as a complete system.

- All-weather navigation will be available.
- Water levels will be similar to 2008 levels.
- Lock capacity will increase slightly as a few new locks come on line and major lock rehabilitations increase chamber sizes; there will be unscheduled lock closures due to age of infrastructure.
- Mariner licensing/qualification requirements will become more stringent.
- There will be additional regulatory requirements for equipment carriage, environmental protection, and operational conditions.
- With increased information availability (through technology), the amount of information required (e.g., in preparation for a voyage) will increase.
- Reduced workload for mariner will continue to be a goal – although difficult to achieve.
- Technology will provide an aid to the pilot/captain – not a replacement for his/her judgment.

One breakout group provided a ‘vision’ for the present (2009) and near future

- Rules/regulations as well as technology requirements should apply to all vessels, particularly recreational vessels.
- If new technologies become required, then the associated services must be reliably provided and consistently available (e.g., 24/7, 365)
- Current flow measurements are important not only for locks and dams, but for all critical areas.
- Crucial information (whether static or dynamic) must be reliable, and provided in a format capable of being used by onboard equipment/systems.
- There needs to be better information about “drift” and other waterway obstructions (what type, when, where, etc.).

Immediate Issue: National Pollution Discharge Elimination System (NPDES) needs technical solution in terms of standardization of recording and recordkeeping of discharges.

Vision: For Year 2013

In general:

- Increased level of vessel traffic management -- both by design and circumstance.
- Increased levels of automation (e.g., seamless data communications).
- Information will be tailored for both provider and users.
- More mariners will be technology savvy, but have less pilothouse experience than previous generation.
- Information displays will show what is needed based on current situation or task-at-hand.

Components

Electronic chart data/nautical pubs - Increased use of smart data (data tagged with intelligence. Reduce (or eliminate) printed Notices-to Mariners (NotM), NTNI, & lock tickets. System-wide updates of Aids-to-Navigation (AtoN), Notices to Mariners (NotM, notices to navigation, etc. Seamless integration for the mariners, such as river permits, safety zones, CDC reports, air gap, lock lower gauge, etc.

AIS - Will be in widespread use by inland system operators. Will play a more significant role (but, we don't know the full extent). Will enable increased situational awareness from vessel and shore-based operators (e.g., location & movement of other vessels).

Lock Operations - Will likely be more rules (increase in assignment/management)

VTS - Will play an increased role (information on ice, flooding, buoys, etc.)

AtoN - Virtual buoys could be used in lieu of ice buoys.

Towboat operator's “wish for”:

- 1) better current flow information (locks, dams, bridges, etc.)
- 2) drift (floating debris)

Vision: For Year 2020

In general:

- Navigation technologies will be more fully integrated and easier to use in the pilot house.
- Better information will be displayed on less equipment through increased integration.
- There are more government-private partnerships and cooperation. In particular, government agencies will need to deal with smaller/less capable entities (e.g., small companies and local governments)
- More information is available to enable planning. This includes pre-voyage briefing, expected weather, waterway status, etc.
- Rapid notification of changed conditions (e.g., high water, maritime security/MARSEC level) will enable decision-making on operations/requirements/actions.

Components:

Electronic charts/nautical pubs - Standards will be in place for file/data formats (e.g., Inland Electronic Navigational Charts (ENCs), internet protocol, XML, NMEA2K). This will enable development of new applications/uses for data.

Communications - Single data entry and one-time reporting to USACE, USCG, IRS in standardized format.

AIS - Connectivity between vessels beyond AIS (e.g., transmitting/sharing radar data, intended maneuvers, depth areas, shoaling, etc.). This will require standards, cooperative agreements between participants, and possible oversight/coordination by government agencies (e.g., NOAA & USCG)

Towing Operations – Management of reciprocal towing agreements between companies to maximize use of towing capacity. Currently done informally, will require some sort of clearing house.

Practice

Required Capabilities (and how implemented)

Communication infrastructure that is consistent, dependable and with sufficient bandwidth for all required information. Needs to be low-cost, no restrictions on use, and continuous connectivity. Need standard data exchange formats and connection protocols.

- Will need to identify dead zones. Challenge is to get commercial carriers to install and operate (a funding issue).

Navigation equipment – Single screen. Composite, task-oriented display. Capability to display separate layers information. Audible warnings of hazardous conditions generated by computer. Heads-up display in wheelhouse.

- While underway, have simulation running in background based on current environmental conditions, vessel parameters and past best practices. This functional capability to be used for real-time decision support and/or for future training/evaluation (e.g., for lock approach).

GPS – GPS geo-fencing would trigger required reports based on vessel location and/or speed.

AtoN - Use AIS devices on buoys for current location and depth. Electronic publishing of buoy positions and depth. (e.g., via web site). Includes, system wide reporting of discrepancies in AtoN. Use of forward looking Infrared (FUR) capabilities and other low-visibility aids.

Locks and Bridges - Extend improved positional technology to other locations such as bridge piers (e.g., use of laser range finder on certain bridge piers, or wireless ranging sensor).

- Have air gap sensors at all bridges. Data available real-time and projected for planning purposes. Data also needed up to 2 days in advance. Initial focus: top 20 bridges.

- RTCV meter info at problem bridges. Owner of bridge must OK this.

Barges - Electronic ID for tracking of barges and contents. Need a system that automatically manages itself and not dependent upon personnel.

- Ensure communications – USACE needs info from tugs/barges prior to arrival at locks – standardize dimension descriptions, commodity codes, to allow for electronic sharing of information (info flow is both directions). Accurate tonnage is important.
- Make the lock into a “weigh station” – get accurate measurement of tonnage in the lock.
- Manage operations as a system - avoid traffic jams at locks
- Better depth information (e.g., at all 4 corners of a tow).

Necessary R&D Activities

- Look into other transportation modes for ideas (e.g., aviation flight plans, dynamic overhead signs for highways, FedEx/UPS package shipping code sharing, etc.).
- Computer models on vessel, simulation of vessel avoidance.
- Predictive maintenance and monitoring. FEM/Maximo whereby key components are instrumented (e.g., locks, gates, motors, pumps, cylinders, etc.) so as to improve preventative maintenance.

Technical Obstacles

- Limitations in AIS bandwidth and other maritime radio frequency allocations.
- Integration among and between private companies and government agencies (individual companies often have their own proprietary system).

Demonstration Projects

- Improvements to lock technology – real-time distance from bow nose, etc. Mel Price might be a good location (north of St Louis).
- AIS AtoN demonstration – provides real-time depth as well as lat/lon position
- Automated information exchange at locks
- Make a section of the river with multiple locks a managed section not by individual locks.
- Use of “virtual” buoys (or alternatively, an electronic navigation aid)

Some “Way-out-There” Possibilities

- Automated towboats/remote monitoring much more closely than now. So-called “navigating off the bridge” – alert to mariner to change heading, collision avoidance recommendations.
- “Smart AIS” – ability to automatically detect vessel equipment failure, information need and provide it automatically (e.g., positioning).
- River Highway Concept where by queuing technology (near term) dock-to-dock is implemented. Would involve lanes to facilitate safe transits at some locations.