Leading the Revolution in the Port Industry:
The Hampton Roads Center for Intermodal Transportation

Joseph F. Bouchard, Ph.D.
December 23, 2005
(Updated January 16, 2014)

The Revolution in Intermodal Port Operations

In an era of globalization and "just in time delivery," the US economy is critically dependent upon the capacity, efficiency and resilience of maritime transportation, which carries 95% of all goods that enter and leave the country. The growth of maritime shipping is rapidly approaching the capacity limits of US ports. Although many US ports are pursuing increased capacity through expansion of container terminals, waterfront property that can be used for this purpose is becoming increasingly scarce. The alternative approach is to increase cargo velocity through those terminals so they can handle greater container volume. Additionally, the shipping industry is highly competitive and both importers and exporters demand the lowest possible rates in order to reduce the cost of their products. Current efforts by US ports to increase cargo velocity and reduce costs are limited to incremental improvements to existing cargo handling and business processes, which will not be sufficient to meet future growth in maritime trade over the long term.

A revolution in intermodal transportation has been launched at select European and Asian ports: extensive application of automation and robotics are being used to enhance the effectiveness and reduce the operating costs of intermodal marine terminals. This is the most significant transformation in maritime shipping since the introduction of containerization in the late 1950s.

American ports lag far behind several of their European counterparts in adopting advanced technology for intermodal cargo handling. Several U.S. ports have adopted computer systems for tracking and processing containers and a few are conducting trials of systems that provide greater automation of container tracking, such as radio frequency identification (RFID) readers; but even the most advanced of these systems fall far short of the advanced technology already being employed in Europe. Several major European ports have adopted extensive automation and robotics to streamline and reduce the cost of intermodal container operations. By comparison, U.S. ports rely on inefficient, manpower-intensive processes for moving containers. This results in greater costs per container, which ultimately are passed on to consumers in the cost of the goods they buy. Unless our nation is willing to let foreign firms dominate the application of advanced automation and robotics in US ports, we need to gain a leadership position in these areas.

Other east coast ports will face increasing pressure from their shipping customers to provide the same level of efficiency and cost savings. Those that invest in automation of container operations will experience sustained growth at a significantly higher rate than ports that cling to the old, manpower-intensive approach.

Many in the port industry argue that unions will resist automation because it threatens their jobs. That is undoubtedly true, but the conclusion that union opposition precludes automation is false. Unions opposed containerization in the 1950s and 1960s, but were unable to prevent it from transforming maritime shipping. An inclusive planning process that takes union concerns into account can ease the labor concerns arising from automation of container operations. The European experience is instructive in this regard. European ports are no less unionized than American ports, yet several major ports have adopted extensive automation of container operations, even replacing human-operated vehicles with robotic vehicles for moving containers.

The Opportunity for Hampton Roads

Hampton Roads has a unique opportunity to lead the nation in the automation of intermodal container operations. Hampton Roads in one of two ports in which the automation revolution will first reach the United States. The new APM (Maersk) terminal being built in Portsmouth will have extensive automation of container operations – not at the level of the most advanced European ports, but an order of magnitude greater than any other US container terminal. APM can confidently expect that the resulting efficiency and cost savings will give their new terminal a significant competitive advantage, with sustained rapid growth in business until the new terminal reaches its maximum capacity. This will spark a revolution in the US port industry as other ports seeking increased container handling capacity and reduced costs turn to automation.

The scope and pace of this revolution in the US port industry will depend in part on progress in a number of related transportation issues. It does little good to increase the efficiency and productivity of intermodal container operations on marine terminals if the overall capacity of a port or flow rate in and out of terminals is constrained by other factors, such as traffic congestion or even environmental concerns. For marine terminal automation to achieve its full potential, research will be required in a wide range of areas related to intermodal transportation so that the entire intermodal transportation system, including its ground and maritime components as well as the marine terminals where they interface, can support the growth in cargo flow that is projected in the years ahead.

Hampton Roads provides the ideal location for research and development in advanced intermodal transportation technology. The port industry in Hampton Roads encompasses the full range of maritime transportation, including container terminals, break bulk, bulk petroleum and coal, vehicles (roll-on/roll-off carriers), a cruise ship terminal, and short sea shipping via barge. The port is the second largest commercial port on the East Coast overall and the third largest container port on the East Coast. Major projects to expand intermodal shipping through the port are in progress or will be launched in the near future: Norfolk Southern's Heartland Corridor rail project, the new APM container terminal in Portsmouth, and the Virginia Port Authority's new Craney Island Marine Terminal. As a result of this expansion, over the next two decades the Port of Hampton Roads will grow to become the second largest container port on the East Coast and will be poised to seize the first place slot. Additionally, the Department of Transportation anticipates a significant increase in short sea shipping due to highway congestion – a segment of maritime shipping already in place in the port. The Port of Hampton Roads thus provides an excellent venue for research and development across the full range of intermodal and other maritime transportation technology.

The Center for Intermodal Transportation

Hampton Roads should launch a program to become the national center for research and development in intermodal transportation by establishing the Hampton Roads Center for Intermodal Transportation.

The research opportunities in intermodal transportation are very broad in scope:

- Application of advanced automation and robotics to enhance the effectiveness and reduce the operating costs of intermodal marine terminals.
- Other engineering fields in which advanced technology can enhance the overall capacity, efficiency and resilience of the intermodal transportation system:
    - Civil engineering (better container terminals, roads, rail lines, etc.).
    - Ocean engineering (better waterfront structures and construction methods).
    - Naval architecture and marine engineering (more capable and efficient ships, and developing a concept for viewing container ships and terminals as a unified system)
    - Systems engineering and software development (more efficient design and management of intermodal cargo operations).
- Modeling and simulation of intermodal transportation systems. The Virginia Modeling, Analysis and Simulation Center (VMASC) and the Emergency Management Training, analysis and Simulation Center (EMTASC), a consortium of the leading corporations in the modeling and simulation field, already have experience in modeling logistics systems.
- All of the fields in science and engineering related to reducing the energy costs of intermodal transportation, as well as better ways of meeting air quality standards – already a major issue on the west coast.
- Physical oceanography and marine biology, including better means of integrating environmental compliance (water quality) and resilience (resisting storm damage) into port facility design and operation, and ensuring the safe navigation of ever larger vessels. This may also include better ways of preventing introduction of invasive species.
- Diverse fields like labor relations, public administration and political science could present research opportunities. Labor unions opposed containerization and are expected to oppose automation of intermodal cargo operations. Port development in some ports, such as Charleston and Los Angeles, has been constrained by public opposition to the impact of port growth on traffic congestion.

Across all of these areas, the Center would focus on research that produces practical results: enhanced technology, designs, management, operations and policies that government and the private sector can adopt to enhance intermodal transportation. In addition to conducting research and development, the Center would hold conferences, symposia and workshops on maritime transportation technology, and conduct demonstration and pilot products to assess the performance of new technologies in the maritime operational environment.

Three colleges and universities in Hampton Roads are already conducting research related to intermodal transportation:

- Old Dominion University. The Maritime Institute, the Department of Systems Engineering, and the Virginia Modeling, Analysis and Simulation Center (VMASC) have conducted research on port logistics and modeling of Virginia Port Authority cargo operations. The Transportation Research Institute in the Civil and Environmental Engineering Department and the Center for Innovative Transportation Solutions are conducting research on various aspects of transportation, including freight and multi-modal transportation. The Center for Innovative Transportation Solutions is a member of a US Department of Transportation Tier 1 University Transportation Center.

- The College of William and Mary. Three professors in the Mason School of Business received a grant from the Transportation Security Administration in 2004 to model cargo flows through US ports.

- Hampton University. The Eastern Seaboard Intermodal Transportation Applications Center was established in 2005 as a Department of Transportation Tier II university transportation center by the Safe, Accountable, Flexible, Efficient Transportation Equity Act (SAFTEA) to study regional transportation issues in Hampton Roads. As a Tier II center, it receives a grant of $500,000 for each of fiscal years 2006 through 2009 ($2 million total).

The presence of several large corporations in Hampton Roads that have divisions performing design and engineering work in the areas of transportation and logistics provides a strong foundation for a center of excellence in the automation of intermodal container operations. In addition by stimulating the growth of research and development in Hampton Roads, the center would act as a magnet to attract companies already engaged in automation of European ports and make Hampton Roads the location other US ports come to for expertise in intermodal transportation.

Recommendation

Establish a regional center for intermodal transportation research in Hampton Roads using whatever funding is immediately available, including Federal grants for specific projects, state funding as was provided for the modeling and simulation cluster, and private sector and foundation funds. Begin building a reputation for excellence in preparation for having the center designated a DOT university transportation center in the next transportation authorization bill, which should be passed in 2010. Set a goal of becoming at least a Tier II University Transportation Center ($2 million over 4 years) or Tier I University Transportation Center ($3 million over 3 years), with a long-term goal (2015) of becoming a Regional University Transportation Center ($6.225 million over 3 years) or National University Transportation Center ($16 million over 5 years).