Port Operations and Logistics

Sustainability and STEM Careers

June 2010
Agenda

• Virginia Port Authority Overview
• Unit 1 - Port Pollution
• Unit 2 - Green Ships
• Unit 3 - Port Logistics
• Unit 4 - Containerization
Objectives

• Develop an awareness of Virginia Port operations and their economic impact
• Develop an understanding of Port Logistics
• Gain knowledge of Port Sustainability Initiatives
• Explore port related careers
• Reinforce Science, Technology, Engineering and Math (STEM) related Standards of Learning (SOLs)
• Develop workplace Readiness Skills
Virginia Port Authority (VPA) History

• Prior to 1971, seaport terminals were managed separately by individual Hampton Roads cities of Norfolk, Portsmouth and Newport News
• Virginia Port Authority was created by an Act of the General Assembly and unified port operations
  ▫ Portsmouth Marine Terminal (PMT)
  ▫ Newport News Marine Terminals (NNMT)
  ▫ Norfolk International Terminals (NIT)
  ▫ Virginia Inland Port
Vision Statements

• Port of Virginia primary gateway for international cargo transported through Mid-Atlantic and Mid-West regions.

• Virginia Port Authority - promotes economic development and stimulates job growth through international trade.
VPA Overview

- Port-related business provides over 343,000 jobs yearly
- $13.5 billion in payroll revenues, and
- $1.2 billion in local tax revenues.
- Since 1996,
  - warehousing and distribution investment has increased by over $416 million
  - employed over 12,000 people in Hampton Roads.
- The Virginia Inland Port, located in Front Royal Virginia, has attracted 24 warehousing and distribution centers
  - providing a total income of $599 million with over 6 million square feet of space
  - over 7,000 workers.
- Wal-Mart, Target, Home Depot, Dollar Tree, Lillian Vernon, and Cost Plus - distribution facilities in the Commonwealth because of a world class port facility and structure.
Background - Facility Locations

• 3 marine terminals located on the Harbor of Hampton Roads with 50 foot deep-water channels
• No bridge obstructions in the channels leading to the Authority’s terminals
• Served by 4 railroads
  • – Norfolk Southern
  • – CSX
  • – Norfolk and Portsmouth Belt Line
  • – Eastern Shore
• Close proximity to major Federal Interstates
  • (I-164, I-264, I-464, & I-664) and State highways
Virtual Tour of VPA

- Click to show [Virtual Tour of VPA](#)
Future Development

- **Craney Island Marine Terminal** is the future of the VPA
- $2.2 billion construction cost, including $400 million for dike and levee construction
- Feasibility study by the VPA and the US Army Corps of Engineers complete
- Anticipated to be constructed in four separate phases
- Phase I includes two years for design, two years to construct levees, two years to fill and four years for terminal construction
- Anticipated opening of Phase I is 2017
Port Pollution - Unit 1

- Almost 90% of the world's trade is carried by ship. 2.7% CO2 emissions come from shipping
  - Air Pollution
  - Water Pollution
  - Noise Pollution
  - Storm water Management
  - Careers
Air Pollution

• Shipping ports produce air pollution and greenhouse gas emissions
• Port air pollution threatens public health
• U.S. ports are among the largest sources of air pollution in their cities
• Ships use low grade bunker fuel
• Burning fuels release toxic air contaminants, smog, and greenhouse gases
Air Pollution Control Strategies

- Use of alternative fuels such as LNG
- Changing operating procedures to improve efficiency
- Use newer diesel engines that pollute less
- Install pollution control equipment
- Switch to grades of diesel fuel containing lower sulfur content
- Electric Dock Service
  - A docked cargo ship can burn seven tons of diesel fuel a day to run its electrical generators.
Nitrogen Oxides (Nox)

Particulate Matter (PM)

Air Pollution
Water Pollution

- Damage to Marine Life and Ecosystems
- Depletion of oxygen in water
- Wastewater and Leaking of Toxic Substances
- Accidental Spills
- Storm water Runoff
- Dredging operations
Spill Control Measures

- Setting up floating booms
- Spraying of dispersing agents — Gulf leak of 2010
- Pumping out any fuel still in the tanks
- Transferring fuels and other hazardous materials to a recycling center
- Cleaning the water surface with skimmers, followed by treatment in settling tanks
Oil boom and skimmers
Noise Pollution

• Causes environmental and health problems
• Mitigation strategies:
  ▫ Use of noise barriers
  ▫ Limit vehicle speeds
  ▫ Alter roadway surface texture
  ▫ Use traffic controls that smooth vehicle flow to reduce braking and acceleration
  ▫ Tire design
• Cost of adding to new facilities is low
Noise Reducers

Noise Barrier

Tread Design
Stormwater Management

- Vegetated Swales
- Water skimmers
- Oil/water separators
- Sediment Traps
- Retention Ponds
APM Terminals Portsmouth
Environmental Initiatives

- Maintain buffer of undeveloped forest and wetlands
- Planted 200,000 wetland type plants
  - Saltgrass
  - Needle Rush
  - Marsh Elder and Wax Myrtle
- Donated $5.3 million to the Elizabeth River Trust to reseed oyster beds
Careers

- Green conscious operations will generate an increase in port related jobs as ports expand and become more sustainable.
- Example: Design and Production of a Electric hostler port truck
- Video tour - [http://www.youtube.com/watch?v=0f1AlrG8gVU](http://www.youtube.com/watch?v=0f1AlrG8gVU)
Electric truck Specifications

- **Performance**
  - Maximum speed: 40 mph
  - Maximum range (empty): 60 miles/full charge
  - Maximum Range (fully loaded): 30 miles/full charge

- **Charging Specs**
  - Charging Time (60% charge): 1 hour
  - Charging Time (100% charge): 3-4 hours
Electric truck Specifications cont’d.

- **Price per truck**: $189,950 (yard hostler model); $208,500 (on-road model)
- **Price of charger**: $75,000, can charge 4 vehicles simultaneously
- **Charger Connection**: existing 440v system (total output 80kw)
Green Ships - Unit 2

- Reduce use of Bunker Fuel
- Design Solutions
- Tugs and Barges
- Careers
Reducing Bunker fuel Usage

- Most ships use bunker fuel
- Causes health problems ranging from asthma to cancer
- Ships are responsible for 2.7% of world carbon dioxide emissions.
Green Ship Design Solutions

- Exhaust gas scrubbers
- Trim Optimization
- hydrogen-hybrid engines
- Ballast water treatment
- Waste Heat Recovery
- Conversion to Biofuels
- Wind Energy
Exhaust gas scrubbers

- Scrubbers can be used for washing the exhaust gas from the main engine
- Scrubbers remove Sulfur dioxide, or SO$_2$, emissions
- And harmful particles from exhaust gases
Trim and Drag Optimization

- Minimize water resistance to minimize fuel consumption.
- Silicone based paint reduce drag while protecting the ocean from biocide leakage.
- Low drag can save 1200 tons of fuel per year/ship
Bulbous Bow

Bulbous bow reduces drag on ships increasing fuel efficiency 12 – 15 percent.
Hull Drag and decreased efficiency

- Surface fouling increases drag by 20 to 60%, reducing a vessel's speed by 10%
- Increasing its fuel consumption by as much as 40%,
- According to research by the US Navy.
- This problem cost the Navy approximately 300 million annually to remediate.
Barnacle growth on ship hulls
Hydrogen-hybrid engines?

- Hydrogen-hybrid produce zero-emissions
- 1st design based on British Waterways vessel powered by stored hydrogen
- No need to carry high pressured gasses on board ship
Ballast Water

- Used to provide stability during a voyage
- Water many times is taken on at one port and discharge at another.
- This practice introduces non-native organisms to different environments
- Chemical biocides
- Heating Ballast water
- Filtration
- Ballast Exchange
Waste Heat Recovery (WHR) Systems

- Utilize the waste heat from the engine to heat up steam for a turbo electric generator.
- There is a potential of up to 14 % CO$_2$ reduction with a new optimized Waste Heat Recovery System.
Biofuels

- Ethanol and biodiesel, can be blended with or substituted for diesel
- Biodiesel which is made from oil of soybeans and used cooking oil.
- Rapeseed and Canola oils can be used for motor oils and hydraulic fluid.
Wind Energy

- Use of sail kites
- Autopilot controls the sails
  - Determines optimal shipping routes
  - Packs and unpacks the sail
  - Sail has 5,000 sq meters of surface area
- Sails contain giant compressed air compartments
- Shaped like a paraglide
- Generates 5-25 times the power of conventional sails
Tugs and Barges

- More fuel efficient and safer than trains and trucks
- Move 1 ton of cargo 576 miles on 1 gallon of fuel
- Annually 620,000,000 tons of cargo is moved via the inland waterways
Tugs and Barges

If waterborne cargo were diverted to highway or rail:

- Truck traffic would double on the Interstates
- Rail tonnage would increase 25%
Tugs and Barges - Green?

- A 15 barge tow can carry 22,500 tons of cargo or 767,000 bushels of grain or 6.8 million gallons of fuel.
- By rail this would require 2 trains each with 100 jumbo hopper cars winding through 2.75 miles of track.
- By truck this would require 870 semitrailers in a line 34 miles long on our highways.
Careers

• Explore Port Careers - http://port.thinkport.org/workingattheport/default.asp
• Port of Long Beach Career videos
• Such as:
  ▫ Longshoremen
  ▫ Tug boat operations
  ▫ Pilots
  ▫ Customs and border protection
  ▫ Marine operations
  ▫ Accounting
  ▫ Freight forwarding and customs brokerages
  ▫ Trucker
  ▫ Port Security
Port Logistics - Unit 3

- Port Movement Equipment
- Port Automation – APM Terminal
- Container Terminals
- Bulk Cargo
- Intermodal Freight Transport
  - Road Transport
  - Rail Transport
- Careers
Port Movement Equipment

- Rubber Tire Gantry
- RMG’s
- Straddle Carrier
- Reach Stacker
Port Automation

- APM Terminal – Portsmouth, automation leader
- Remote control operated Gantries
- Rotterdam and Hamburg use automated guided vehicles
- Radiation portal monitors (RPMs)
- Gate Operations increase throughput and security
- Container Tracking System (RFID)
- Transportation Worker Identification Credential (TWIC) ID
Radiation Portal Monitors (RPM’s)
Transportation Worker Identification Credential (TWIC) Identification Card System
Container Terminals

• Where cargo containers are transshipped between different transport vehicles
• Straddle carriers optimize movement
• Automated systems use algorithms to assign carriers jobs to increase productivity
Algorithm sample

- Other samples
Bulk Cargo

- Dry Bulk
- Liquid Bulk
- Break Bulk
Dry Bulk - Examples

- A lot of dry bulk goods are moved via tugs and barges along major rivers and the Great Lakes
- Coal, Bauxite, cement, wood chips
- Grain (wheat, maize, rice, barley, oats, rye, etc.)
- Iron (ferrous & non-ferrous ores, pig iron, scrap metal, pelletized taconite, etc.)
- Chemicals (fertilizer, plastic pellets, resin powder, synthetic fiber, etc.)
- Dry edibles (alfalfa pellets, citrus pellets, livestock feed, flour, peanuts, raw or refined sugar, seeds,)
- Bulk minerals (sand & gravel, copper, limestone, salt, etc.)
Liquid Bulk

- Petroleum
- Liquefied natural gas (LNG)
- Gasoline
- Chemicals
- Liquid editables (vegetable oil, cooking oil, fruit juices, etc.)
Intermodal freight transport

- Uses multiple modes of transportation (rail, ship, and truck)
- The method reduces cargo handling
- Improves security
- Reduces damages and losses
- Allows freight to be transported faster
Road Transport

- National, regional and local truckload (TL)
- Less than truckload (LTL) services
- Domestic air and intermodal services
- Specialized services (flatbed, oversized, GOH)
- Port and intermodal
- Retail store and distribution center deliveries
- Local same day express pickup and deliver
Distribution centers
Rail Transport

• Safe, clean, efficient

• Container well cars
• “Piggyback" or TOFC (*trailer on flatcar*)
• Container on Flatcar (COFC)
• Crescent Corridor Intermodal Initiative
Container Well Car

Trailers on Flat Car (TOFC)
Crescent Corridor Intermodal Initiative

• Ease congestion
• Reduce Area Pollution
• Increase rail freight transportation capacity
• Improve mobility
• Improve the environment
• 73,000 Green Jobs
Careers - Requiring HS Diploma

- Longshoremen or Stevedore
- Fork lift Operators, Gantry Crane Operator
- Crane Operators, Straddle Carrier Operator
- Material Handlers
- Logistics technicians
- Rail car brakemen
- Truck drivers

- Explore Port Careers -
  http://port.thinkport.org/workingattheport/explore/default.asp
Port Operators - Job characteristics

- Work in small teams
- Outdoors and in all weathers
- Physically fit
- Work with your hands
- Use Mechanical Handling Equipment (MHE)
- Able to work safely
  - Explore Port Careers -
    http://port.thinkport.org/workingattheport/default.asp
Careers – Requiring College Degrees

- Logistics Analysis
- Intermodal Transportation
- Import/export Operations
- Supply Chain Management

- **Top schools** for Transportation and Distribution
  - Ohio University
  - Purdue University
  - St Louis University
Containerization - Unit 4

- Container shipping
- Modular standards
- Container Innovation
- Supply Chain Management
- Warehousing and Distribution
- Careers
Container Shipping

• The U.S. container shipping began on April 26, 1956
• Malcolm McLean put 58 containers aboard a refitted tanker ship, the *Ideal-X*, and sailed them from Newark to Houston.
• Ideal-X was a converted T-2 tanker with 58 trailer trucks bodies attached to the main deck.
1956 first Container Ship

SS Ideal X
Container Ships

- Use standard intermodal containers as directed by the International Organization for Standardization (ISO)
- Approx. 90% of manufactured cargo worldwide is transported by container ship
- Can carry up to 15,000 Twenty-foot equivalent units (TEUs)
Modular standards

- Modular standards of 20- and 40-foot container lengths, set by the International Organization for Standardization in the early 1960s
- The 53-foot container is in widespread use in U.S. domestic freight
Container Ports - cargo loads for 2009:

- Container Port
  - Los Angeles
  - Long Beach
  - New York City / New Jersey
  - Oakland, California
  - Savannah, Georgia
  - Tacoma, Washington
  - **Hampton Roads, Virginia**
  - Seattle, Washington
  - Charleston, South Carolina 2.0
  - Houston, Texas

- TEUs (mil)
  - 6.7
  - 5.0
  - 4.5
  - 2.0
  - 2.3
  - 1.5
  - **1.7**
  - 1.5
  - 1.1
  - 1.8
Container Innovation

- Foldable Containers -
- Roll-on/roll-off (RoRo) - [http://port.thinkport.org/allabouttheport/roro.asp](http://port.thinkport.org/allabouttheport/roro.asp)
- ConRo -
Trans-Rak containers-

- 4 full-size cars transported in one 40 feet Hi-Cube container
- Protection of cars from damage
- Waterproof and anti-break-in design
- Quick and easy to load/unload
- Load from the ground or trailer level
- Does not require extra devices
- Lloyd's Register certified
Supply Chain Management (SCM)

- Spans all movement and storage of raw materials, work-in-process inventory, and finished goods from point of origin to point of consumption.
- Reduce total logistics costs
- Take a systems approach when planning logistical activities
- Maximize inventory use & trade-offs to develop the most efficient and effective SCM strategy.
Supply chain logistics management

• Packaging
  ▫ Cartons, Bins
  ▫ Master Cartons
  ▫ Containerization/Unitization
    • Rigid Containerization
    • Flexible Containerization
Pallets

- Platform with enough clearance to enable the insertion of forks
- Materials: Wood (most common), paper, plastic, rubber, and metal
- Size of pallet is 48 x 40 in. pallet is most popular in US
- 1200 x 800 mm "Euro-Pallet" is the standard pallet in Europe
Green Pallets

- 2 billion plus wooden pallets used in the US alone
- This equals 1 million acres of hardwood forest
- Substantial cost savings
- Weight reduction
- Improved safety
- Reduction in waste disposal fees
Green cost savings

• Here is a simple savings scenario in dry freight costs using corrugated versus wood pallets:
  ▫ A 53 ft high cube trailer can hold approximately 48000 lbs of product and 30 wood pallets weighing 2100 lbs.
  ▫ The weight difference between a 12 lbs corrugated pallet and a 70 lbs hardwood pallet in a truckload is 1740 lbs.
  ▫ This 58 lbs per pallet-difference in LTL equates to one free truckload for every 27 truckloads shipped.
First in First out (FIFO)
Material Handling Systems

Mechanized Systems

- Click on pic for video

Forklift Trucks

Conveyers

Tractor-Trailers
Automated Systems

Automated Guided Vehicles (AGV)

Click on pic

Automated Sortation Systems

Carousels (Live Racks)

Robotics
Automated Storage & Retrieval System (AR/RS)
RFID

- Radio frequency identification (RFID) tags talk to networks
- The tags communicate with an electronic reader
- The reader is connected to large networks which can collect, manage and analyze large amounts of data.
Information Directed Systems

RF (Wi-Fi) Systems

Pick to Light Systems
Careers – (Non-Degree)

- Warehouseman
- Forklift operators
- Stevedores
- Security guards
- Truck drivers
- Captains & Mates of Water Vessels
- Dispatchers
- Cargo handling equipment mechanics
- Marine cargo inspectors
Careers – Requiring College Degrees

- Green Supply Specialist
  - Certification – California State University
- Logistics Analyst
- Pilots
- Transportation Management
- Logistician
- Distribution managers
- Supply Chain Management
- Scholarships Opportunities:
  - The Containerization & Intermodal Institute (CII)
Colleges

- **U.S. Merchant Marine Academy**
  - Marine Transportation - A program combining nautical science and maritime business management.
  - Maritime Operations and Technology - A marine transportation program enhanced with marine engineering studies.
  - Logistics and Intermodal Transportation - A program combining nautical science and logistics and intermodal management.
Colleges

• Old Dominion University Maritime Institute
  ▫ Maritime and Supply Chain Management
• SUNY Maritime College
  ▫ International Transportation & Trade
  ▫ International Transportation & Trade / Intermodal and Maritime Security
  ▫ Marine Business and Commerce with a Humanities Study Area Concentration
• Rutgers University