Port Operations and Logistics

Sustainability and STEM Careers

June 2010

Agenda

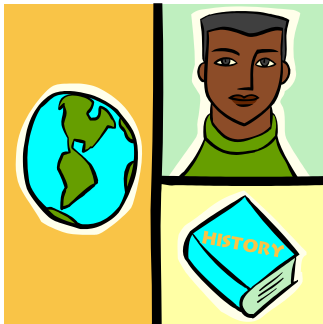
- Virginia Port Authority Overview
- Unit 1 - Port Pollution
- Unit 2 - Green Ships
- Unit 3 - Port Logistics
- Unit 4 - Containerization

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.

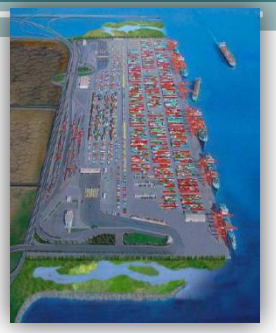
Background - Facility Locations

- 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

Click of image for a Virtual Tour of VPA

- Show video at http://www.vit.org/

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 worlds trade is carried by ship. 2.7% CO_2 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

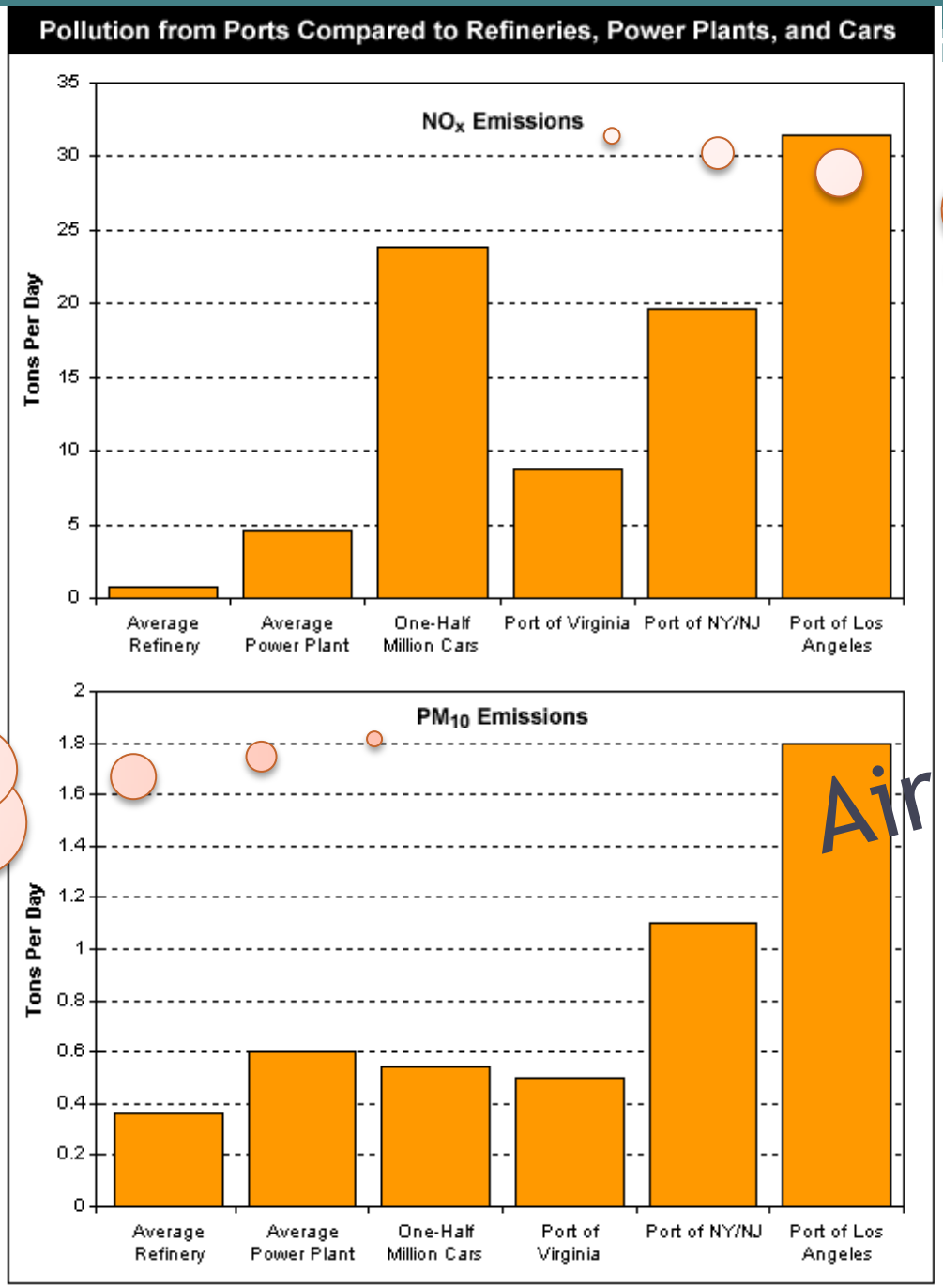
Air Pollution Control Strategies

- 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.

Air Pollution

Nitrogen Oxides (Nox)

Particulate Matter (PM)



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

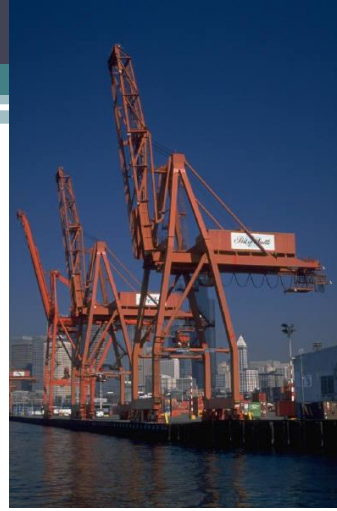
Noise Barrier

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

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 con't.

- 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

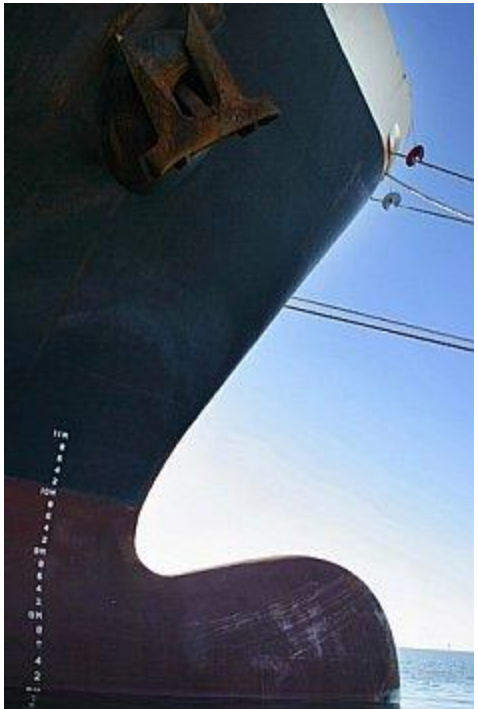
- Scrubbers can be used for washing the exhaust gas from the main engine
- Scrubbers remove Sulfur dioxide, or SO_2, emissions
- And harmful particles from exhaust gases

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

RMG's

Straddle Carrier

Rubber Tire Gantry

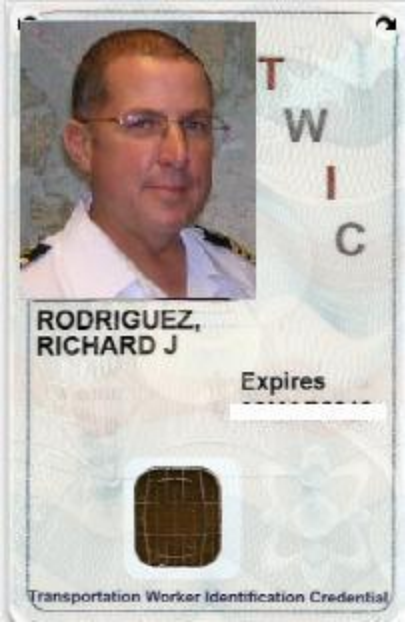
Reach Stacker

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

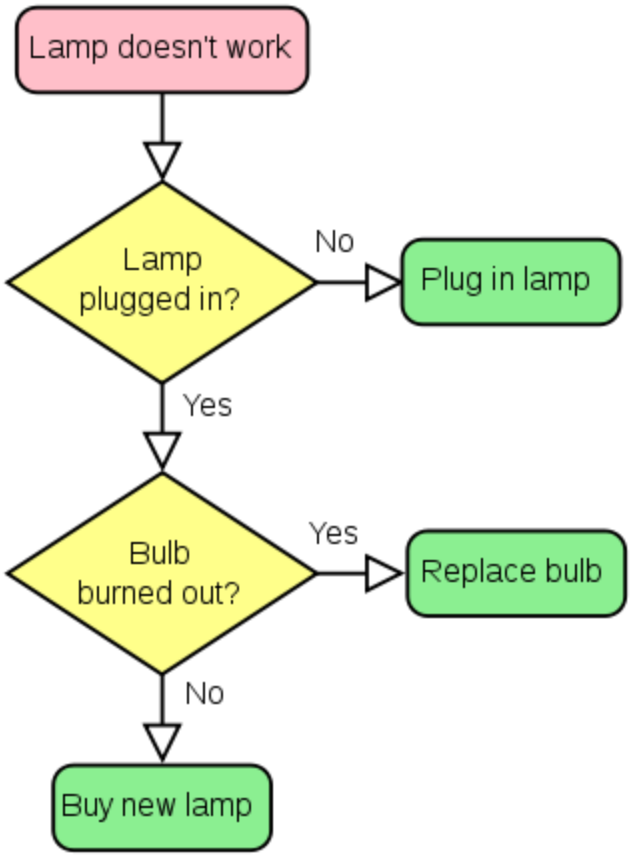


Container Terminals

- 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**

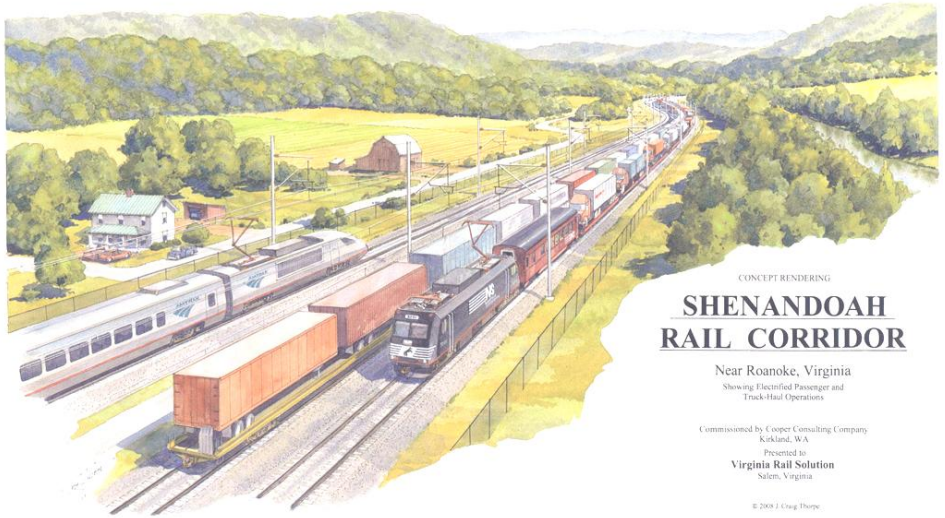
- Container well cars
- “Piggyback" or TOFC *(trailer on flatcar)*
- Container on Flatcar (COFC)
- Crescent Corridor Intermodal Initiative

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

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	**TEUs (mil)**
Los Angeles	6.7
Long Beach	5.0
New York City / New Jersey	4.5
Oakland, California	2.0
Savannah, Georgia	2.3
Tacoma, Washington	1.5
Hampton Roads, Virginia	**1.7**
Seattle, Washington	1.5
Charleston, South Carolina 2.0	1.1
Houston, Texas	1.8

Container Innovation

- Foldable Containers -
- Roll-on/roll-off (RoRo) - http://port.thinkport.org/allaboutheport/roro.asp
- ConRo -

Trans-Rak containers-

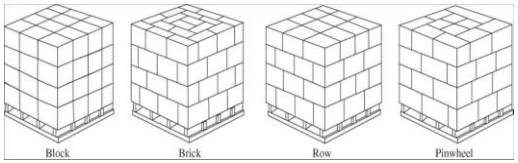
- 4 full-size cars transported in one 40 feet Hi-Cube container
- Protection of cars from damage
- Waterproof and anti-break-in design
- Quick and easy to load/unload
- Load from the ground or trailer level
- Does not require extra devices
- Lloyd's Register certified

Supply Chain Management (SCM)

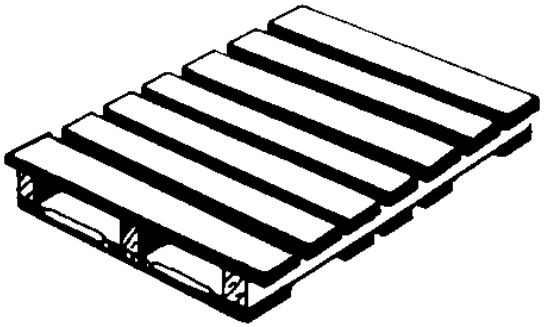
- Spans all movement and storage of raw materials, work-in-process inventory, and finished goods from point of origin to point of consumption.
- Reduce total logistics costs
- Take a systems approach when planning logistical activities
- Maximize inventory use & trade-offs to develop the most efficient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

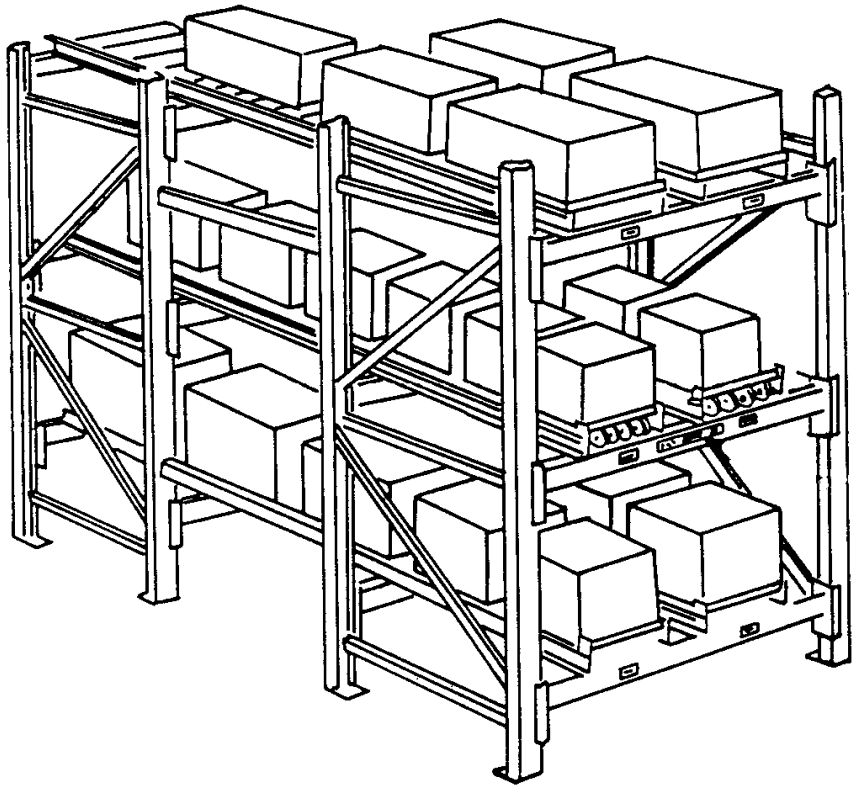
Green Pallets

- 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

Tractor-Trailers

Forklift Trucks

Conveyers

Automated Systems

Click on pic

Automated Guided Vehicles (AGV)

Robotics

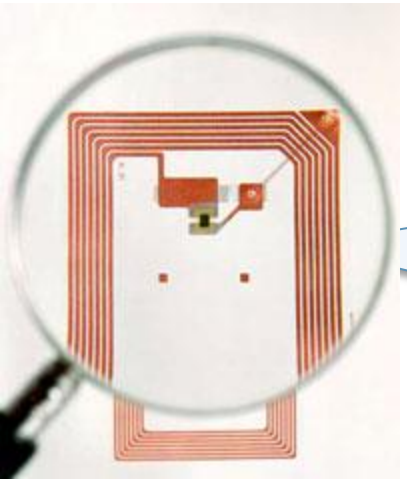
[Automated Sortation Systems]

Carousels (Live Racks)

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.



1999 RFID Tag for tracking luggage

RFID Tag

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

- 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