

# **CONTAINERIZATION AND MODERN CARGO STOWAGE**

## **LECTURE 5**

### **Container Terminals and Ships**

# CONTAINERS

The background of the slide is a photograph of a busy port. In the foreground, there are stacks of colorful shipping containers in various colors like red, blue, and white. Behind the containers, several large gantry cranes are visible, some in red and white, others in blue. The cranes are positioned over a body of water, likely a harbor or a bay. The sky is a pale, hazy blue.

- Looked at containers, types and markings
- Now, what happens to them
  - First
    - Terminals
    - Ships
  - Then
    - Handling
    - Securing

# TERMINALS

A large container terminal with multiple gantry cranes and stacks of containers. The cranes are tall and have long jibs extending over the water. The containers are stacked in neat rows along the pier. The water is visible in the foreground, and the sky is a pale, hazy blue.

- Introduction
  - Where containers arriving by ocean vessels are transferred to inland carriers, such as trucks, trains, or canal barges and vice a versa
    - Transshipment for onward transport by land or sea



# TERMINALS

The background of the slide is a faded image of a port terminal. It shows several large gantry cranes (shoos) used for loading and unloading containers from ships. The cranes are positioned along a pier, and stacks of colorful shipping containers are visible in the foreground and middle ground. The sky is overcast, and the water of the harbor is visible at the bottom of the frame.

- Introduction
  - Locations
    - Large amount of real estate / capital costs
      - Shore crane vs. ship's crane
      - Storage area for container – yard
      - Quays and open area in favor of Finger piers and warehouses
    - Easy access to transport methods
    - Deep water
      - Larger ships
    - Close to sea not cities
      - Replaced inland locations

# TERMINALS

- Evolution of the port of Rotterdam



# TERMINALS



- Introduction
  - Four basic functions
    1. Receiving
    2. Storage
    3. Staging
    4. Loading
  - Import
    - entering the terminal by sea and usually leaving by land modes
  - Export
    - entering the terminal by land and leaving by sea modes



# TERMINALS

The background of the slide is a faded image of a port terminal. It shows several large gantry cranes with their complex steel structures and cables. In the foreground, there are stacks of colorful shipping containers in various colors like red, blue, and white. The water of the port is visible at the bottom of the image.

- Introduction
  - Receiving
    - container arrival at the terminal, either as an import or export, recording its arrival, retrieving relevant logistics data and adding it to the current inventory
  - Storage
    - placing the container in a known and recorded location so it may be retrieved when it is needed
      - Stacked

# TERMINALS



- Introduction
  - Staging
    - preparing a container to leave the terminal
  - Loading
    - placing the correct container in the right order on the ship, truck, or other mode of transportation



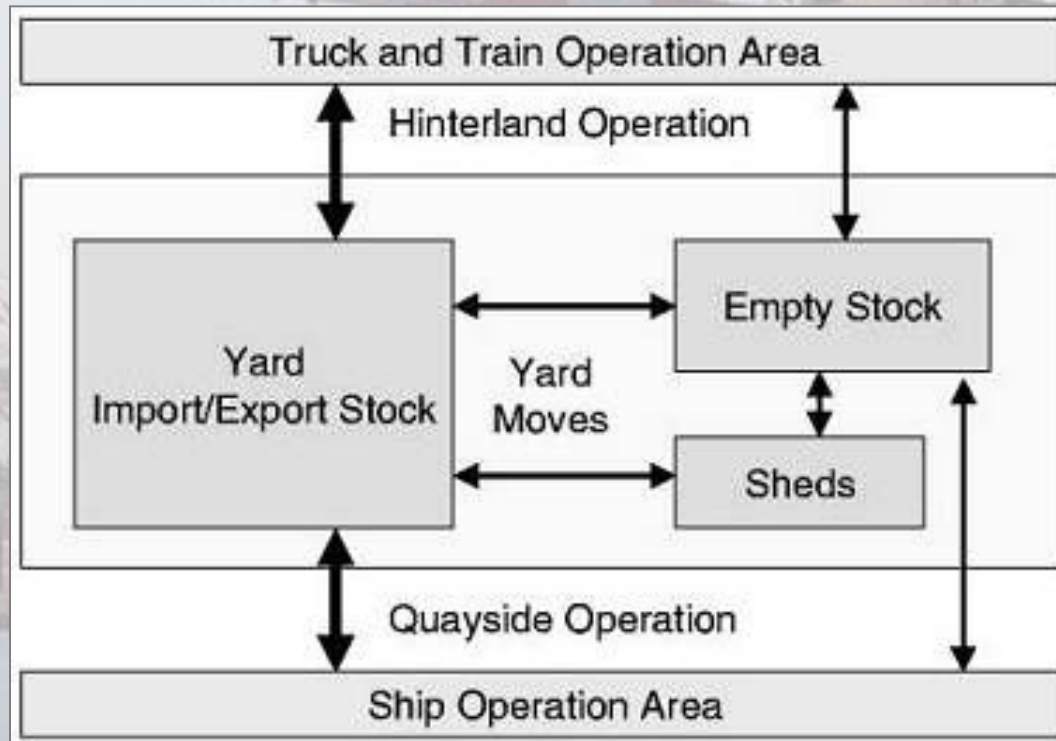
# TERMINALS

The background of the slide is a photograph of a busy port terminal. In the foreground, there are several large gantry cranes with red and white striped jibs. Below the cranes, there are stacks of colorful shipping containers in various colors like blue, red, and white. The port is situated on a body of water, and the sky is a pale, hazy blue.

- Introduction
  - Freight flow system with two external interfaces.
    - Quay
      - loading and unloading of ships
    - Landside
      - loading and unloading of trucks and trains

# TERMINALS

- Introduction
  - Freight flow system with two external interfaces.



# TERMINALS





# TERMINALS

The Port Elizabeth intermodal complex, Port of New York / New Jersey



Two major terminals: **Maher Terminal** (largest intermodal port terminal on the East Coast) and **APM Terminal** (a branch of the Maersk shipping company)



# TERMINALS





# TERMINALS

The background of the slide is a faded image of a port terminal. It shows several large gantry cranes (QCs) positioned along a quay. In the foreground, there are stacks of colorful shipping containers. The sky is overcast, and the water of the harbor is visible at the bottom.

- Operations
  - Discharging a ship
    - Containers moved off the ship with a manned Quay Crane (QCs)
    - QCs puts the containers on vehicles
      - like automated guided vehicles (AGVs)
    - AGV moves it to the stack/yard
      - Yard has numerous lanes where containers can be stored
      - Lanes are served by, for example, automatically controlled Automated Stacking Cranes (ASCs)







# TERMINALS



# TERMINALS

- Operations
  - Discharging a ship
    - When an AGV arrives at a lane, the ASC takes the container off the AGV and stores it in the stack
    - Containers later retrieved from the stack by the ASCs and transported by the AGVs to transportation modes such as barges, deep-sea ships, trucks or trains.
  - Reverses to load containers on a ship



# TERMINALS

A large port terminal with multiple gantry cranes and stacks of shipping containers. The cranes are red and white, and the containers are stacked in various colors. The terminal is situated on a pier with water in the foreground.

- Operations
  - Computerized movement and tracking
  - Further discussion of handling equipment in next lecture
  - Videos of terminals

# TERMINALS

- Largest world terminals

Rank	Port	Country	2010 <sup>[1][2]</sup>	2009 <sup>[3]</sup>	2008 <sup>[4]</sup>	2007 <sup>[5]</sup>	2006 <sup>[6]</sup>	2005 <sup>[7]</sup>	2004 <sup>[8]</sup>
1	Shanghai	 China	29,069	25,002	27,980	26,150	21,710	18,084	14,557
2	Singapore	 Singapore	28,431	25,866	29,918	27,932	24,792	23,192	21,329
3	Hong Kong	 China	23,699	20,983	24,248	23,881	23,539	22,427	21,984
4	Shenzhen	 China	22,510	18,250	21,414	21,099	18,469	16,197	13,615
5	Busan	 South Korea	14,194	11,954	13,425	13,270	12,039	11,843	11,430
6	Ningbo	 China	13,144	10,502	11,226	9,349	7,068	5,208	4,006
7	Guangzhou	 China	12,550	11,190	11,001	9,200	6,600	4,685	3,308
8	Qingdao	 China	12,012	10,260	10,320	9,462	7,702	6,307	5,140
9	Dubai	 United Arab Emirates	11,600	11,124	11,827	10,653	8,923	7,619	6,429
10	Rotterdam	 Netherlands	11,140	9,743	10,784	10,791	9,655	9,287	8,281
11	Tianjin	 China	10,080	8,700	8,500	7,103	5,950	4,801	3,814
12	Kaohsiung	 Taiwan	9,180	8,581	9,677	10,257	9,775	9,471	9,714
13	Port Klang	 Malaysia	8,870	7,309	7,970	7,120	6,326	5,544	5,244
14	Antwerp	 Belgium	8,470	7,309	8,663	8,176	7,019	6,482	6,064
15	Hamburg	 Germany	7,910	7,007	9,737	9,890	8,862	8,088	7,003
16	Tanjung Pelepas	 Malaysia	6,540	6,000	5,600	5,500	4,770	4,177	4,020
17	Los Angeles	 United States	6,500	6,748	7,850	8,355	8,470	7,485	7,321
18	Long Beach	 United States	6,260	5,067	6,350	7,316	7,289	6,710	5,780
19	Xiamen	 China	5,820	4,680	5,035	4,627	4,019	3,342	2,872
20	New York/New Jersey	 United States	5,290	4,561	5,265	5,299	5,093	4,785	4,478



# TERMINALS



- Shanghai
  - Yangshan container port
  - Completely new facility built from scratch
  - Opened in 2005
  - Well outside the existing port facilities
    - Changjiang delta, in Hangzhou Bay, 35 km offshore

# TERMINALS









- Shanghai
  - Well outside the existing port facilities
    - Existing port facilities too shallow to accommodate the latest generation of containerships
    - Provide additional capacity to meet traffic growth expectations
      - World's third longest bridge with a length of 32.5 km was built to link the port to the mainland
    - Expected capacity of 15 million TEUs
    - Video



# SHIPS

- Characteristics of Container Ships
  - Cargo service provided
    - general cargo, semi-container, purpose-built container ships
  - Ship sizes
    - Panamax, Post-Panamax, Suezmax, Malacamax
  - Service
    - feeder ships, mother ships
  - Handling modes
    - Lo/Lo, Ro/Ro; geared, gearless; hatchless
  - Development generations
    - Look at each

# SHIPS

		Length	Draft	TEU
First (1956-1970)	 Converted Cargo Vessel	135 m	< 9 m	500
	 Converted Tanker	200 m	< 30 ft	800
Second (1970-1980)	 Cellular Containership	215 m	10 m 33 ft	1,000 – 2,500
Third (1980-1988)	 Panamax Class	250 m	11-12 m	3,000
	 Panamax Class	290 m	36-40 ft	4,000
Fourth (1988-2000)	 Post Panamax	275 – 305 m	11-13 m 36-43 ft	4,000 – 5,000
Fifth (2000-2005)	 Post Panamax Plus	335 m	13-14 m 43-46 ft	5,000 – 8,000
Sixth (2006-)	 New Panamax	397 m	15.5 m 50 ft	11,000 – 14,500

**Six Generations of Containerships**



# SHIPS

- First Generation – 1960s
  - Modified tankers or general cargo vessels
    - Least expensive and risky ship
      - Containerization still unproven
      - Carriers even used general cargo ships or partly modified ships
  - Transport up 1,000 TEUs
  - Onboard cranes – “geared”
    - most port terminals were not equipped to handle containers
    - Lo/Lo – Lift on, Lift off loading

# SHIPS

- *Ideal X*
  - First container ship
  - Converted WWII surplus T-2 tanker
    - Deck strengthened for containers
    - Sailed April 26th 1956 from Port of Newark, NJ to the Port Houston, TX
  - Carried 58 35-foot (8 ft. wide by 8 ft. high) containers and a regular load of 15,000 tons of bulk petroleum



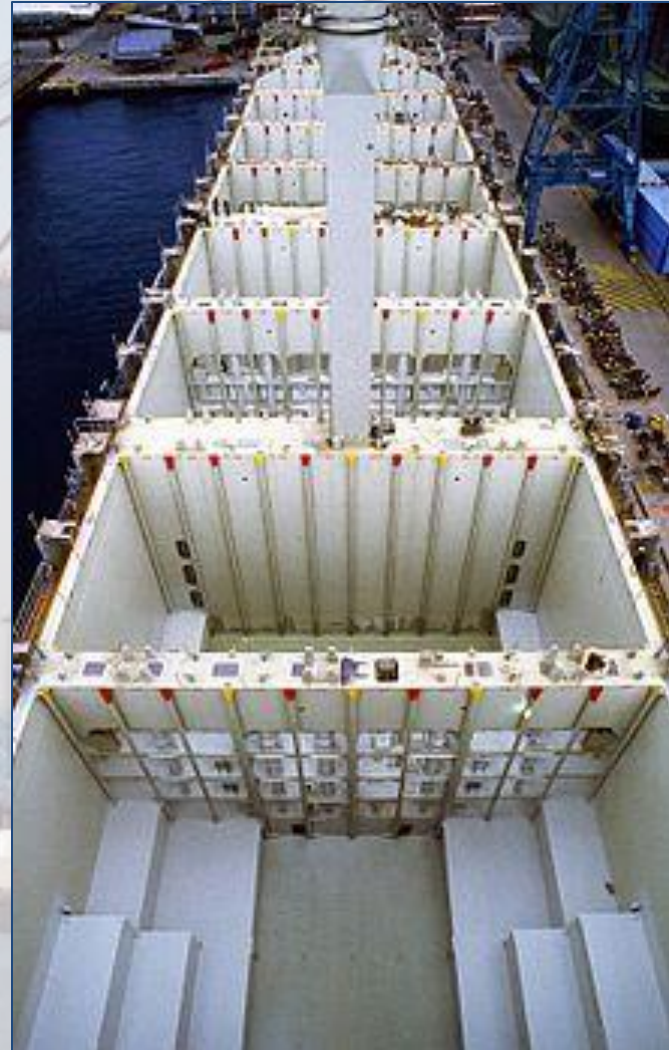


# SHIPS

- Second Generation – 1970s
  - Containerization widely adopted
  - First keel up purpose built container ships
    - U.S Lines' Lancer class
  - 1,200TEU ships capable of 22 kts.
  - Hatchless (no holds) construction
    - Cargo space comprised of cell guides
    - Open hatch cover – huge bilge capacity
  - Gearless (some)
    - cranes removed to carry more containers
  - Container terminals developed
    - Shore cranes

# SHIPS

- Cellular Holds





# SHIPS

- Third Generation – 1980s
  - Economies of scale pushed for larger ships
    - More containers carried the lower the costs per TEU
  - Panamax
    - Limited by the size of the locks
      - 965ft. (294.13m) long, 107ft. (32.61m) wide, , and 39.5ft. (12.04m) (tropical fresh) deep
  - About 4,000 TEUs

# SHIPS

- Forth Generation – mid-1990s
  - Post Panamax
  - Market risk since a ship above the panamax size required a substantial amount of cargo to be used
    - Required intermodal transport across North America
      - Land bridge
    - Rapid growth of global trade made such a ship class a marketable
    - Draft limitations at ports



# SHIPS

- Fifth Generation – early 2000s
  - Post Panamax Plus
  - Reaching 8,000 TEUs
  - Require worldwide handling networks
    - Transshipment ports and feeder ships
    - Singapore – transshipment port

## Feeders

- Smaller ships that distribute containers from the large port to smaller regional ports
- Ships under 3,000 TEU
- Likely to be geared



# SHIPS

- Sixth Generation – 2006
  - Maersk introduced the E Class
  - 11,000 to 14,500 TEUs
  - "New Panamax"
    - New locks 2013 – 2014
    - 1,400ft. (426.72m) long, 180ft. (\*54.86m) wide, 60 ft. (18.29m) deep
    - About 12,500 TEU.



# SHIPS

- Sixth Generation – 2006
  - Emma Maersk



General characteristics	
Class and type:	Mærsk E-class container ship
Tonnage:	170,974 GT 55,396 NT
Length:	397 m (1,302 ft)
Beam:	56 m (184 ft)
Draught:	15.5 m (51 ft)
Depth:	30 m (98 ft) (deck edge to keel)
Propulsion:	80 MW (109,000 hp) Wärtsilä 14RT-Flex96c plus 30 MW (40,000 hp) from five Caterpillar 8M32
Speed:	25.5 knots (47.2 km/h; 29.3 mph)
Capacity:	156,907 DWT 14,770+ TEU 1000 TEU (reefers)
Crew:	13, with room for 30

# SHIPS

- **Three Containership Classes**
- *Maersk Jamestown*
  - Feeder
  - 2,800 TEU
- *Lica Maersk*
  - Panamax
  - 4,200 TEU
  - 40 ft. draft
- *Evelyn Maersk*
  - 12,500 TEU
- All built in 2000





# SHIPS

- Fleet Characteristics
  - 2010, container ships made up 13.3% of the world's fleet in terms of deadweight tonnage.
  - 2009, the average age of container ships worldwide was 10.6 years
    - youngest general vessel type
  - As of October 2010
    - 4,831 Container ships

## Largest containership operators, 2010<sup>[1]</sup>

1. Maersk Line – Denmark
2. MSC – Switzerland
3. CMA CGM Group – France
4. Evergreen Line – Taiwan
5. APL – Singapore
6. COSCO – China
7. Hapag-Lloyd Group – Germany
8. CSCL – China
9. Hanjin -Rep. of Korea
10. NYK – Japan

# SHIPS

The background of the slide is a faded image of a busy port. In the foreground, there are several large gantry cranes with red and white structures. Below them, stacks of colorful shipping containers (blue, red, white) are visible. The port is situated along a body of water, and the sky is a pale, hazy blue.

- **Use of ships**
  - **Liner shipping services**
    - A regular scheduled shipping service
    - Most container carriers provide this service
      - Allows for predictability of freight arrival



# SHIPS

- **Use of ships**
  - **Charter services** (also known as Tramp)
    - Act of hiring (renting) a ship
      - **Voyage charter**, the charterer rents the vessel from the loading port to the discharge port
      - **Time charter**, the vessel is hired for a set period of time, to perform voyages as the charterer directs
      - **Bareboat charter**, the charterer acts as the ship's operator and manager, taking on responsibilities such as providing the crew and maintaining the vessel.

# SHIPS

- **Use of ships**
  - **Charter services** (also known as Tramp)
    - Act of hiring (renting) a ship
      - **Charter Party**, the completed chartering contract
  - Container unique charters
    - **Vessel Sharing Agreement (VSA)**
      - An agreement between two or more carriers in which a number of container positions ("slots") equal in space are reserved on particular vessels for each of the participants
    - **Slot Charter**
      - Carrier charters slot space on other carrier's vessel



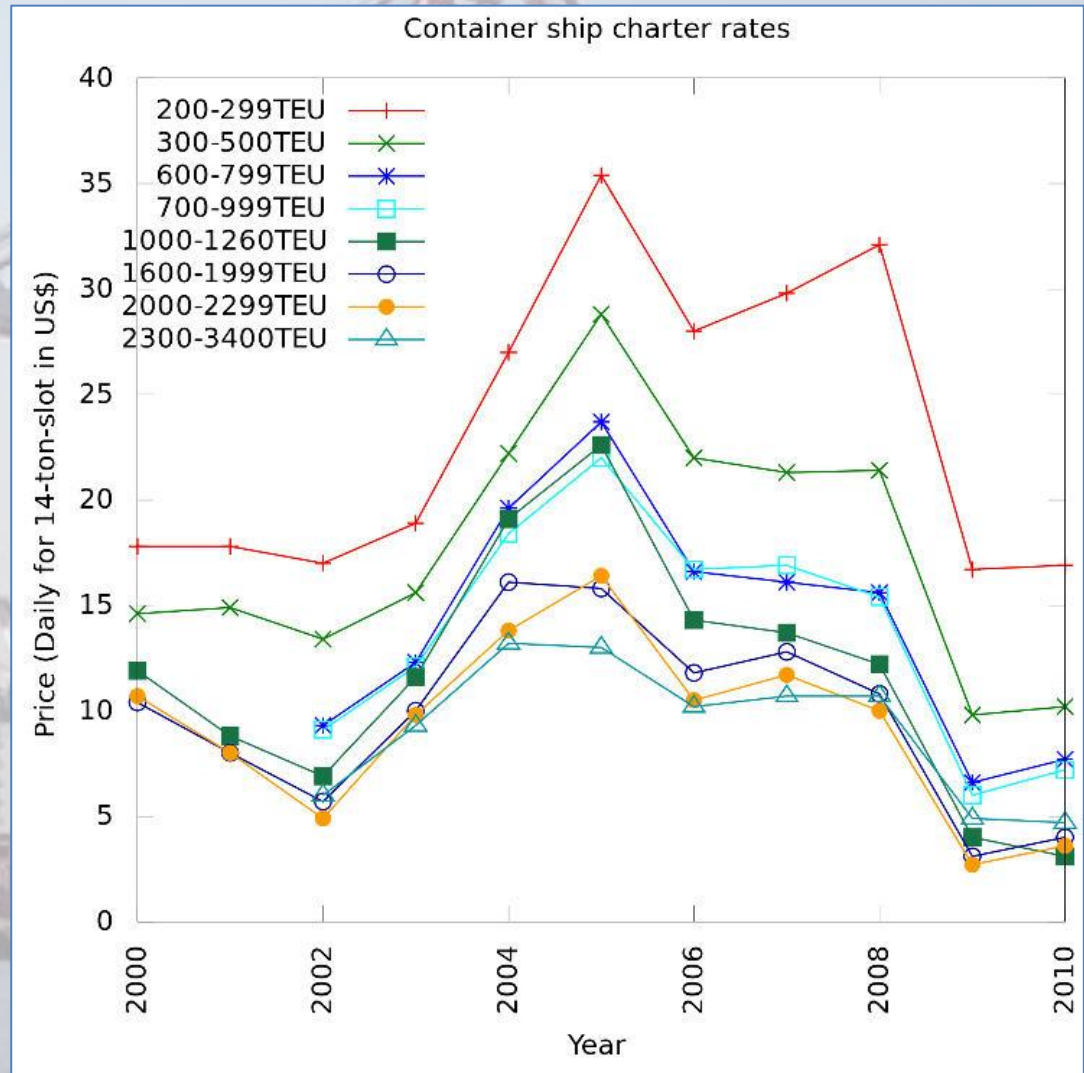
# SHIPS

- Freight rates

Recent liner freight rates (in 1000 US\$/TEU) <sup>[84]</sup>									
From	To	2008				2009			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Asia	U.S.	1.8	1.8	1.9	1.9	1.7	1.4	1.2	1.3
U.S.	Asia	0.8	1.0	1.2	1.2	0.9	0.8	0.8	0.9
Europe	Asia	1.0	1.1	1.1	1.1	0.9	0.7	0.8	0.9
Asia	Europe	2.0	1.9	1.8	1.6	1.0	0.9	1.0	1.4
U.S.	Europe	1.3	1.4	1.6	1.7	1.5	1.4	1.4	1.5
Europe	U.S.	1.6	1.6	1.6	1.6	1.3	1.2	1.1	1.3

# SHIPS

- Freight rates





# CONTAINERIZATION

The background of the slide is a faded image of a busy port. In the foreground, a large gantry crane is visible, with its complex steel structure and cables. Below the crane, there are stacks of colorful shipping containers. In the distance, other cranes and the outlines of ships can be seen against a hazy sky. The overall scene is industrial and maritime.

- Looked at terminals and ships
- Next Lecture:  
Begin looking at handling containers
- Assignment:  
Chapter 1: *Marine Cargo Operations*, Meurn  
Chapter 8: *Cargo Work*, House

# CONTAINERS

## References:

- *Marine Cargo Operations*, Meurn, 4<sup>th</sup> ed. 2011
- *Cargo Work*, House, 7<sup>th</sup> ed., 2005
- Rodrigue, J-P et al. (2009) *The Geography of Transport Systems*, Hofstra University, Department of Global Studies & Geography, <http://people.hofstra.edu/geotrans>
- <http://www.containerhandbuch.de>



## Purpose:

- *All materials are presented strictly for educational purposes only*