

LECTURE 1

INTRODUCTION TO PORT FUNCTIONS

A port serves as a hub for various activities, such as loading and unloading cargo and facilitating passenger travel by sea. Ensuring safety from wind, weather, and potential damage to the hull or bottom of ships is a primary concern, along with providing secure docking. In this safe environment, commercial operations like loading, unloading, and restocking ships take place. These activities can be conducted while the ship is docked at a quay or anchored offshore, using barges and tenders. The primary factor influencing a port's location is the commercial need for the transportation of goods and passengers. While not every safe location is suitable as a port, a port must inherently be a safe location. Historically, ports have been established in naturally protected areas, though modern technology allows for the construction of safe harbors as needed.

A port serves as the connection point between land and sea transport for both shippers and travelers, making strong land transport links essential, along with facilities for storing, handling goods, and processing passengers. Ports can be an added expense for shippers, potentially hindering trade, so efforts are made to minimize these costs to foster trade and promote port growth.

From an economic standpoint, a port acts as a gateway to the advantages of international commerce, which is why governments often support and may subsidize key ports. However, ports can also facilitate undesirable activities like smuggling and, more recently, terrorism.

For port managers, a port represents a business that, when managed effectively, can generate profit. On the other hand, poor management can lead to financial losses. In a national context, the strategic significance of non-financial goals for a port can be considerable.

Even with shifts toward more technologically driven operations, a port continues to be a source of direct and indirect employment for the numerous businesses linked to its functions.

A port serves various functions to address the diverse needs of its stakeholders. In this lecture we will examine the different types of ports and their roles. It will also discuss the importance of a port within the framework of international trade.

THE INFLUENCE OF PORTS ON ECONOMIC GROWTH

When a nation embraces global trade, it benefits from more than just access to essential resources. Trade enables a country to focus on producing goods it excels at while importing those it produces less efficiently at lower costs. It fosters opportunities for businesses to adopt world-class management practices and cutting-

edge technology, creating expansive global markets that drive investment and innovation. Trade contributes significantly to national prosperity, and ports serve as the crucial gateways facilitating this exchange. However, as part of the transportation chain, ports can also pose obstacles to trade if not managed efficiently.

If a single port serves an inland market, it risks creating a monopoly, which often leads to elevated prices and inefficiency. This scenario burdens all goods passing through the port, amplifying costs for industries reliant on its services. Historically, the solution has been state or community ownership, such as trust ports in the UK. However, while state ownership may control pricing, it can introduce its own inefficiencies, which continue to hinder trade.

Where a port does not have enough capacity to function, it can disrupt trade and hinder the economic growth of the entire inland region, known as the hinterland, that the port serves. When ports are congested, ships face long waiting times for berths, which forces shipowners to continue paying crews and other operational costs without generating income. These congestion-related expenses may be transferred to shippers as surcharges. In severe cases, persistent congestion can even lead shipping lines to avoid a particular port altogether.

However, ports that are efficient, with the capacity to handle demand and quick goods clearance systems, help reduce costs. Greater efficiency boosts trade, which in turn drives production, creates jobs, and opens up new markets. The port's role in stimulating this economic multiplier effect is a key factor in regional development.

Ports can become bottlenecks, hindering the smooth and efficient flow of goods due to various inefficiencies, particularly organizational ones. Large ports are ideal for industries that rely on imported bulk raw materials. Over time, clusters of related industries often develop around these core sectors. Storage and distribution hubs are commonly situated within or near ports, enabling opportunities to enhance the value of imported or exported goods. These value-added activities may include packaging, re-packaging, labeling, testing, tracking and tracing goods in transit, and contributing to the flow of organizational information.

GLOBAL TRADE AND SHIPPING

The expansion of global trade, driven by globalization, has necessitated advancements in port capacity and efficiency to accommodate the increased demand.

Global production and consumption patterns have shifted due to globalization. Manufacturing firms can now relocate their operations to regions in the east where labor is more affordable than in Europe and North America. Cost-effective sea transport enables goods to be sent back to western markets, ensuring profitability. Additionally, the manufacturing process can be spread across multiple countries, with components produced in different locations, assembled in another, and then distributed globally for sale.

Global markets foster competition on an international scale, leading to a decrease in the cost of goods due to global competition. This push to lower costs has a direct effect on the transportation sector. By developing unitized cargo systems, most notably through the use of containers, the shipping industry was able to reduce the cost of shipping. This innovation significantly reduced the time ships spent in port from days or weeks to just a few hours. With increased mechanization, fewer dock workers were required. The benefits of economies of scale were quickly recognized, prompting the construction of larger ships—a trend that continues today. Mechanization and economies of scale have also resulted in smaller crews being needed to transport the same volume of goods. The growth in ship size has necessitated the development of bigger, more efficient ports.

Inland transport systems connecting ports to their surrounding areas have improved in response to demands for greater efficiency, leading to the advancement of road, rail, and waterway infrastructure. The hinterland areas for individual ports have expanded, sometimes overlapping with those of neighboring ports. This has intensified competition among ports. For instance, in northwest Europe, ports such as Hamburg compete with Antwerp, Amsterdam, and Rotterdam for container traffic. There is also regional competition among ports, including those in northwest Europe and the Mediterranean.

Ports play a crucial role in the global supply chain. When evaluating overall supply chain expenses, ship owners do not choose ports solely based on the cost of port services. For instance, Rotterdam has become the leading port in Europe due to its deep-water accessibility, high-efficiency terminals, and strong connections via road, rail, and inland waterways to central Europe.

The total supply chain approach to cost management has also influenced the growth of air cargo transport and its effect on sea freight. A significant aspect of distribution expenses involves the financing of goods. Compared to air transport, shipping by sea is generally slower and less reliable, which is one reason maritime lawyers play an essential role. High-value and perishable goods are usually shipped by air, while lower-value goods with less urgency are transported by sea. Shippers face specific requirements, with factors such as physical handling and document processing at ports playing a crucial role in determining the preferred mode of transport.

Some multinational corporations have leveraged its expertise to develop, own, and manage terminals across the world. This trend of multinational ownership has generally led to higher expectations for enhanced standards and operational efficiency at ports. Advancements at one port or terminal often inspire similar improvements elsewhere, thereby boosting competition among ports.

PORT LOCATION OVERVIEW

Ports are established to meet the economic need for transferring goods between land and maritime transport. A port includes sea approaches that ensure access and protection, along with land-based infrastructure like quays, warehouses, and administrative buildings.

Even an excellent natural port site requires sufficient commercial activity to thrive as a commercial port. In the southwest of England, although there are numerous suitable port locations, only a few function as active commercial ports. For instance, Falmouth possesses ideal characteristics for access and shelter but lacks the volume of cargo generated by its surrounding area to sustain a commercial port operation.

The growth of cargo generation plays a key role in the advancement of commercial ports. Early ports typically developed alongside urban settlements, often situated at the lowest river crossing points. Ships of that era were small enough to dock near the shore, allowing cargo to be transferred directly to and from wagons. As settlements expanded, the demand for shipping services rose, leading to the construction of river berths and long quays for efficient cargo handling. The industrial revolution, with advancements in shipbuilding, spurred the creation of artificial docks. The need for regular steamship services led to the introduction of enclosed dock systems. As trade flourished and ships grew larger, new docks were established further downriver, closer to the sea, a trend seen in many river ports.

The Pool of London, located on the River Thames, was historically the hub for cargo handling. Over time, enclosed docks were constructed to accommodate the growing needs of trade and shipping, with operations gradually shifting towards the Thames Estuary, culminating in the development of the Port of Tilbury. In 2013, a new container port, London Gateway, was opened further downstream. This port was developed to provide the required capacity for London and the southeast of England to meet the future demands of the container shipping industry.

Old ports often maintain a historical significance even after becoming obsolete due to advancements in technology. To fund the development of areas further downstream, these outdated docks in city centers can be repurposed as valuable real estate for modern projects.

In some cases, governments have selected locations for new ports and declared them as officially recognized ports. The factors influencing site selection can be complex and not solely based on geographical or commercial convenience. Gaining legal recognition as a port can generate demand, fostering growth and additional demand. When competition is limited or nonexistent, ports that are established through proclamation have the potential to expand and thrive.

Ports can be designed or expanded to focus on a specific commodity with consistent demand. For example, Port Hedland in Australia primarily serves as an export hub for iron ore, which is transported by train from inland mines. These types of commodity ports don't require a large local population or extensive surrounding area to function effectively. At times, the port may even perform activities like refining or concentrating the commodity, such as processing iron ore for better transport efficiency. However, the port may cease operations once the commodity decreases.

Modern port development is increasingly occurring on both greenfield and brownfield sites, offering large areas of affordable land.

These locations typically feature short, deep-water access points and efficient inland connections to a broader hinterland. Additionally, the presence of skilled labor, robust industrial infrastructure, and a focus on environmental considerations are key factors that contribute to the appeal of these sites.

PORT TYPES

Ports can be categorized based on either their geographical characteristics or their functional activities.

GEOGRAPHICAL PORT TYPES

Understanding the geographic location of a port can reveal its operational strengths and limitations. For instance, some ports require costly and environmentally impactful maintenance dredging, while others do not. Additionally, while a mountainous fjord may provide natural shelter and deep waters, it might not have the dense urban centers that produce significant cargo traffic. Key types of geographical ports include:

The Ria: A ria is a submerged river valley, formed by rising sea levels following an ice age. The deepest parts of a ria are typically in the narrow sections where strong currents help maintain a clear seabed. Examples of rias include the harbors of Sydney, Brest, San Francisco, and Plymouth.

Tidal Estuaries: Flat, tidal estuaries, such as the Thames Estuary leading to London and the Elbe Estuary providing access to Hamburg, can be dredged to create deep-water channels. These estuaries have beds made up of loose, post-glacial deposits.

Delta Regions: The submerged delta of the Rhine-Meuse-Scheldt system has facilitated the growth of key European ports like Rotterdam and Antwerp. As rivers slow upon reaching the sea, sediment-rich waters deposit silt, forming sandbanks. Regular dredging or clearing of silt is needed to keep port access open, and new channels can be created through these deposits. Dredged materials can be repurposed to create additional land for industrial port expansion.

Coastal Submergence Post-Glacial Period: Coastal submergence after the last glacial period, combined with river and weather erosion, has formed geographic features suitable for port construction, as seen in Southampton and New York.

Artificial Harbors: Artificial harbors are constructed by extending walls, known as moles, into the sea. Building and maintaining these structures is costly, and without regular dredging, silt accumulation can become a significant issue. If an artificial harbor cannot accommodate increasing ship sizes, it may require expansion or risk becoming obsolete. Dover in the UK and IJmuiden in the Netherlands are notable examples of successful artificial harbors.

Non-Tidal River Ports: Non-tidal river ports are located on rivers such as the Amazon, Mississippi, and Rhine. These ports can be affected by seasonal water level fluctuations and changing channels. However, they provide cost-effective, eco-friendly transport options to inland regions.

FUNCTIONAL ACTIVITIES OF PORTS

Ports can be categorized based on their main activities. Within larger ports, specialized terminals manage various operations. The primary types of operational ports include container ports, multipurpose ports, bulk ports, ferry ports, and cruise ports.

Container Ports: Container ports are classified into four main categories: direct call ports, hub ports, transshipment ports, and feeder ports.

Direct Call Port: A direct call port features dedicated container terminals designed for high-volume container handling. These ports are connected to rail, road, or barge networks for efficient container movement. Shanghai, the world's busiest and largest container port, had a throughput of 43.5 million TEU in 2020 despite the impact of Covid pandemic.

Hub Port: A hub port functions as a key center for container transportation, utilizing both mainline container vessels and smaller feeder ships. The creation of a hub port does not always require an adjacent industrial area. This type of port serves as a distribution point for containers across a large maritime region. An example is the Port of Algeiras in Spain, strategically positioned between the Atlantic and the Mediterranean, linking regions such as West Africa, Asia, Northern Europe, and the Americas. Algeiras is among the key European hub ports utilized by Maersk Line, alongside Tangier (Morocco) and Rotterdam (Netherlands).

Transshipment Port: A transshipment port is used for transferring containers between different mainline ships. Only a limited number of containers move inland from these ports. Singapore, known as the world's busiest transshipment port, handles around one-seventh of global transshipment volume, with over 33.5 million TEUs processed in 2014. It is a critical node for approximately 200 shipping lines connecting to over 600 ports in more than 120 countries.

Feeder Port: Feeder ports are smaller ports that supply containers to hub ports within a defined region. Teesport in the UK is a European example, facilitating around 20 weekly services to major hub ports like London Gateway.

Multi-purpose and Fruit Ports: In developing regions, less specialized ports still exist to handle various types of cargo. These ports, including multipurpose and fruit ports, are essential for countries with limited container infrastructure.

Multipurpose Port: Some nations face challenges due to underdeveloped hinterland transport systems, which restrict their ability to leverage containerized cargo.

Multipurpose ports are common in trade routes where traffic is lower, making it economically unfeasible to build specialized container facilities. These ports are often a precursor to more specialized developments.

Fruit Port: Ports dedicated to handling fruit require specific facilities for loading, unloading, and storage. These include chilled warehouses and equipment for palletized handling. The rise of refrigerated (reefer) containers has influenced traditional systems. Seatrade, a leading reefer operator, manages shipments such as citrus from Turkey to Europe and tropical fruit from Central America to Europe. Northern European ports like Rotterdam, Antwerp, and Hamburg host specialized fruit terminals, with Antwerp handling substantial volumes of bananas annually.

Bulk Ports: Bulk ports cater to significant volumes of dry and liquid commodities transported globally.

Dry Bulk Commodity Ports: Five main dry bulk commodities dominate maritime trade: coal, iron ore, grain, phosphate, and bauxite. In 2013, these totaled 2.92 billion tonnes, 44% of total dry cargo trade. Major exporters include Australia, Brazil, and Indonesia, while China and India lead in imports. Qinhuangdao in China is a leading dry bulk import port, handling 250 million tonnes of coal in 2013.

Liquid Bulk Commodity Ports: Ports for liquid bulk cargo, such as oil, are situated near production and consumption areas—for example, export ports in the Middle East and Gulf of Mexico and import ports near refineries like Milford Haven. The emergence of fracking and renewable energy is reshaping trading patterns. Liquefied natural gas (LNG) is a growing sector needing specialized facilities, such as the South Hook LNG terminal in Wales, which covers 25% of the UK's gas needs.

Coastal Bulk Ports: These ports often specialize in particular bulk cargoes like oil products and scrap metal, supporting coastal trade.

Ferry Ports: Ferry ports facilitate the transport of passengers and vehicles and are crucial for connecting islands with mainland areas. A ferry port has infrastructure such as ramps, parking, and administrative buildings to support efficient operations. Dover is the busiest, managing millions of passengers and vehicles annually.

Cruise Ship Ports: The growth of the cruise industry has driven the need for specialized ports offering passenger amenities and ship services. These ports serve as stopovers or turnaround points, providing facilities for boarding, disembarkation, and provisioning. The Port of Miami is known as the global cruise capital, handling over four million passengers annually. Southampton in the UK is a major cruise port with dedicated terminals.

ROLES AND FUNCTIONS OF PORTS

Ports serve a range of essential roles that can be categorized as traditional, transport or transit, industrial, and network functions. When analyzing these roles, it is crucial to understand their interconnected nature.

TRADITIONAL ROLES OF PORTS

From a broad perspective, ports are integral links within the overall transportation network. They offer storage facilities for goods until they are dispatched to their final destinations. These storage facilities can vary widely, from basic parking areas for vehicles to vast tank farms that can store millions of barrels of crude oil. Ports also serve as strategic locations for various types of industry, particularly those that are heavy or closely related to shipping activities.

TRANSIT FUNCTIONS OF PORTS

Ports not only connect different parts of the transport network but also facilitate the transshipment of goods, enabling their transfer between different transportation modes. This function supports the continued movement of goods beyond the port to their ultimate destination. Transshipment can involve transfers from sea vessels to barges, railcars, trucks, or aircraft. The process is increasingly seen between large seagoing vessels as well. The nature of the transport mode used depends on factors such as the type of cargo, journey length, and geographical conditions.

The storage capability of a port complements its transport role. Since ocean-going vessels typically carry much larger volumes than inland transport vehicles, the cargo must often be divided into smaller shipments for overland transport. The provision of storage addresses logistical needs for both perishable and non-perishable goods awaiting further transportation.

INDUSTRIAL ROLES OF PORTS

The industrial function of ports is a natural extension of their transport and transit roles. Transshipment involves handling costs and onward movement in smaller, often more costly transport modes. This economic reality has encouraged industries, especially those processing raw materials, to establish operations within port areas. Ports require significant infrastructure, including waterways, ship berths, roads, railways, and designated industrial areas. These facilities demand substantial long-term investments and play a crucial role in shaping the economic and physical landscape of the region.

Network Roles: Hub-and-Spoke Ports and Load Center Concept

The growth of containerized shipping has transformed port usage patterns. To maximize scale economies, ports serving regular liner services have specialized. Two main types have emerged: hub ports and feeder ports. Hub ports, also known as load centers, serve as primary points for container handling. In contrast, feeder ports are smaller and handle lower cargo volumes.

Hub ports function as central nodes in a network of feeder ports, creating a system known as a 'hub-and-spoke' model. Containers are transported to the hub and then distributed outward along the spokes. This concept is similar to air transport, where large aircraft serve major hubs and smaller planes handle feeder routes. The strategic importance of a port's location, particularly in container shipping, significantly influences its value within a shipping company's route structure.

PORTS AND INDUSTRIAL DEVELOPMENT AREAS

Ports are strategically located to foster industrial and economic growth. These areas are categorized into three main types: free ports, Maritime Industrial Development Areas (MIDAS) ports, and Industrial Development Zones (IDZs).

• Free Ports

A free port, also known as a free trade zone or export processing zone, is a secure port area where customs duties are not imposed. These zones are designed to attract manufacturers and processors for both domestic and international markets. Goods can be stored without customs duties and can be processed or value-added before re-exportation. This system supports economic development by enabling duty-free transactions. The Port of Aden is an early example that utilized its free port status to attract shipping, while the Suez Canal Container Terminal, aiming to become the largest in the Mediterranean, also benefits from free port status.

MARITIME INDUSTRIAL DEVELOPMENT AREAS (MIDAS) PORTS

MIDAS ports emerged in Europe during the 1960s to support heavy industry, intensive land use, and the need for water-based transport, which collectively drove industrial growth. Examples include Teeside in the UK and the Botlek area in Rotterdam. However, with the decline of heavy industries, these areas shifted focus towards lighter industries.

INDUSTRIAL DEVELOPMENT ZONES (IDZS)

As heavy industry and manufacturing shifted from traditional industrial centers to Asia, a modern form of MIDAS, known as Industrial Development Zones (IDZs), was established. IDZs are connected to international seaports and function similarly to MIDAS, promoting economic development with a focus on environmental sustainability. Notable IDZs are found in China, India, and South Africa.

• Container Transshipment

Transport efficiency is enhanced by economies of scale, reducing costs per unit. Container ships have increased in size, with the largest now holding over 19,000 TEUs. Container shipping companies are consolidating their operations at fewer major ports, leading to the development of hub-and-spoke networks. These hubs serve as key centers for regional container operations. Transshipment is facilitated through partnerships between shipping companies and ports, which help fund large-

Joint ventures also enable the creation and use of dedicated container terminals, allowing shipping lines to manage terminal and landside operations, maintaining the cost benefits of large ships by minimizing inefficiencies.

- **Intermodalism**

International containerization became viable after the International Organization for Standardization (ISO) set standardized external container dimensions in 1965. This standardization, including lengths of 20ft and 40ft, a maximum width of 8ft, and heights of 8ft or 8ft 6in, allowed for seamless transfers between different transportation modes. These standards, along with standardized documentation and electronic data transmission, enabled shipping companies to provide door-to-door services and track containers throughout their journey.

Container terminals play a pivotal role in the intermodal system, serving as transfer points where delays can occur. Reducing container dwell time—the period containers remain at the terminal—improves overall efficiency. Factors contributing to dwell time include transportation delays, documentation, customs procedures, and security clearances.

Electronic Data Interchange (EDI) facilitates document exchange between exporters, importers, shipping companies, ports, and customs authorities. Advanced customs clearance can expedite outbound shipments, though some developing countries may only allow customs processing at ports, potentially causing delays and impacting port capacity.

PORT OWNERSHIP OVERVIEW

Historically, many ports were under public ownership, which served to shield users from potential monopolistic practices. In countries with underdeveloped financial markets, public funds were often used to finance port development. Public ownership was logical, as it provided ports as public services, avoiding the privatization model where profits could be prioritized over trade and economic benefits.

MODELS OF PORT OWNERSHIP

PRIVATE PORT

A private port is managed by private entities but remains under the regulatory oversight of the government. This model allows ports the flexibility and competitive edge needed to adapt in the market. In the late 20th century, the United Kingdom transitioned many state-owned and trust ports to private ownership, aiming to:

- Enhance efficiency through competition;
- Facilitate fundraising through open market access;
- Lessen public sector financial obligations.

This shift enabled port and terminal managers to experience new levels of freedom and accountability, with infrastructure investments often supported by venture capital.

LANDLORD PORT

In a landlord port model, the port authority (often a state or municipal body) owns the port infrastructure, while private companies own and operate the superstructure, such as warehouses and equipment. These private firms lease space from the port authority and handle various services, including stevedoring and pilotage.

TOOL PORT

In a tool port, the port authority owns both the infrastructure and superstructure but does not provide operational services like stevedoring or pilotage.

SERVICE PORT

A service port is one where the port authority owns and maintains all facilities and directly provides the full range of port services. This model is still prevalent in many developing nations.

CURRENT TRENDS

Globally, there has been a movement from state-run service ports to public-private partnerships (PPPs). Decentralization from direct government control is also common, as state-run ports have often been seen as less efficient, with political influences overriding commercial interests. Modern ports face strong competition and complex management due to the interconnected nature of transportation networks, including motorways, railways, and inland waterways.

PORT ACTIVITIES

Port activities are managed by various entities, including the port or harbor authority, port terminal operators, and service organizations.

PORT OR HARBOR AUTHORITY

This body is legally mandated to oversee port infrastructure development and maintenance. In a landlord port, its key responsibilities include infrastructure and spatial planning, environmental management, operational services, finance, marketing, personnel management, and real estate maintenance. The harbor master handles environmental safety and security.

PORT TERMINAL MANAGEMENT

Large ports have multiple terminals dedicated to specific types of trade. In a landlord port, terminals are leased to private operators who manage policies and business activities.

For example, a container terminal's management team handles operations, maintenance, marketing, IT, accounting, and support services.

SERVICE ORGANIZATIONS

These organizations are responsible for specialized activities such as stevedoring, pilotage, and security. They have their own management and report to the port or terminal to ensure high standards of service.

