

Shipping and Logistics Management

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Preface

This book serves to consolidate the knowledge we have acquired from being educators and researchers of the shipping and logistics industry. It is our aim, in synthesizing the principles of shipping, to describe the core elements and to discuss pertinent strategic and operations issues in the industry. We also aim to share research outputs that promote best practices in and improve the management of shipping and logistics activities.

The book is organized in four parts. Chapters 1–4 present an overview of the shipping business. The shipping business is essential to the development of economic activities as international trade needs ships to transport cargoes from places of production to places of consumption. Chapter 1 discusses several basic questions in the shipping business and these include the following: Why is there demand for shipping? What is a shipping system? Who are the actors in shipping? Chapter 2 examines the freight rate mechanism in the shipping market and introduces the concept of the “shipping cycle”. There are four separate but interrelated markets in the shipping industry, namely, the freight market, which trades sea transport, the second-hand market, which trades used ships, the new building market, which trades new ships, and the demolition market, which deals with scrap ships. These four shipping markets are closely interrelated. Chapter 3 provides managerial insights into the four shipping markets and explains how these shipping markets are related to each other. In analysing the container shipping industry, it is desirable to understand the factors influencing the capacity of the bulk shipping industry, explain how these factors affect the container shipping market grounded on a sound theoretical framework, and find empirical evidence to examine these relationships. Chapter 4 reports a study in the container shipping industry based on the industrial organization paradigm that “industry structure determines the conduct of firms whose joint conduct then determines the collective performance of the firms in the marketplace”.

Chapters 5–8 discuss issues related to shipping operations. Strategy is important in shipping because it facilitates the identification of business opportunities, gives an objective view to solve business problems, provides a framework to im-

prove internal and external collaboration, assists in controlling business activities, minimizes the negative effects when threats arise, helps make better decisions, guides effective allocation of resources, provides methods to manage changes, and nurtures consistency in the management of the shipping business. Chapter 5 discusses the development and implementation of shipping strategies. An important factor affecting organizational performance relates to the continuous growth of firms. Chapter 6 analyses the decision of capacity adjustment in the container shipping industry with empirical evidence. In container shipping, carrying capacity is one of the essential resources to sustain business growth. Although deployment of mega ships is a popular means by which carriers achieve efficiency gains, a balance between ship size and the scope of service is required when they determine their fleet mix. Chapter 7 examines how fleet size in terms of the number of ships and the average ship size can influence the performance of shipping firms. In addition, the SCOPE framework, identifying service frequency, customer value, optimal vessel size, ports of call, and extensive market coverage as the important elements for determining fleet mix in shipping services, is presented for managerial reference on the fleet size decision. Chapter 8 examines the liner shipping industry from the network perspective with a focus on developing an analytical framework for the development and operations of liner shipping networks.

Chapters 9–12 are related to intermodal transport, which involves door-to-door services encompassing ocean-going services and land-based transport services. Chapter 9 identifies the key actors in the container transport chain, including the primary customers, transport facilitators, and transport operators, and discusses their roles in container transport. The rise of intermodal transport has resulted in dramatic changes in the patterns of freight transport. In an integrated transport system, intermodal freight transport is characterized by various operations elements. Chapter 10 presents the INTERMODAL model using Hong Kong as an illustrative case to identify the operations elements of an intermodal transport system. Empty container management is a major cost item for many container shipping firms and reductions in handling costs can be profitable for them. Chapter 11 presents a model for managing empty containers with four major dimensions: strategic planning, procurement of empty containers, movement of empty containers, and technical efficiency. The importance of adoption of technology to enhance transport security has been well acknowledged in research and practice. Chapter 12 discusses the implications of the different types of institutional isomorphic forces affecting adoption of technology from the perspectives of container transport operators that have taken the initiative to adopt technology for container transport security enhancement and those that have followed other firms to adopt technology.

Chapters 13–16 focus on port management. Ports are places where there are facilities for berthing or anchoring ships and where there is cargo handling equipment to process cargoes from ships to shore, shore to ships, or ships to ships. Chapter 13 discusses the different roles of ports, the main facilities in container terminals, and the processes at container terminals. Chapter 14 starts with a discussion of the development of global container terminal operators and the inter-

organizational interaction model in analysing the container terminal community, followed by an evaluation of the efficiency of global container terminal operations. A PROFIT framework is provided for the reference of container terminal operators to plan and manage their operations and development. There is a need for the container port to operate as an “agile port” to cope with the uncertainties of the changing operating environment. Chapter 15 discusses the characteristics of agile ports. To facilitate the implementation of the concept of “agility” in ports, a ten-step implementation framework is presented. This structured ten-step approach provides a useful road map for the container port industry to adopt an agile port system. Chapter 16 focuses on discussing port development. The chapter begins with an introduction to the 4C forces (i.e., containerization, concentration, collaboration, and competition) to examine the operating environment of container shipping. With growing complexity in shipping services, there is a trend in the shipping industry to use the hub-and-spoke approach. In any shipping hub, firms involved in upstream and downstream activities operate together and their collective economic actions lead to the emergence of a transport complex economy.

This book consolidates selected research findings of significance and relevance to the practice of shipping and logistics management from our ongoing scholarly endeavours as educators and researchers in the field. We hope that the reader will find our book interesting and informative about the latest developments in the management and practices of shipping and logistics management.

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Chapter 1

International Trade and Shipping

Abstract The shipping business is essential to the development of economic activities as international trade needs ships to transport cargoes from places of production to places of consumption. In this chapter we discuss several fundamental questions in the shipping business. These questions include the following: Why is there demand for shipping? What is a shipping system? Who are the actors in shipping? Broadly speaking, sea transport can be divided into tramp and liner shipping. The purpose of tramp shipping is to provide convenient and economical transport for bulk cargoes that require cross-ocean movement. Bulk cargoes can be classified into dry bulk and liquid bulk. The demand for the transport of liquid bulk by sea is served mainly by the sector of tanker shipping. The main function of liner shipping is to satisfy the demand for regular cargo transport. Shipping and international trade are interrelated. This chapter also examines fundamental topics in the shipping business such as the sea transport system, international trade patterns, and international maritime passages.

1.1 The Importance of Shipping

Shipping is concerned with the transport of cargo between seaports by ships. “Shipping” is a term that is open to interpretation. For some, “shipping” means ships and seaborne businesses. For others, “shipping” refers to any mode of transport that moves goods between two geographical points. Trends in the shipping business are moving towards the concept of economies of scale in operations, the development of network-based management, and the adoption of technology to improve efficiency and effectiveness. The varied interpretations of shipping imply that the shipping business has become increasingly dynamic and complex.

Shipping is one of the world’s most internationalized industries. Shipping should not be viewed only from a narrow national perspective. Rather, it should be

looked at from a broad view of world development, particularly in the international trade sector (Farthing 1993). In studying the shipping business, we need to understand the world economy as well. Shipping is fundamental to international trade as it provides a cost-effective means to transport large volumes of cargo around the world. Shipping and seaborne trade have made possible the progression from a world of isolated areas to an integrated global community. For example, China and India have been rapidly expanding their export of industrial parts and products, and this resulted in a global shortage of cargo vessels in 2004.

Shipping as a core element of economic development has a long history. Adam Smith, the father of economics, considered shipping as a source of low-cost transport that could open up markets. Smith (1776) mentioned that “as by means of water carriage a more extensive market is opened to every sort of industry ... it is upon the sea-coast that industry of every kind naturally begins to subdivide and improve itself”. Water carriage facilitates specialization that enables products to be sold at low prices.

Movement of goods by sea is the economic lifeblood of many countries. The shipping business has been essential to the development of economic activities as business transactions and trade need ships to transport cargoes from the place of production to the place of consumption. This chapter starts by discussing some basic questions in shipping.

1.1.1 Why Is There a Demand for Shipping?

Demand for shipping services arises from demand for goods. Economists refer to merchant shipping as derived demand. The demand for a shipping service results from the demand for the goods that it transports. Freight, which generally refers to the cargo carried, is generally not transported to a location unless a demand for the product exists. Thus, demand for shipping is derived from customers’ demands for the product. The movement of cargo by sea transport comes about as a result of trade with one party (i.e., the consignor¹) selling commodities to another party (i.e., the consignee²).

1.1.2 What Is a Shipping System?

The shipping business involves the physical transport of cargoes from an area of supply to an area of demand, together with the activities required to support and facilitate such transport. A transport system involves three key components that

¹ The consignor is the person or company shown on the bill of lading as the shipper.

² The consignee is the person or company to whom commodities are shipped.

are used for the movement of goods, with nodes linking them together (Steenbrink 1974):

1. fixed infrastructure such as ports or terminals;
2. vehicles such as ships or barges using the fixed infrastructure to move cargoes;
3. organizational systems necessary to ensure that the vehicles and the fixed infrastructure are used effectively and efficiently.

A shipping network is a kind of transport system comprising sea lanes that link up ports, with connecting services provided by other actors in the shipping industry. Hence, shipping services involve a number of commercial activities, including the provision of infrastructure, the operation of vehicles, and the management of organizational systems such as enterprise resource planning, which is an information system that integrates all the operations and related applications for an entire enterprise.

1.1.3 Who Are the Actors in the Shipping Business?

Shippers seek shipping services to transport their cargo from a port of loading to a port of discharge. The principal contributors for hiring ships include exporters and importers, shippers and receivers, and consignors and consignees. The shipping business involves a number of actors to support and facilitate the transport of cargoes by sea. These actors include:

- *Shipowners*: Parties that own ships and make decisions on how to use existing ships to provide shipping services, when and how to buy new ships, and what ships to buy.
- *Shipbuilders*: Parties that build new ships and sell them to shipowners.
- *Scrap dealers*: Parties that buy old ships from shipowners for scrapping.
- *Terminal operators*: Parties that provide port services to ships, such as berthing and cargo handling.
- *Intermodal transport operators*: Parties that provide intermodal transport services for the door-to-door movement of cargoes.

Other actors in the shipping business that are closely related to the shipping business include:

- *Ship agents*: Companies that represent owners of the vessels, and are engaged in the routine business related to vessel arrival, operation, and departure of ships.
- *Charterers*: Entities that employ ships to transport cargoes.
- *Shipbrokers*: Specialist intermediaries between shipowners and ship charterers, or between buyers and sellers of ships.
- *Common carriers*: Transport operators that provide services to the general public at published rates.
- *Non-vessel-operating common carriers*: Transport operators that have no operating vessels but coordinate the provision of shipping services.

As shipping involves a number of business activities, the transport of goods by sea is important from an economics perspective for many countries. The shipping business is essential to economic development since international trade and related business activities rely on the efficiency and availability of shipping services. Sea transport and economic development always go hand in hand with each other.

1.2 Freight Market

Although the shipping business is an economic sector, there are important subdivisions in the sea freight market. The sea freight market is linked with ships that can carry different types of cargoes. Generally, the freight market can be divided into the tramp market and the liner market.

1.2.1 Tramp Market

The purpose of tramp ships is to provide a convenient and economical means to transport goods that require cross-ocean movement. One of the key characteristics of tramp shipping is to seek cargoes all over the world and provide flexibility in sea transport to satisfy the needs of world trade (Kendall and Buckley 2001). The tramp ship can be any vessel that does not have a fixed itinerary and mainly carries dry cargoes in bulk from one or more ports to one or more different ports. Tramp ships go from place to place depending upon where they can find cargoes. Tramp shipping mainly carries only one commodity at a time and usually carries cargoes from one shipper. In the tramp market, cargoes are carried at freight rates, whereby the terms and conditions are negotiated usually on a case-by-case basis. Tramp ships carry dry bulk cargoes that are used by many industries.

Bulk cargoes can be classified into dry bulk and liquid bulk. Demand for the transport of liquid bulk by sea is served mainly by the sector of tanker shipping. Ships designed for the transport of liquid in bulk are called tankers. The main cargoes carried in tankers are liquid and gas. Ships designed to carry liquefied petroleum gas (LPG)/liquefied natural gas (LNG) are referred to as LPG carriers or LNG carriers. The design and construction of tankers and those of tramp ships are different since these vessels carry different types of cargo. For example, the methods used for the loading and discharging of tankers are pumps and pipes, which are not used in tramps. Another distinguishing characteristic is the physical size difference between tankers and dry bulk ships. Owing to economies of scale, the larger a ship is for the transport of cargoes, the lower is the unit cost. In general, tankers are larger than bulkers. Tanker shipping was one of the first types of shipping to make use of this important concept to improve operations efficiency (Metaxas 1971). An example is the deployment of ultralarge crude carriers with a carrying capacity of over 300,000 deadweight tons.

1.2.2 Liner Market

A main function of liner shipping is to satisfy the demand for regular transport under which cargoes are transported through regular routes and with regular schedules. Liners operate according to a schedule of ports of loading and discharge, usually adhering to a published timetable with set conditions of carriage. They operate like trains of international seaborne trade (Farthing and Brownrigg 1997), with cargoes made up of a large number of different consignments from different shippers. Liner cargo is mainly made up of manufactured or partly manufactured goods. The majority of liner cargo is carried in containers. Containerization seems to have become a “must” for ports, as the provision of container facilities is considered to be one of the prerequisites for success in the new shipping business environment (Notteboom 2002).

Cargo liners are more expensive vessels than tramp ships because their building and operating costs are usually higher. For example, cargo liners usually deploy ships of speed higher than that of tramp ships. The full cellular container ships are separated into compartments, which enable containers to be dropped in vertically between systems of container guides and to be stacked in holds. Furthermore, several tiers of containers can be carried on top of the hatch cover. Their accommodation is larger, with more facilities and comfort than tramp ships. As the cargoes transported by liners belong to many shippers, the administrative processes of cargo liners are far more complex. As a result, both the construction and the operational costs of liners are higher.

1.3 World Economic Development and Shipping

The economic development in the nineteenth century predetermined the path of the world's shipping industry. Thanks to the industrialization of the West in the nineteenth century, the world experienced a boom in international exchange of goods, which brought an unprecedented boom of international trade by sea transport. The basis of the world trade system in the twentieth century originated in the West: it dealt with the flow of industrial goods from Europe to the rest of the world, as well as the flow of raw materials to Europe from the rest of the world. The pattern of seaborne trade changed from time to time. Some trade grew rapidly, some stagnated, and some declined. The West has maintained its leadership role in the global manufacturing of high-technology products, but there is no guarantee that this trend will continue.

Owing to changes in the world's production pattern, economic developments in emerging countries such as China and India have increasingly contributed to the shipping business by generating more cargoes for sea transport (Stopford 2004). China, India, and other emerging economies are favourably competitive not only in terms of their low-value-added, high-labour-content jobs, but also in

terms of their advanced manufacturing activities. Their path to prosperity is by means of utilizing the world's best manufacturing companies and the best technologies to employ their workers and build their economies. Increasingly, the exports of China and India to the USA are composed of advanced-technology products. For instance, Intel and Microsoft announced huge investments in India to build world-class infrastructure for more complex, high-value-added works (Panchak 2006).

Among the world's major emerging economies, known as BRICs (i.e., Brazil, Russia, India, and China), shippers are targeting cashing in on the growth of global trade. Rising demand from BRICs prompts liner shipping companies to increase their carrying capacity. For example, against the backdrop of growing demand for liner shipping services, shipping business leaders in Japan – NYK, MOL, and K Lines – have developed ambitious plans to expand their fleets. These three shipping companies increased their carrying capacity from 758,537 20 ft equivalent units (TEUs) (NYK 290,678 TEUs, MOL 246,895 TEUs, and K Lines 220,964 TEUs) in 2004 to 1,028,632 TEUs (NYK 349,040 TEUs, MOL 366,871 TEUs, and K Lines 312,721 TEUs) in 2008.

Seaborne trade has attained a growth rate of about 50% since 1990 (Morrison and Ward 2004). In 2004, it amounted to about six billion tons of goods annually, accounting for more than 90% of world trade by volume. This accelerating growth rate may be caused by China, which has become one of the world's biggest consumers of raw materials. Bulk trade has experienced booms on China's import side. On the other hand, China is rapidly expanding exports of manufactured parts and finished products. Chinese factories are producing huge quantities of seaborne exports. The majority of China's export goods are transported in container ships. This has resulted in a global shortage of ships, both bulk ships to serve China's imports and container ships to serve its exports. Therefore, since 2004, major shipping companies around the world have been aggressively developing their carrying capability and investing in vessel construction.

1.4 Sea Transport System

An important point to note in international trade is that emerging countries usually have a high trade volume and a high output level. For instance, much of the growth in bulk trade has centred on countries in Southeast Asia. For coal, the demand primarily comes from extra steam-grade coal imported into Japan and South Korea. Demand for iron ore mainly comes from China, whose imports totalled 208 million tons in 2004. China is now not only producing a quarter of the world's steel, but is also importing around 36% of global iron ore. On the other hand, containerized exports from Asia have increased dramatically since China has become the factory of the world in producing manufactured products. A study

from the Port Import–Export Reporting Service indicates that imports by the USA from China increased by 18.3% in 2003 (Mongelluzzo 2004).

The reasons for the high trade volume and high output level in emerging countries are summarized below:

- Emerging countries have greater needs for raw materials.
- Along the long road to economic development, local resources may be depleted and the need for import arises.
- Emerging countries, such as China and India, are able to supply low-cost labour to produce manufactured products for export.
- Emerging countries can afford imports as they have cargoes to export.

1.4.1 Shipping Intensity

It seems that economic growth generates international trade, which in turn creates demand for sea transport. Further to the relationship between seaborne trade and economic growth, we turn to discuss the concept of shipping intensity. Shipping intensity can be used to measure the propensity for sea transport in different economic sectors. Some economic activities have a higher propensity for sea transport. The concept of shipping intensity explains the relationship between economic activity and the level of sea transport being adopted. Table 1.1 shows the shipping intensity of different sectors of economic activity.

Agriculture, mining, and manufacturing are in general directly involved with trade, either through imports or through exports, where growth in these economic sectors usually generates demand for sea transport. On the other hand, businesses in the sectors of telecommunication and professional services generate fewer cargoes for shipping. Looking forward, economic activity is likely to shift away from trade-intensive sectors towards service sectors. Economic outputs are being directed towards value-added products/services. Changes in economic activity will have consequences for trade. In general, service-based economies use less sea transport. The new sources of job growth in economies and industries, such as software development, education, biotechnology, tourism, and business services, are less likely to be contributors for shipping demand.

Table 1.1 Shipping intensity

Economic activity	Shipping intensity
Agriculture	High
Mining	High
Manufacturing	High
Telecommunication	None
Professional services	None

1.4.2 Concept of Parcel Size Distribution

To explain how the shipping business approaches the task of transporting cargoes, the concept of parcel size distribution (PSD) is useful. A “parcel” is an individual consignment of cargo for shipment. For a particular commodity trade, PSD describes the range of parcel sizes in which cargo is transported (Stopford 2004). The use of PSD to determine the transport of bulk and general cargo is illustrated in Fig. 1.1.

PSD answers the question “which cargoes go in which ships?” Cargo of similar sizes tends to use the same type of shipping service. For example, movement of bulk commodities such as iron ore and coal requires the use of bulk carriers since the cargo parcels are big enough to fill an entire ship. On the other hand, for movement of general cargoes such as radios and watches container liner shipping services are preferred since these cargoes are mainly small consignments, which are too small to fill a whole ship, and it is better to load them with other consignments on a ship for transport to fully utilize the shipping space and spread out the shipping cost. Hence, the PSD concept is useful for classifying cargoes into “bulk cargo” and “general cargo” to determine how cargoes are to be shipped.

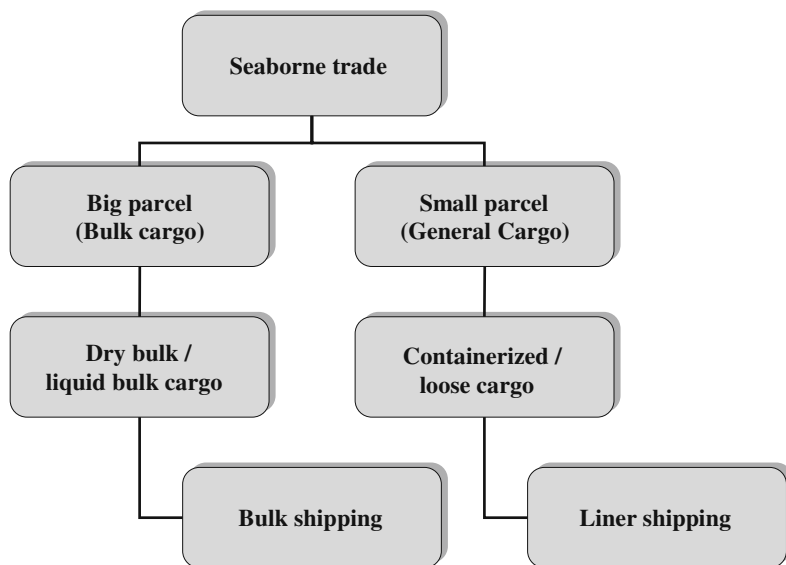


Fig. 1.1 Transport of bulk and general cargo

1.5 International Trade Pattern

Sargent (1930) commented that “the ultimate determining element in the employment of shipping lies in the sum of geographical conditions of each region in relation to other regions of the world, though the effect of such conditions may be modified greatly by economic or political policy on the part of individuals or government”. With over 80% of the world trade by volume being handled by ocean carriers, sea transport remains the backbone supporting international trade and accelerating globalization (UNCTAD 2008).

1.5.1 World Output and World Trade

Economic indicators such as world output growth and trade volume play a decisive role for shipping mangers to make business decisions on adjusting shipping capacity (Branch 1998). Generally speaking, there is a positive relationship between growth in world output and growth in world trade. Figure 1.2 presents the relationship between growth in GDP and trade volume from 2002 to 2007. The figure indicates a positive relationship between growth in seaborne trade and world output growth. A decrease in world output growth led to a decrease in both exports and imports. On the other hand, an increase in world output growth triggered demand for both exports and imports.

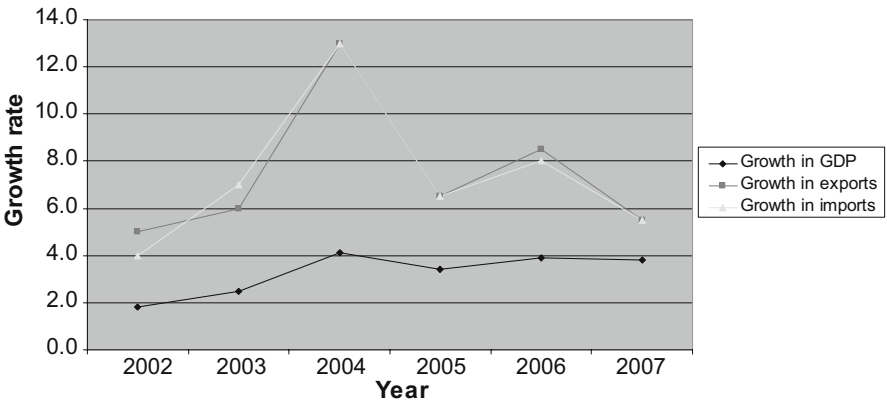


Fig. 1.2 Growth rate of world output and world trade. (Source UNCTAD 2008)

Figure 1.2 also shows that world exports and imports have been growing at a faster pace than world GDP. Globalization and trade liberation are the main drivers for this high growth rate in seaborne trade. World markets have become increasingly globalized. To a large extent, this reflects that the majority of, if not all, countries are adjusting to trade liberalization pressures observable around the world (Branch 1998). These pressures have led countries to form international trading blocs, such as the World Trade Organization (WTO) and the North American Free Trade Agreement (NAFTA). There are also other trading blocs such as the Association of Southeast Asian Nations (ASEAN) and the Asia-Pacific Economic Cooperation (APEC) to encourage the growth of intra-Asian trade.

These trading blocs have a common objective: to open up new trading opportunities by facilitating international trade. International trade brings widespread economic impact to local, regional, and national economies. The world's most massive industrial developments over the past two centuries first took place in Europe, followed by North America, and then East Asia. These trade patterns have shaped the ocean trade routes. The growth in international trade has led to a rapid growth in manufactured sectors, which represent the world's largest markets for seaborne shipment (Fleming 2002, 2003).

1.5.2 Overall Seaborne Trade

The volume of international seaborne trade increased significantly in the last few decades. Table 1.2 shows the development of international seaborne trade from 1970 to 2000. According to UNCTAD (2004), cargo transported by ships can be broadly classified into several categories, namely, seaborne trade in oil, main bulk, and dry cargoes. Oil includes crude plus products, whereas main bulk consists of five commodities, namely, iron ore, gains, bauxite, aluminium, and rock phosphate. Dry cargoes include minor dry bulks and liner cargoes. Since 2000, the patterns of international seaborne trade have been experiencing constant changes where minor bulks and liner cargoes have evolved as major shipping commodities, with their cargo volume loaded reaching 2,533 million tons. Tanker trade remains in second position, whereas main bulk is the least important in terms of cargo volume loaded.

Transport demand is affected by both the volume of cargo and the distance for transport, which determine the time it takes the ship to complete the voyage. Table 1.3 provides data on total demand for shipping services measured in ton-miles. Ton-miles is the tonnage of the cargo shipped multiplied by the average distance over which it is transported. In 2007, world seaborne trade was estimated at 32,932 billion ton-miles. With China and other countries seeking to diversify their sourcing of energy from distant markets, the number of ton-miles for crude

Table 1.2 Development of international seaborne trade (in millions of tons loaded)

Year	Oil	Main bulk	Other dry cargoes	Total
1970	1,442	448	676	2,566
1980	1,871	796	1,037	3,704
1990	1,755	1,288	1,285	4,008
2000	2,163	1,876	2,533	5,987

Table 1.3 World seaborne trade (in billion ton-miles)

Year	Oil	Main dry bulks	Other dry cargoes	World total
1970	6,487	2,049	2,118	10,654
1980	9,405	3,652	3,720	16,777
1990	7,821	5,259	4,041	17,121
2000	10,265	6,638	6,790	23,693
2005	11,749	9,119	8,730	29,598
2007	12,440	10,827	9,665	32,932

Table 1.4 World seaborne trade by region in 2007 (in percentage share of tonnage)

Region	Goods loaded	Goods unloaded
Africa	10	5
Americas	23	19
Asia	40	48
Europe	18	27
Oceania	9	1

oil and oil products increased by 2.5%. For all other dry cargoes, the number of ton-miles increased by 6.1%. The number of ton-miles for dry bulk cargoes is expected to grow continuously as a result of the need of China to import iron ore from new suppliers located in Latin America to meet its increasing demand for these raw materials.

Major loading and unloading areas are located in developing regions, followed by developed economies and transition economies. Table 1.4 shows the geographical breakdown of total goods loaded and unloaded by region. The results show that Asia ranked top in terms of percentage share of loaded tonnage, with a share of 40%, followed in descending order by the Americas, Europe, Africa, and Oceania. In terms of unloaded goods, Asia also ranked top, with a share of 48% of total trade volume, followed by Europe, the Americas, Africa, and Oceania.

1.6 International Maritime Passages

In discussing international trade, it is essential to consider the world geographical pattern. The basic features of sea transport are constrained by the world's geography. International maritime routes are forced to pass through specific locations corresponding to passages, capes, and straits. These routes are generally located between major economic zones, such as western Europe, North America, and East Asia. Figure 1.3 illustrates international maritime passages.

1.6.1 *The Panama Canal*

The Panama Canal is approximately 80 km long between the Atlantic Ocean and the Pacific Ocean (Panama Canal Authority 2009). This waterway cuts through one of the narrowest saddles of the isthmus that joins North America and South America. The Panama Canal uses a system of locks—compartments with entrance and exit gates. The locks function as water lifts: they raise ships from sea level (the Pacific or the Atlantic) to the level of Lake Gatun (26 m above sea level); ships then sail the channel through the Continental Divide. The Panama Canal handles about 12% of American international seaborne trade. In December 1999, the Panama Canal became the property of Panama under the jurisdiction of the Panama Canal Authority. The same year, Hong Kong port operator Hutchison-Whampoa took operational control of the ports at both the Atlantic (Port of Colon) and the Pacific (Port of Panama City) sides of the Panama Canal with a 25-year lease. The company also became involved in the improvement of the rail line between the two ports to handle the growing amount of containerized traffic. This



Fig. 1.3 International maritime passages