Transport Systems and Logistics Services

5

Learning Objectives

Transport services and logistics services are an integral part of logistics systems. This chapter aims to give an overview of the existing means of transport, the modes of transport and their services, the role that logistics service providers take, and the development they have undergone. In this way, we will equip the reader with a basic understanding of the concepts and service products within the transport and logistics service economy in order to utilize them for the various forms of co-operation.

Keywords

- Transport development
- Modes of transport and transport services
- Categories of modes of transport
- Transport networks
- Transport chains
- Transport technology
- Freight carriers and forwarders
- CEP service providers and integrators
- Contract logistics

H. Gleissner and J.C. Femerling, *Logistics*, Springer Texts in Business and Economics,
DOI 10.1007/978-3-319-01769-3_5,

5.1 Transport Basics

A *transport system* comprises the elements of the goods transported (transport object), the means of transport used (mode of transport, traffic routes), and the transport process as an organized transport sequence (transport chain). The process of service provision results in *transport services* being carried out. Transport services cause movements of people or goods. We can distinguish between internal and external transport services. Internal transport services, for instance, occur within a plant among different departments of a warehouse. External transport services take place between suppliers and customers or between plants and warehouses. Transport processes carried out without actual goods being transported are referred to as empty transport. The criteria for a transport service are a providing location, a destination, and the goods transported. Goods are generally not manipulated during the transport process, i.e., merely the technical process of changing location takes place. The transport service performance is measured in tonne kilometers (tkm).

Companies may use their own vehicles to carry out transport services. This is referred to as private haulage. There has been a tendency, however, towards logistics service providers being commissioned with the transport. The means of transport used for this include air, rail transport, road, and water; all of which are also termed *modes of transport*. The vehicles employed in these modes of transport are trucks, railway carriages, as well as inland and ocean vessels. The totality of both means and modes of transport is the pipeline network.

Transport service is a basic element of *logistics services*. These services comprise all relevant interdependencies between production, transfer, and consumption and are integrated into the value chains of senders and receivers. Apart from the transport component, logistics services also include the subservices of transshipment, storage, sorting services, and auxiliary services. Transshipment consists of the loading and unloading of vehicles. Storage serves to modify the temporal properties of goods and to bridge time. Sorting services, such as sorting and sorting out, alter the quantitative and categorical composition of goods. Auxiliary services include services such as packing, insuring, customs clearance, as well as less significant manipulations of goods and quality checks.

Production and cross-border consumption processes based on the fragmented work flow, and thus the *mobility of goods,* only become possible through transport, traffic, and logistics services in conjunction. The degree of the mobility of goods on a national level and cross-border transports are directly linked to the intensity of the exchange processes and to the level at which division of labor is implemented.

5.2 Significance and Development

The development of the transport and logistics sector largely depends both on the economic development, conveyed in terms of economic growth, and on the further development of the logistic structures and processes within the value adding

systems of the sectors of industry, trade, and service. These can be assessed by looking at the supply chain strategies of companies.

One of the main strategies is decreasing the vertical range of manufacture, i.e., the outsourcing of value-adding steps to suppliers and service providers. This strategy continues to become more popular, which results in a significant increase in the Europe-wide and world-wide flows of goods between companies. The increasing division of labour leads to more freight traffic (measured in tons) and larger transport volumes (measured in tons per kilometer). Both of these parameters are experiencing a growth which is disproportionate to the growth of production (GDP). This development is referred to as *volume of goods effect*. It conceptualizes a decrease in the share of typical bulk goods transported while the share of high-quality general cargo transported increases due to changed procurement and production strategies. An example of such strategies would be the modularization of products and the procurement of these modules (modular Sourcing), thereby increasing the value of the goods at each delivery stage. This development is termed *goods structure effect*.

Apart from an increase in the division of labor and growing site diversification, logistic processes are undergoing changes, especially in the transport sector. This is initiated by modern logistic concepts, including, for instance, the concepts of Just-In-Time (JIT), Efficient Consumer Response (ECR) or Vendor Managed Inventory (VMI) (see Chap. 7). These concepts require high-quality transport services, increased adherence to delivery dates, and speedy transport of small transport lots, i.e., the transport of small shipment sizes with high transport frequency. Effects resulting from this are sometimes referred to as *logistics effect*.

The so-called *integration effect* is brought about by opening up the national markets through free trade areas and WTO treaties in conjunction with an expansion of market and procurement areas, and by establishing world-wide production networks. Increased globalization amplifies these effects. Correspondingly, Global Sourcing, Global Production, and Global Distribution are strategies that are very common among companies. A striking indicator of globalization is, for example, the increased share of container cargo in maritime traffic (see Sect. 4.2.3).

An increase in freight traffic can be observed as a result of the ongoing Europeanization which was essentially fuelled by the creation of a single European market from the 1990s onwards. Additionally, we are seeing changes in distribution structures which are characterized by setting up European central warehouses – primarily in the Benelux countries. Furthermore, a tendency towards relocating production facilities to Central and Eastern European countries, such as the Czech Republic, Poland, and Hungary, has become apparent and individual production stages are increasingly relocated to different countries. In the next few years, these developments will contribute to a significant intensification of cross-border traffic between the EU and accession countries and the bordering countries in Eastern and South Eastern Europe.

All of the aforementioned trends have varying ramifications for transport and logistics service providers, which will be analyzed in the following.

5.3 Modes of Transport and Transport Technologies

5.3.1 Transport Value and Transport Affinity

To roughly assess modes of transport and transport technologies, we can refer to the concepts of transport value and transport affinity. In the following, these concepts will repeatedly be employed in explaining transport systems.

Transport Value defines the individual quality features of the transport modes. Closely related to this is the concept of *transport affinity,* which describes the requirements of the transport object or of the consumer, respectively. Thus, the key requirements are[1]:

- *Mass transport capacity:* capability of a means of transport to transport large volumes at low costs
- *Speediness:* Transport duration, transport speed, capability of a means of transport to quickly transport goods
- *Network-forming capability:* capability of carrying out spatially inclusive and comprehensive transport
- *Predictability*: Measurement for transport time reliability (timeliness) of transports
- *Flexible schedules:* Frequency of transport services, capability to adapt to changed schedules and requirements
- *Spatial Flexibility:* Capability of spatially relocating/integrating means of transport and transport capacities
- *Safety:* Measurement for accident frequency of transports and the amount of damage
- *Environmental impact:* especially the use of energy, pollutant emission, and noise emission

The basis for the individual transport modes' quantitative performance measurement is the tonnage transported. Annual reports on this are published by the Federal Office of Statistics (see Fig. 5.1).

By linking the net tonnage to the distance covered, statements about the transport performance of the modes of transport can be made (see Fig. 5.2). Both of these statistics are also an indicator of the economic development and sector attractiveness. Furthermore, they serve as a basis for traffic planning.

The market shares of the individual modes of transport are visualized in Fig. 5.3.

[1] Cf. Ihde (2001), p. 197 et seq.

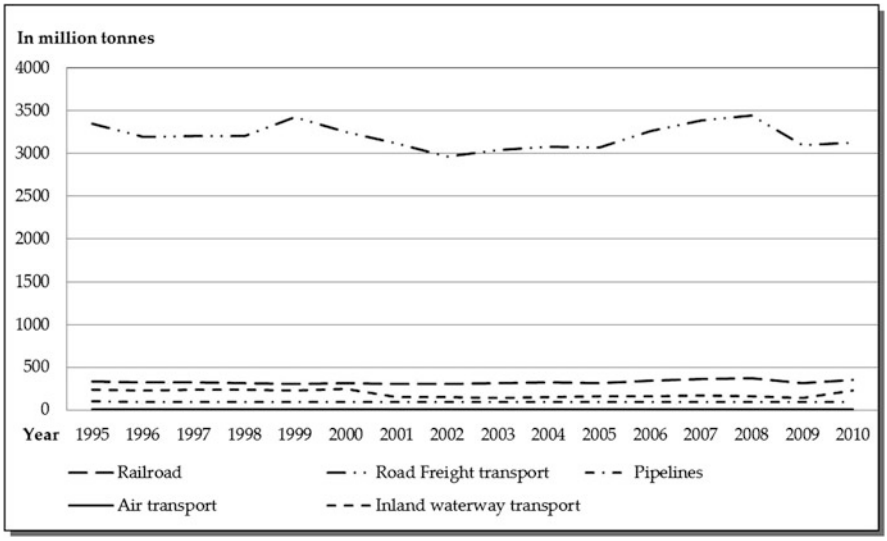

Fig. 5.1 Tonnage transported according to transport modes in Germany (Cf. BMVBS 2012, p. 240 et seq)

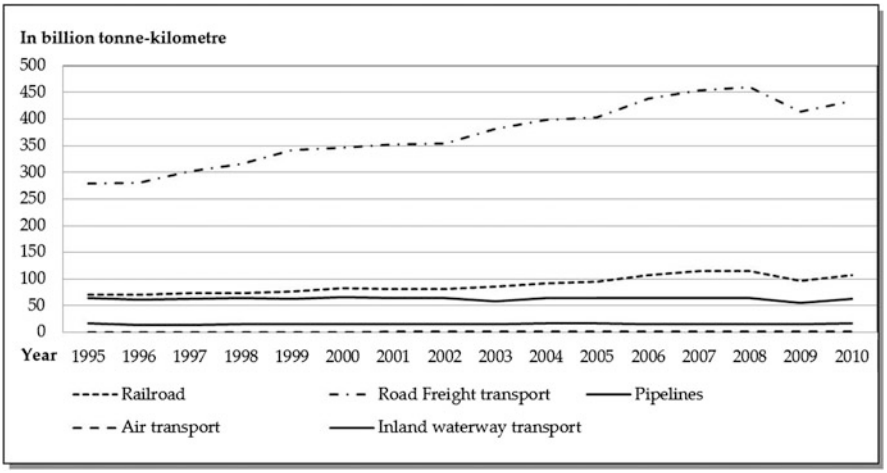

Fig. 5.2 Tonne-Kilometre performance according to modes of transport in Germany (Cf. BMVBS 2012, p. 244 et seq)

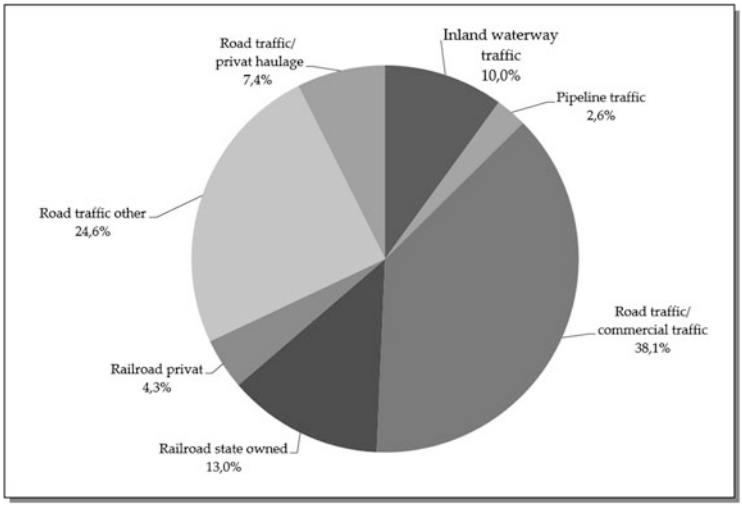

Fig. 5.3 Tonne-kilometer performance according to market share in 2011 in Germany (Cf. BMVBS 2012, p. 247; Bundesnetzagentur 2011, p. 19)

5.3.2 Road Freight Transport

Road freight transport is the most important mode of transport. With about 650,000 km of motor traffic roads, it constitutes the densest road network in the EU (see Sect. 4.2.1) and is therefore unrivalled for spatially inclusive and comprehensive logistic services. Road freight transport can be conceptualized by the characteristics listed in Table 5.1. Road traffic is highly controversial. For one thing, this is because of its environmental pollution through energy consumption, exhaust emission, noise generation, and traffic congestion. For another thing, state subsidies for traffic routes and the ongoing competitive distortion within Europe (despite liberalization) due to varying factor costs in the individual states (personnel, taxes, duties etc.) are cause for debate.

The most important distinguishing characteristics of road freight transport are shown in Fig. 5.4.

Commercial road transport is the transport of goods by means of motor vehicles in a business context or in return for payment. *Private haulage*, however, is transport carried out by industrial companies or commercial enterprises using their own vehicles. The distinction between short-distance and long-distance traffic harks back to the time when the governmental regulation of the transport market system will a significant impact on the supply and the market outcomes of road freight traffic. Capacity restrictions by granting concessions and tariff commitments to regulate pricing were supposed to increase or at least stabilize the train‘s market share compared to the truck’s market share, which eventually yielded no success. Additionally, national companies were to be protected against foreign competition by means of restrictive cabotage regulations. *Cabotage* is a foreign carrier’s permission to perform transports in a specific country, so long as they begin and end in the

Table 5.1 Important characteristics of road freight transport

Characteristics of Road Freight Transport
Good network-forming possibilites (i.e.. a good linkage between the primary elements of the traffic system is possible)
Speediness in conjunction with a relatively low transport risk (Direct delivery in door-to-door transport, transshipment and/or intermediate charging are only conditionally necessary or not necessary at all)
Rational utilization of the network (normally via groupage, delivery traffic and feeder traffic)
Utilization of vehicles specific to the volume of goods (silo truck and dump truck, refrigerated transport, tank transport, luggage transport, container transport, semi-trailer truck, high-capacity transport, heavy-load transport etc.)
Cost optimization and environmental-impact optimization by means of the piggy-back system with railway
In long-haul transport abroad, road freight transport is often used for the first and the last transport stages, e. g. pre-transport from sender to the sea-going vessel (sender) and onward transport from port of discharge to the buyer on the target market
Relatively short standstill periods and latency
High flexibility (with regard to acceptance dates, delivery deadlines, dates for transport and possibilities for new dispositions of goods and transport modes)
Complex competitive relationships (both within road freight transport and with other modes of transport)

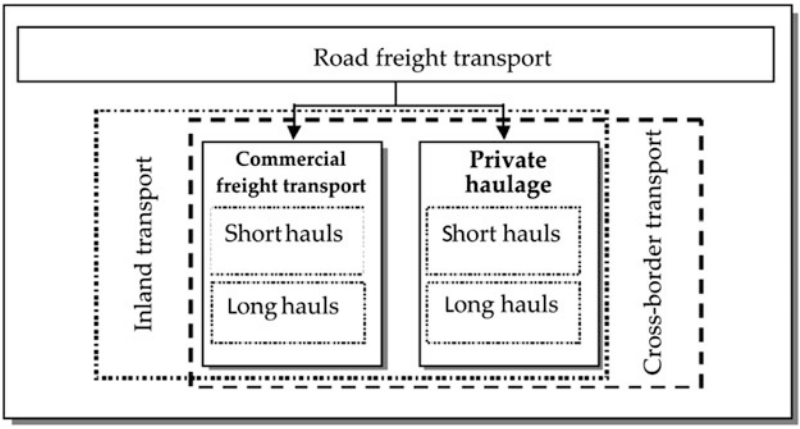

Fig. 5.4 Distinguishing characteristics of road freight transport

same country. Following the realization of free movement of services within the EU, the 1990s saw extensive deregulatory measures in the transport market, which resulted in free formation of prices and the abolishment of capacity restrictions.

High adaptability to the manifold and changing tasks of senders who service vast areas has made road freight transport the mode of transport which is most suitable to perform logistics services. In short-distance transport and long-distance transport up to 400 km, trucks are markedly faster than trains, both nationally and internationally. This is especially true for direct door-to-door transport relations.

Medium-sized service providers continue to be prevalent in road transport. Due to this, the transport services sector is having difficulties meeting the increasing requirements of senders. Individual carriers can only rarely service areas comprehensively, which is why they mainly work as subcontractors for major forwarders or co-operate with other providers.

5.3.3 Rail Freight Transport

The development of the railroad was essential for the industrialization and the establishment of raw-material-intensive base industries. In this respect, the advantages of rail transport in the form of scale advantages came into their own for bulk transports and long-range transports.

After the shift towards post-industrial economic structures, the railroad now has to meet different demands. The *volume-of-goods effect*, the *goods-structure effect*, and the *logistics effect* are increasingly changing the economic requirements compared to the traditional requirements the railroad had to fulfill. In addition, railroad transport has lost its erstwhile monopoly position on traditional mass-transport markets to inland vessel transport, pipeline transport, and road freight transport.

However, with rising environmental awareness and more bottlenecks in the road network, the railroad system is currently experiencing a comeback. This is supported by a trend towards containerization, which greatly enhances the possibilities of multi-modal traffic. An example of this would be the Hinterland traffic of sea ports. Furthermore, privatization has invited the development of innovative service offers, such as the Railport concept for cargo traffic suited to rail transport (see case study 4.1). Railports are simple and flexible transshipment points for general cargo, containers, bulk goods etc. between trucks and trains. A comprehensive network allows for main-run transports largely to be carried out by train, while pre-transports and onward transports are conducted by truck.

Table 5.2 summarizes logistically relevant and system-specific characteristics of the railroad in the context of freight traffic.

Figure 5.5 gives an overview of providers of rail freight transport services.

The efforts that have been made to privatize the so far dominant national railroads in Europe brought with them considerable changes for the rail freight transport market. These changes are part of a long-lasting process, since railroad transports have their legal basis in the German constitutional law and are therefore guaranteed. The privatization process of *Deutsche Bahn AG* and their efforts towards improving their capabilities of market cultivation have made great progress. A structural layout of *Deutsche Bahn AG* – Germany's main service provider of railroad transport – is depicted in Fig. 5.6.

Table 5.2 Important characteristics of rail freight transport

Characteristics of rail freight transport
Highly capable of performing mass transport resulting in low direct costs for production
Especially suited for long and direct mainland transport
Suitable for almost any kind of goods (for valuable, large-volume or bulky goods, for bulk-goods if there are no convenient connections via canals or rivers and for goods that cannot or may not be transported on the road)
Speediness in the case of block trains or direct trains without shunting
Timetables and rail-track allocation greatly ensure timely delivery. Relative independence from rush-hours in road traffic, holiday traffic and adverse weather conditions
Safe transport handling, especially when transporting hazardous materials, relatively environmentally friendly method of transport
Relatively low network density and thus limited possibilities for door-to-door transport, which entails costly and time-consuming transshipment activities. However, subsidies for railroad sidings to warehouses in industrial estates
Strict adherence to timetables and allocated train lengths
Low transport speed (more time required), especially in the case of single wagons due to the shunting procedures required for train formation and because of prioritized passenger service
Weak competition from foreign railroad competitors due to limited marketablity
Border delays due to varying technical requirements of country-specific railroad systems

By means of route allocation to third parties, other private service providers of railroad transport can enter the market. They mainly offer and run block train services. Figure 5.7 gives an overview of the different railroad transport services.

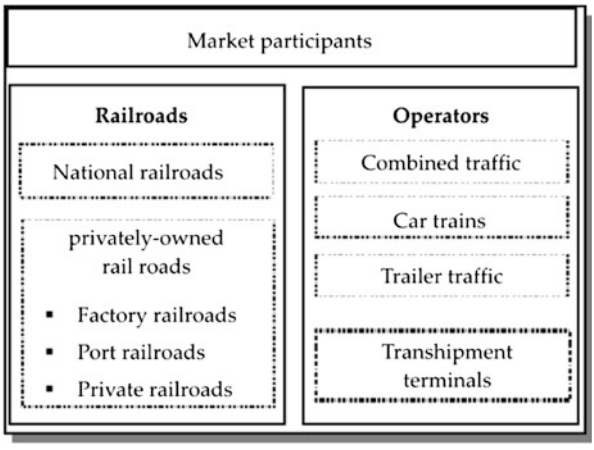

Fig. 5.5 Market players in rail freight transport

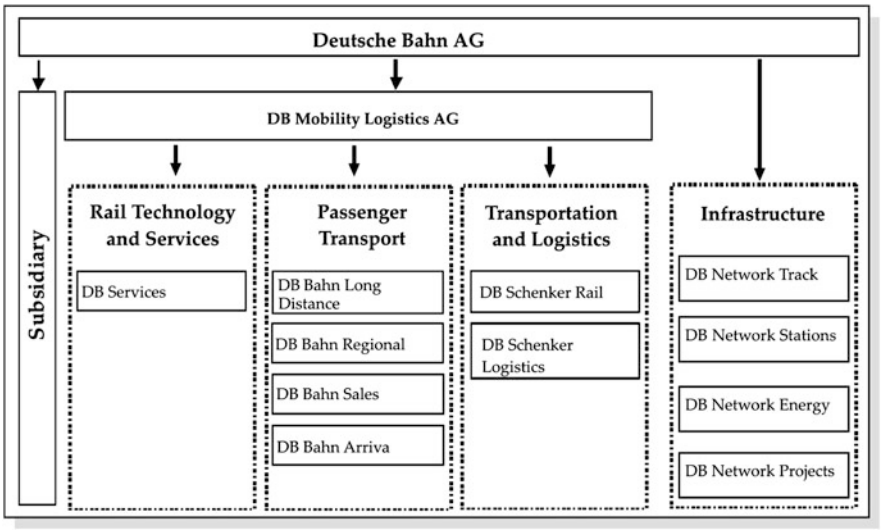

Fig. 5.6 Group structure of the Deutsche Bahn AG (Cf. Deutsche Bahn AG 2010)

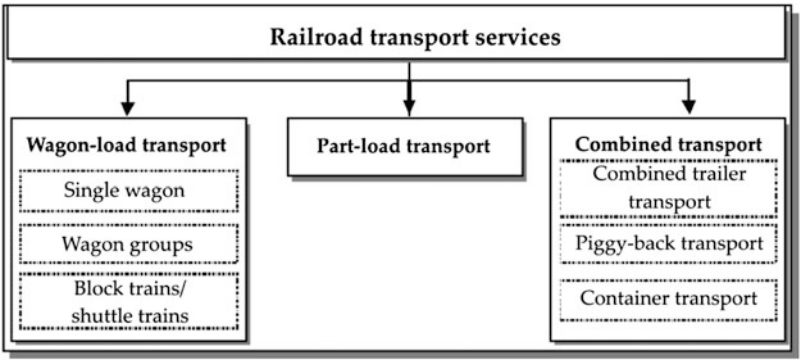

Fig. 5.7 Rail freight transport products

Wagon-load traffic is the transport of a major volume of goods as closed cargo by a means of transport. Characteristically, wagonload goods include goods such as agricultural and forestry produce, fertilizers, coal, ore, and quarrying produce.

Consignments below wagonload size are termed part loads and delivered by means of *part-load shipping*. This includes traditional general cargo above a package weight of 30 kg. Shipments like this are usually dispatched on pallets. Unlike road freight traffic, rail freight traffic is hardly used for part-load traffic any more. Such shipments are rather dispatched as consolidated cargo using combined traffic.

Single wagon transport is characterized by single wagons or small wagon groups which are loaded by customers who often have their own railroad siding and which

the railroad service provider then transports to the destination station. Effective train formation can be achieved by grouping together several customers' wagons with the same destination. Today there are flexible service offers that allow for single wagon transports to be freely commissioned on an international level with regard to time, volume, and relation. As a part of these services, 1,400 freight traffic locations and 4,000 private rail track sidings are being operated. Freight traffic locations are goods stations, public loading stations, or border crossings. Amongst other things, they serve as a basis for tariff kilometer calculations within the German rail network.

Block train traffic enables the transport of a customer's high volume of goods from sender to receiver in complete trains without en-route handling. This kind of transport is usually employed for price-sensitive bulk goods and breakbulk cargo which do not require speedy transport or different wagon types, e.g., raw materials and products of the mining or mineral oil industry and building materials.

Block train traffic in the form of *shuttle trains* or *direct trains* are high-quality services for linking production sites as well as for procurement logistics and distribution logistics. This type of transport services are customized by means of individual timetables and thus guarantee on-schedule delivery. Shuttle trains provide point-to-point connections with fixed sets of wagons and without further addition of wagons during transport.

Besides its product range of bulk train services (*flextrain, variotrain and plantrain*), *DB Schenker* has developed industry-specific concepts catering to the needs of, for example, the paper industry, the chemical industry, the waste management industry, and the mineral oil industry.

Carriers provide c*ombined cargo* services, which come in the form of bulk trains or groups of wagons. Here, different carrier wagons are employed for containers, swap bodies and trailers. Combined cargo has the benefits of speediness by taking advantage of favorable traffic conditions at night. Furthermore, loading and discharge take place at the production site or at the warehouse and containers may serve as intermediate or buffer storage facilities.

Combined transport is utilized if trucks, trailers, and swap-bodies are to be transported using piggy-back transport. In Germany, the handling process for this is implemented by the company *Kombiverkehr Deutsche Gesellschaft für kombinierten Güterverkehr GmbH & Co. KG*. Currently, there are 230 limited partners holding stakes in *Kombiverkehr*, of which 50 % are held by forwarders and carriers and another 50 % by *Deutsche Bahn AG*.

Kombiverkehr operates over 50 transshipment terminals. Their services include the *Kombi-Netz 2000+* service, which is a system of 26 trains that service 60 relations on weekdays and the *Albatross Express* service of the freight forwarder *Transfracht*, which connects the ports in Hamburg and Bremen to 18 Hinterland terminals using nightly container trains.

The future market potential of rail freight services is largely dependent on the continued development of logistically relevant services and of the capacities to implement them. Constructing exclusive cargo routes and separating passenger transport and cargo transport will be an essential prerequisite for this. Not only should this happen on a national level, but also on an international, cross-border

level, which calls for extensive deregulation in the EU-wide railroad sector. Furthermore, infrastructural, operational, and vehicle-related technical impediments need to be disposed of to enhance inter-operability.

Case Study 5.1: Railroad Usage in Industrial Logistics

BASF SE (*The Chemical Company*) is one of the world's leading chemical companies. Its subsidiary BASF Schwarzheide favors rail transport for the transport of their goods. The company's site in Lausitz produces a wide range of plastics, foam rubber, pesticides, and waterborne coatings. PU dispersions and Laromer® brands (coating raw materials) complement their portfolio. Feedstock, packaging, operating supplies, and technical goods are needed for the production process. The means of transport eligible for receiving and sending goods are tank wagons, covered freight wagons, road tank vehicles, trucks, various containers, and utility vans.

The development of economical, reliable, and environmentally-friendly transport concepts and their target-oriented implementation, as well as regular monitoring makes the site logistically attractive, even without direct connection to waterways. For the own transport volume and for other companies based on the same premises, BASF Schwarzheide GmbH uses an EU-wide block train railroad network provided by private railroad companies. This network connects BASF sites in Ludwigshafen, Antwerp, and Schwarzheide on a daily basis. The liberalization of the European rail freight traffic has allowed for competition to develop with *Deutsche Bahn AG* for these relations. This was the prerequisite for cost-effective rail freight traffic.

An international forwarder operates a public container terminal on the company premises in Schwarzheide (see Sect. 4.2.5). The terminal is being expanded to a hub for Eastern Europe with connections to Poland, Ukraine, and Russia. Plans to extend the connections to China are underway. The container terminal in Schwarzheide is connected to the German combi-terminal network, thus maintaining strong connections to Ludwigshafen and the whole of Europe. Various providers of combined transport services design and develop these networks in co-operation with partners and organize transports with different carriers.

A good railroad infrastructure and integration into the European block train and container network enable economical and high-quality rail transports. This provides immense potential for a shift from road transports to railroad transports. Customers, suppliers, the producer, and various service providers are included in the development of logistics concepts and transport concepts.

The transport system implemented at BASF Schwarzheide shows that cargo transport can purposefully be operated by rail (see Fig. 5.8). The transport shares in 2009 are:

Total traffic volume	100 %	1.8 million t
By rail	65 %	1.2 million t
By road	35 %	0.6 million t

In the future, the share of rail freight traffic is planned to be further increased at BASF Schwarzheide GmbH.

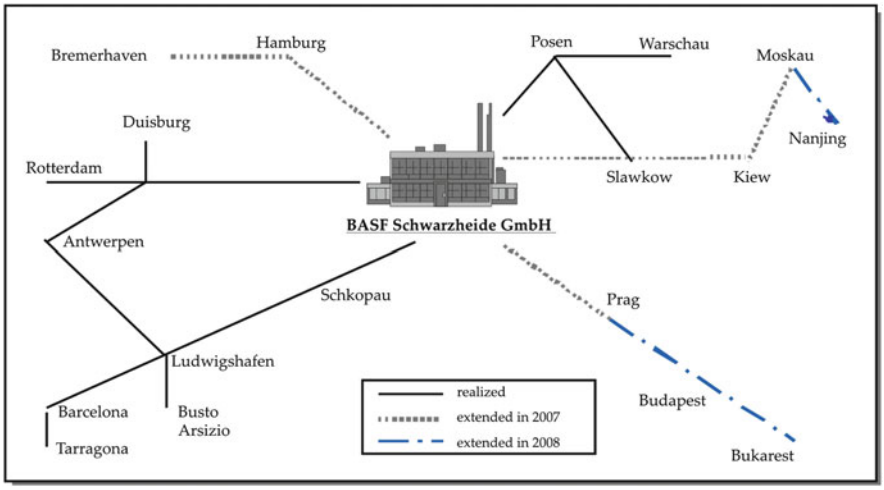

Fig. 5.8 Railroad transport network of BASF Schwarzheide GmbH (Cf. BASF Schwarzheide GmbH 2008)

5.3.4 Sea Freight Transport

International trade and international division of labor have only become possible through the development of maritime traffic. Transportation of goods by sea enables cost-effective transport of bulk goods over long distances. The most relevant characteristics for a logistical assessment of maritime navigation are shown in Table 5.3. The increasing containerization of consignments and shipments has been extremely conducive to the development of sea traffic. Containers bring with them the advantage of standardization (ISO standards), which may render the transshipment of goods unnecessary within a transport

Table 5.3 Important characteristics of sea freight transport

Characteristics of sea freight transport
Transport of large volumes of goods possible or usual
Especially suited for long-haul and intercontinental transport
Suited for almost any type of goods
Relatively cheap relation between transport cost and capacity (in € per tkm)
Rather high safety during transport
Relatively low transport speed (high time requirement)
Highly dependent on weather conditions

system and which makes it possible to change from one transport mode to another within a short period of time.

Thus, container shipping assumes a central role in maritime traffic and has greatly influenced the relevant transport and handling technologies as well as shipbuilding developments and ship sizes. High-performance container gantry cranes with handling capacities of over 55 containers per hour make it possible to load and discharge even the largest container ships within 1 or 2 days.[2] Quick discharge makes short laytime at the port possible. This reduces laytime charges in ports, enables speedy implementation of transport, and reduces the round-trip time of containers.

On the other hand, the development of goods volumes and ship sizes significantly influences the sea traffic and sea port infrastructures, leading to fewer ports in a specific area being navigable for large container ships (Main Ports) and to feeder services having to supply the main ports with consignments from smaller ports and Hinterland ports. Feeder services are small container ships capable of navigating canals and commuting between the large international container ports, smaller seaports, and inland ports accessible to coasters.

Some of the port infrastructure determinants are:

- Width and depth of fairway
- Wharfage, open space, and storage area
- Handling facilities, container gantry cranes
- Information and communication systems

Of major importance, alongside the infrastructure, is the port location. The following basic location factors of sea ports can be identified[3]:

- *Seafront location*: geographical location in relation to the main open sea traffic routes. Thus, for incoming ships via the English Channel the Antwerp-Rotterdam-Amsterdam range (ARA) is at a temporal advantage of about 1 day compared to the German North Sea ports.
- *Coast location*: proximity to open fairway. Thus, the ports of Bremen and Hamburg are at a distance of up to 100 km from the open sea.
- *Hinterland location*: economic area which operates its sea traffic via that specific port with varying expansion and depending on type of goods and transport modes. An example of this is the so called *Rheinschiene*, the route alongside the river Rhine.

Due to the large volume of exports, the ports with the world's greatest handling tonnage are located in Asia. The reception ports of Europe and North America are found among the lower ranks (see Table 5.4).

[2] Cf. Vis/Harika (2005), p. 58.

[3] Cf. Ihde (1991), p. 99 et seq.; Brinkmann (2005), p. 5 et seq.

Table 5.4 The world's largest container ports, 2010–2012 (Cf. Hafen Hamburg Marketing e. V. 2013)

Port	2010 (Volume handled in 1,000 TEU)	2011 (Volume handled in 1,000 TEU)	2012 (Volume handled in 1,000 TEU)	Change (compared to the previous year in %)
1. Shanghai	29,069	31,500	32,529	+3.3
2. Singapore	28,430	29,937	31,649	+5.7
3. Hong Kong	23,532	24,404	23,097	-5.4
4. Shenzen	22,510	22,570	22,941	+1.6
5. Busan	14,137	16,175	17,020	+5.2
6. Ningbo	13,144	14,686	16,830	+14.2
7. Guangzhou	12,550	14,426	14,744	+2.2
8. Quingdao	12,012	13,020	14,500	+11.4
9. Dubai	11,600	13,000	13,300	+2.3
10. Tianjin	10,080	11,582	12,300	+6.2

With regard to the organization of the sea traffic market and its market participants, the following performance patterns can be identified:

- Regular services with scheduled routes
- Charter traffic, one-time booking of an entire ship for a certain relation
- Occasional services (tramp shipping), booking for a specified volume of cargo according to specific transport needs (comparable to consolidated cargo transport in road freight transport)

Providers of scheduled services have formed alliances in so-called *liner conferences*. These are cartels with fixed agreements on prices and quotas. Their objective is to secure the clearing collateral in international sea traffic. Providers who do not participate in these conferences are called *Outsiders*. They try to position themselves on the market by means of cheaper freight rates.

For some time, shipping companies have been trying to influence cost structures through flagging-out. This means a deletion from international shipping registers and instead registering in so-called flag-of-convenience states (e.g. Liberia, Cyprus, Panama, Bahamas, Malta). National regulations as to manpower, safety requirements, and minimum wage do not apply in these states. Flagging-out rates have been on the increase for years (1994: 48 % world-wide; 2001: 62 %

world-wide).[4] Second registers and plans to introduce a European maritime shipping register are supposed to put a check on these developments.

The traditional procedure of *overseas container transport* can be described through the process chains of *Carrier's Haulage* and *Merchant's Haulage*.[5] With *Carrier's Haulage*, sea shipping companies offer door-to-door container freight transport. The sea shipping company takes the empty container to the sender's ramp, organizes pre-carriage of the container to the sea port, provides ship transport, organizes on-carriage to the receiver, and collects the discharged container. It assumes liability for the entire transport process and commissions other carriers with the forwarding of the goods. The carrier issues bills of lading, which are bankable documents of title confirming the rights to the goods transported and containing detailed liability regulations.

In the case of *Merchant's Haulage*, the sender instructs their forwarder to carry out transport. The forwarder orders a container from a sea shipping company and organizes the pre-carriage. The sea shipping company is responsible for the transport at sea. A corresponding forwarder receives the container from the sea shipping company at the port of destination and takes out customs clearance and transport in the country of destination. The container is returned to the sea shipping company after discharge.

Apart from sea shipping companies there are *Non-Vessel-Operating Common Carriers* (NVOCC). A NVOCC provides overseas transport and operates in a fashion similar to that of a sea shipping company. The only difference is that a NVOCC does not operate its own vessels and in most cases does not rely on its own containers. Freight capacity is chartered from sea shipping companies at their transport relation (also referred to as slot charter). Subsequently, the NVOCC offers these freight capacities to its customers on the market. The NVOCC is entitled to issue the necessary freight documents (bill of lading). In many cases it also operates its own offices both at the places of dispatch and destination or works with partners that organize dispatch (pre-carriage) and delivery (on-carriage) of the containers. This guarantees one-stop freight service for the sender.

Case Study 5.2: Container Transport

FCL MARINE AGENCIES GmbH in Bremen is a Non Vessel Operation Carrier (NVOCC) and conducts world-wide container transports. One of their transport operations involved the shipment of 24 off-road racing vehicles to the USA for testing purposes. The value of the vehicles ranged from 175,000 to 250,000 Euros per vehicle. They were loaded into containers in Stuttgart and subsequently shipped to Houston, Texas. Customs clearance for temporary import was taken out by a partner in Houston. The vehicles underwent test drives in the Arizona desert and through the Southern US states (New Mexico, Texas, Louisiana, Mississippi, and Alabama). After 4 weeks the client ordered the containers to be brought to Tuscaloosa, Alabama for return transport. Loading

[4] Cf. Aberle (2009), p. 268.

[5] Cf. Ihde (2001), p. 143 et seq.

the containers out of town so that the vehicles would arrive in Germany in good condition was especially challenging. Following this, the containers were transported to the sea port by truck and subsequently shipped to Germany. The import formalities had then to be taken care of in Bremerhaven and on-carriage to the final destination needed to be arranged. Each step in this high-value transport process was coordinated by FCL who were also the point of contact for the client at the same time.

5.3.5 Inland Waterway Transport

The most important forms of inland waterway transport are bulk goods waterway transport, general cargo waterway transport, and river and maritime navigation.

Bulk goods waterway transport mainly involves the transportation of raw materials and primary products in solid and liquid form. The development of tugboats brought about increased flexibility in the loading and discharging process and in the organization of routes since the transport units (lighters) are decoupled from the motorized push units.

General cargo waterway transport is primarily used for finished goods from the automobile, engineering, and construction sector. Roll-on-roll-off transports are ferry services allowing new vehicles or trucks to drive on and off the vessel, which greatly facilitates handling.

In *river and maritime navigation* there is an overlap between inland shipping – i.e. transport carried out exclusively on rivers and canals – and sea traffic. Owing to their size, vessels used in river and maritime navigation are capable of navigating both at sea (along coastlines) and on large, developed inland waterways (e.g. on the Rhine river up to Duisburg). Thus, by using appropriate navigable units and coastal motor vessels, additional shipping connections may be established, such as *short-sea shipping* (see Sect. 4.2.1).

Further distinctions can be drawn according to product groups transported in inland waterway transport (see Fig. 5.9).

As is the case in sea freight transport, *container traffic* is becoming more and more important for inland waterway transport. The increase in turnover by 2015 is estimated to be 10 % p.a. Accordingly, the significance of inland ports and handling facilities in the Hinterland for groupage in pre-carriage and on-carriage is on the rise. To create high-performance transport chains and to support multimodal traffic, there is increasing demand for multimodal (road/rail) and trimodal (road/rail/inland waterway) port facilities. Moreover, inland ports are increasingly being converted into *logistics service centers* (see Sect. 4.2.6), where procurement-logistical and distribution-logistical services are offered by logistics service providers alongside purely port-logistical services. These developments are largely determined by the characteristics of inland waterway transport, which can be summarized as follows (see Table 5.5).

The supply structure of inland waterway transport market in Germany is essentially dominated by few shipping companies, such as Imperial, Rhenus Partnership, Haeger&Schmidt, Lehnkering and the Deutsche Binnenreederei, which in most cases have emerged from formerly company-owned shippers. Some larger shipping

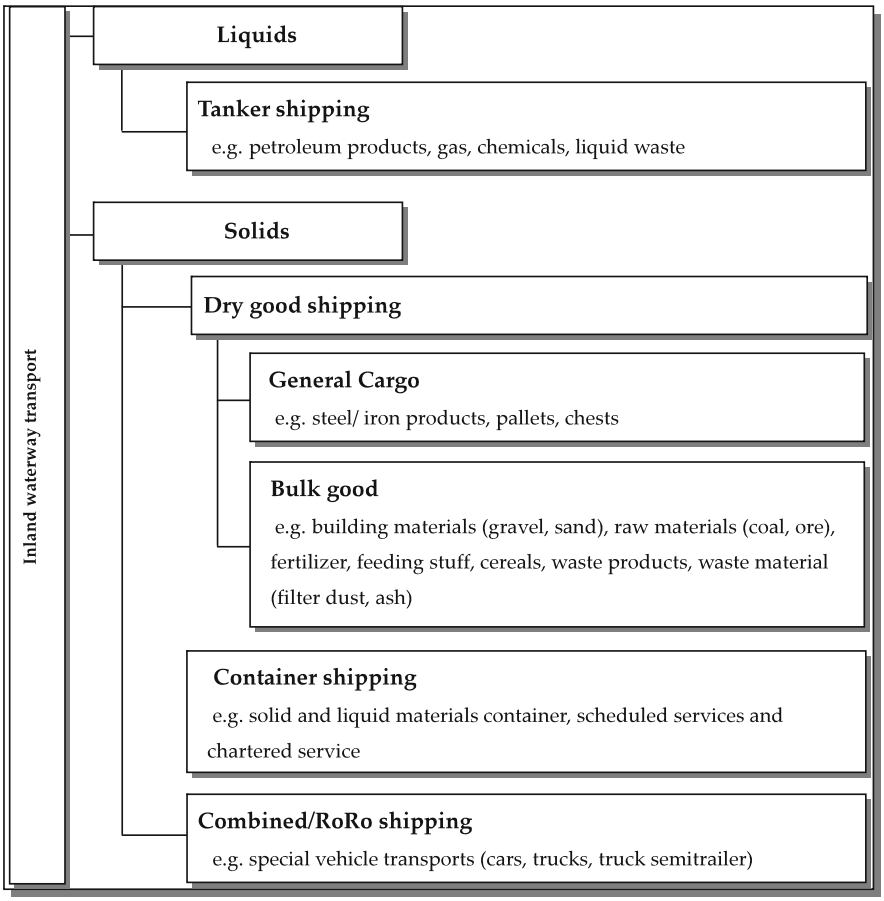

Fig. 5.9 Most important forms of inland waterway transport

companies, as well as many small independent owner operators (private shippers with up to three boats) complement this supply structure. Charterers do not own their own shipping space but merely organize ship transports on behalf of senders. They could be called forwarders for inland waterway transport. The role of shipping companies has changed significantly. While traditionally their responsibilities included the organization of shipping space, the provision of freight, and the disposition and implementation of transport, they primarily only assume the role of shippers nowadays.

The future development of inland waterway transport mainly depends on whether freight traffic forecasts will hold true and on the influence they will have on the modal split. By now, the modal split – i.e. the share that the different modes of transport have in the total volume of transport – is largely determined by the transport mode's capacities and its ecological relevance. Inland waterway transport enjoys a competitive advantage in this regard.

Table 5.5 Most important characteristics of inland waterway transport

Characteristics of Inland Waterway Transport
High mass-transport capacity (low costs at large goods volumes and large distances)
24hr service due to radar navigation
Free capacities on waterways
High reliability and transport safety (also for hazardous goods)
Environmentally friendly (low energy consumption per transport unit)
Low network density
Low transport speed
Dependent on weather conditions (high/low water levels, icing)

Improvements need to be made with regard to consistent navigability by means of expanding inland waterways and upgrading locks (see Fig. 5.10 and Sect. 4.2.1). The purchase of more efficient inland vessels would bring about a general efficiency enhancement and thus increased competitiveness.

Analogously to the situation in rail freight transport, it will be crucial for inland waterway transport to adapt its range of services to market requirements and thus render it attractive for shippers. The rail's competitive behavior will continue to have an influence on inland waterway transport as well as on the persisting competitive gaps between Western European countries (esp. between Germany, Belgium, and the Netherlands).

Case Study 5.3: Service Offers in Inland Waterway Transport: Vehicle Transport

Apart from the transportation of bulk goods, inland waterway transport may also serve to transport high-value goods such as brand-new passenger cars. Ever since the development of an innovative logistical solution by the charterer *E.H. Harms-Terminal Kelheim GmbH & Co. KG*, cars of *Mitsubishi*, *Ford*, and *Renault* have been transported on the Danube from Kelheim or Vienna to Budapest.

Suzuki cars are transported from Budapest to Kelheim on the return trip. Thus, empty trips can be avoided and the cost efficiency of the transporting vessel can be increased. The vessels run on a non-regular schedule according to peak seasons over the year. Trips can also be scheduled or cancelled on short notice in order to react to sector-specific fluctuations in demand in a prompt and flexible manner. This liner service is carried out by the small-scale German shipping company *Trödel* and by *Lehnkering GmbH*. The waterway motor vessel *Heilbronn* is used for the service. The vessel is furnished with three decks with grid floors designed for vehicles up to 2,000 kg each. The *Heilbronn* has a capacity of 205–270 vehicles, depending on vehicle type. The handling of the

Fig. 5.10 Network of North European inland waterways (Deutsche Binnenreederei 2007)

cars is facilitated by means of a bow ramp which connects to the concrete RoRo ramp of the port.[6]

Case Study 5.4: Service Offers in Inland Waterway Transport: Transport of Large-Dimension Goods

The *Deutsche Binnenreederei AG* in Berlin transports rotor blades and equipment for the wind power station manufacturer ENERCON GmbH in Aurich. The rotor blades for the wind power stations are produced in Magdeburg. Using 480 km of inland waterway routes, the rotor blades are then shipped to Emden by means of a liner service, where they are loaded onto overseas vessels. Using a special, double-layered transport rack, six rotor blades can be transported per push-barge. From Magdeburg to Bergeshövede (Dortmund-Ems-canal), two push barges can be coupled together for transport. The barges, however, need to be de-coupled in Bergeshövede to carry on transport individually due to the underdeveloped state of the waterway route. Furthermore, additional ballasting of the barges with water is necessary at the lock in Sülfeld (Mittelland Canal), due to a clearance height of 4.20 m between the water surface and the bottom edge of the bridge.

The barges therefore need to be double-hull vessels. To lower the vessel, the space between the hulls is filled with water, which is subsequently pumped out again.

5.3.6 Air Freight Transport

Air freight transport is becoming more and more important. For one thing, this is due to the creation of global and intercontinental logistics chains with decentralized structures of production and distribution. For another thing, more and more high-value products from the engineering sector (machine parts), the electrotechnical sector (PCs) and the automobile sector (modules, spare parts) are being transported by air freight.

The characteristics of air freight transport are summarized in Table 5.6.

Air freight services fall into the organizationally and institutionally separate partial performances of:

- Air transport services, rendered by airlines
- Air traffic control systems, provided by the air traffic control authorities
- Airport services, provided by the airport.

The supply of air transport services is essentially determined by the market and production conditions in air traffic. These conditions are characterized by oligopolistic competition with market access restrictions, national regulations and traffic laws, high capital intensity, and adherence to flight safety requirements.

Air traffic distinguishes between two institutions, namely the *ICAO* (International Civil Aviation Organization), which includes all countries operating air traffic, and the *IATA* (International Air Transport Association), which organizes

[6] Österreichische Wasserstraßen-Gesellschaft mbH (2007), p. 27.

Table 5.6 Important characteristics of air freight transport

Characteristics of air freight transport
Short transport times in the air
Especially suited for long distances (intercontinental transport)
High transport costs
Small transport capacities compared to other tranport modes
Low network density due to dependence on airport locations
Dependent on weather conditions, especially during take-off and landing

all air-traffic companies. The objectives of the ICAO include the development and promotion of civil aircrafts, international airports, and shared air traffic control systems. One of its most important agreements is the treaty about the *freedoms of the air*, which stipulates universally binding regulations on air sovereignty and technical requirements. The IATA is an antitrust organization whose main goal is to reach agreements on pricing, on-board service, the standardization of free baggage allowance, and on the requirements for registration as an IATA agency.

The logistically relevant air freight services are divided into three segments:

- Scheduled flights and charter flights in passenger transport (belly cargo)
- Air cargo traffic
- Air cargo express traffic, messenger service air mail traffic (CEP services, integrators)

The individual product offerings are subject to restrictions in time, volumes, and price. The decisive factor in opting for air freight transport are the total costs since the high freight rates make it possible to cut costs in other places of the transport chain (storage costs, packaging).

Air freight transport chains may be formed in different ways.[7] Terminal to terminal transport of goods may be carried out by co-loading them onto a passenger plane (Lower Deck) or using a cargo plane. Besides all-cargo planes such as the Boeing 747 or the Mc Donald Douglas MD 11F, there are the so-called mixed versions or *quick changes*, which can be used flexibly as either passenger or cargo planes. In most cases, pre-carriage from the sender to the airport and on-carriage from the airport to the receiver are carried out by truck. In many cases, main carriage is also performed as ground transport on behalf of the airline. This is referred to as Road Feeder Service (RFS) or trucking. In these cases, the freight retains its status as air freight and is billed accordingly.

Airports are bases or start and end points of air traffic within air freight transport chains. They serve as an interface between air and ground transport. While formerly pure infrastructure enterprises, they are now developing into modern service

[7] Cf. Mensen (2007), p. 18 et seq.; Cf. Vahrenkamp (2005), p. 293 et seq.

companies for air cargo handling (Airport Industrial Parcs) (see Sect. 4.2.2). An airport operator's range of services with regard to the air freight sector should include the provision of suitable transport facilities with adequate space and capacity, and quick and direct handling facilities. In addition, minimum ground times as well as 24-h and all-weather operation should be guaranteed.

In order to provide air freight services and to operate air freight transport chains, it is vital that *air freight information and communication systems* be in place. Examples include customs and document processing (electronic air waybill), disposition of holds and flights, tariff and rate calculation, as well as billing and tracking.

Further information and cargo handling systems offer features such as data collection and synchronization for drop-off and receipt processing, inventory management, charge preparation, and generation of loading lists at initial clearance. Air freight forwarders rely on the systems of airlines and other carriers in pre-carriage and on-carriage to view flight schedules, match transport terms, and make bookings. Internet-based applications enable cross-over transactions between agents, countries, and companies.

5.3.7 Pipeline Transport

Another transport technology is pipeline transport. It is an independent mode of transport. However, unlike other transport modes, transport route, transport container, and means of transport form a unit in this instance. Pipelines can be categorized into four groups: oil, gas, and product pipelines, as well as other energy pipelines.

Oil pipelines distinguish between feeder pipelines and distance pipelines. Feeder pipelines only have a rather small diameter of about 10 cm and are operated under low pressure produced by a pump. They transport the oil from the well to central points where it is first processed in order to free it from gases and water. Subsequently, the oil is stored in tanks. Distance pipelines start from these tank farms. These pipelines can have a diameter of up to 1.20 m and are operated under higher pressure. Pumps along the route generate pressure in the pipes and are located according to the relief (altitude difference between ground and sea level). The oil travels several hundred kilometers through the pipeline until it arrives at the port or at a refinery.

The transport of gas in *gas pipelines* is similar to the transport of oil but differs as to the operating conditions and the equipment used. Smaller pipelines lead from a gas field to a gasworks where the gas is cleared of impurities such as water, sulfur, toxic gas, sulfides, and dioxides. After this cleansing process at the gasworks, the gas is fed into the distance pipeline. In contrast to oil pipelines, compressors along the route generate sufficient pressure in the pipeline.

Product pipelines transport refined mineral oils such as gasoline, diesel fuel, and heating oil but also secondary products such as vaseline, paraffin, bitumen, petroleum coke, lamp oils, and lubricants from refineries to storage and distribution centers. Additionally, gases filtered out in the oil and natural gas production process (butane, ethane, propane) are transported in liquid aggregate state to refineries where they are separated again. As opposed to oil and gas pipelines, product pipelines do not solely

transport one specific type of goods. Moreover, they serve to carry several different products consecutively or even simultaneously.

To avoid an intermingling of individual components when transporting different products, three basic procedures may be utilized[8]:

- The valves necessary to separate the batches at the infusion stations briefly remain closed
- *Balloons* which are marginally smaller in diameter than the pipeline are inserted between the individual batches
- A buffer batch is interposed in between two products which may intermingle with both products

Mineral oils and liquid gases require higher pressure for transport since they are lighter than crude oil or natural gas. Furthermore, higher pressure is required to prevent mixtures of liquids and gas as such a mixture could permanently damage the pumps in the pipeline.

Energy pipelines comprise so-called two-phase pipelines which are mainly used as feed pipes between oil or gas fields. They simultaneously transport liquids and gases resulting from the extraction process. These two products are separated in refineries and gasworks close to the production area. Another type of energy pipelines are liquefied-natural-gas pipelines which – after liquefaction in special plants – carry the natural gas to a port for transport by tankship or collect it from the tankship at the port of destination. Energy pipelines also include the rarely used type of coal-slurry pipelines. These pipes carry finely ground coal blended with water.

Transcontinental pipelines stretching from production areas to consumption areas or to sea ports attract the most attention. In these cases the pipelines span long distances and are installed either above ground, underground, or on the seafloor. Since they are to a greater or lesser extent taken for granted, less attention is attracted by shorter pipeline networks used as an integral part of production, as can be found in the pharmaceutical or chemical industry or in the communal supply and disposal networks for gas, water, and sewage. The characteristics of pipeline transport are summarized in Table 5.7.

However, owing to its investment volume and high fixed costs, pipeline transport is not very wide-spread. Thus, pipeline traffic only accounts for a small share of

Table 5.7 Important characteristics of pipeline transport

Characteristics of pipeline transport
High mass-transport capacity, depending on pipe diameter and conveyor speed
High network-forming capability (mostly direct connection from sender to receiver)
High reliability and thus planability
Low risk of air or water pollution (in case of flawless construction and smooth operation)
Environmentally friendly by avoiding emissions

[8] Cf. Brecht et al. (1982), p. 31.

the total traffic volume (see Figs. 5.1 and 5.2). In most cases pipelines are constructed and provisioned by the users themselves – normally raw material producers.[9] In the wake of the Cold War, large capacities of pipelines previously

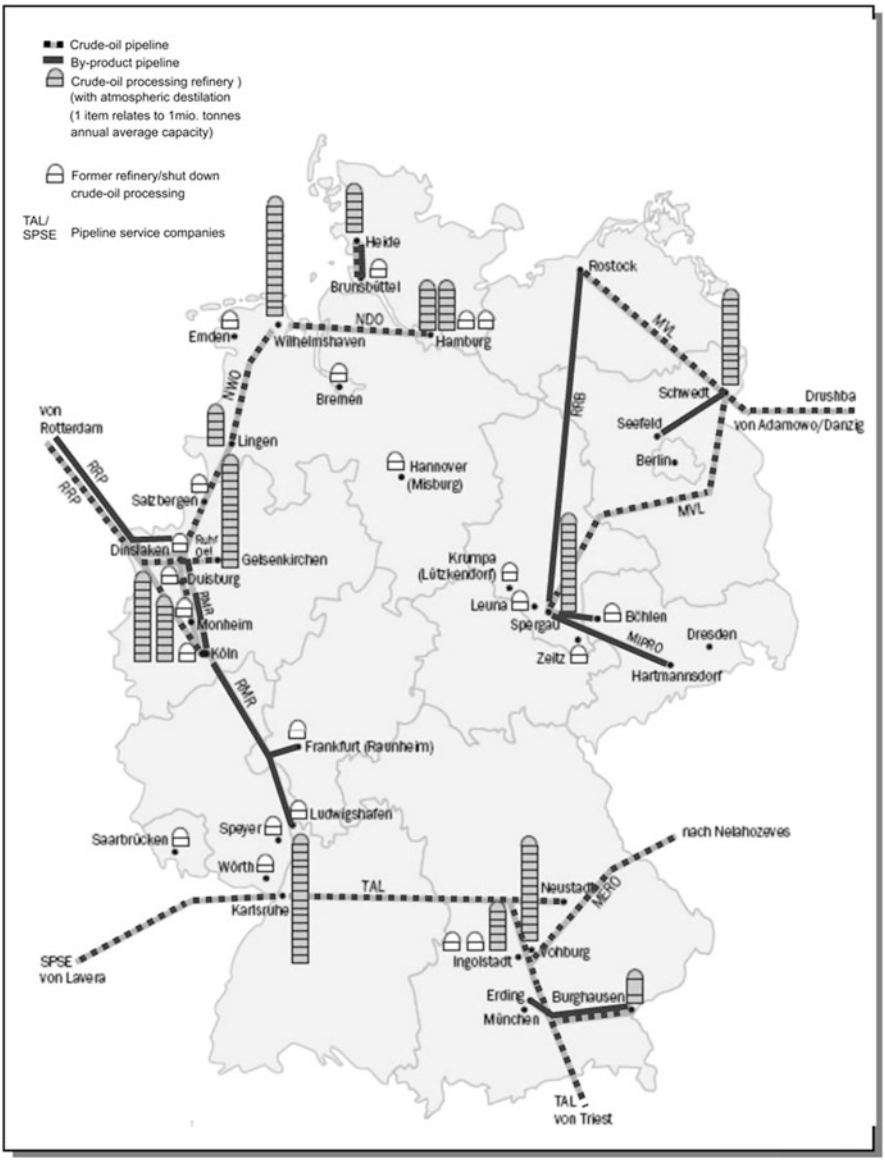

Fig. 5.11 Pipeline network and refineries in Germany (Mineralölwirtschaftsverband e. V., Hamburg 2011, p. 10)

[9] Cf. Ihde (2001), p. 190 et seq.

used for military purposes could additionally be harnessed for civil utilization. The main traffic routes of the German pipeline network with European connections are depicted in Fig. 5.11.

5.4 Transport Systems and Means of Transport

5.4.1 Transport Chain

A transport system can be designed as a *transport chain*. A transport chain is characterized by the technical and organizational linkage of the stations which a goods transport passes, starting from the place of dispatch (source) and ending at the receiving point (drain). The transport from sender to receiver can generally be broken down into pre-carriage, main carriage, and on-carriage. This distinction is mainly made for general cargo transports. Here, pre-carriage describes the process of collecting the goods from the sender and transporting them to a transshipment point. The shipment is then bundled and transported to another transshipment point during main carriage. What follows is the dispersion to the recipients during on-carriage (see Fig. 5.12).

Transport chains may be designed as a single-link chain. In this case, transport objects are transported directly from the source to the drain, whereas in multi-link transport chains, transport may be effected using different means of transport (disrupted transport) or using different transport modes (combined transport). Figure 5.13 shows single-link and multi-link transport chains as well as application examples.

With *direct transport*, no handling between sender and receiver takes place but an entire loading unit is exchanged. Direct transport is primarily used in road freight transport, to a lesser extent in rail freight transport, and occasionally in inland waterway transport in the form of combined transport. In cases of full chartering of cargo aircrafts and ocean vessels, direct transport may also constitute a viable solution in air freight transport and sea freight transport.

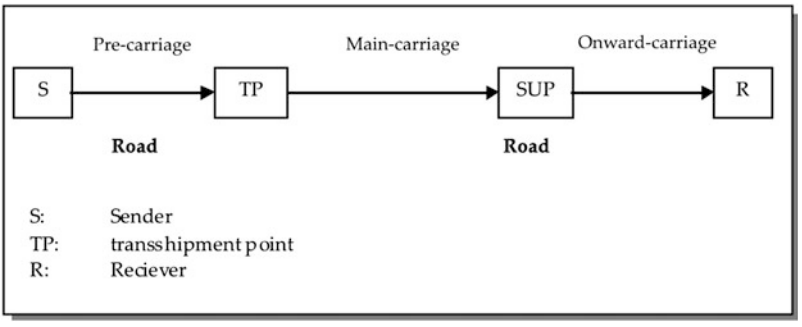

Fig. 5.12 Pre-carriage, main carriage and on-carriage

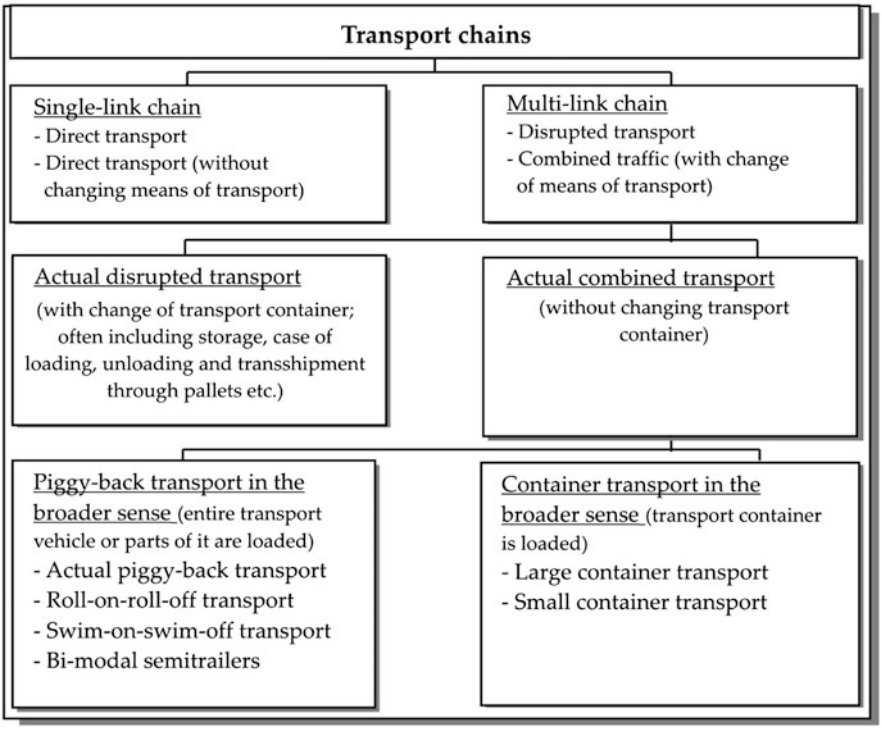

Fig. 5.13 Setup of transport chains (Cf. Jünemann and Schmidt 1999, p. 328)

Table 5.8 Important characteristics of combined transport

Characteristics of combined transport
Benefits from the individual transport modes advantages (costs, safety, adherance to delivery dates, environmentally friendly etc.)
Favorable transport times for long distances
Relatively environmentally friendly
Disrupts the transport chain
Rather time consuming due to transshipment of goods
Increased need for spatial and technological capacities due to transshipment

In order to benefit from the advantages of the individual transport modes, especially on long distances and under ever-changing transport conditions, systems have evolved which make use of two or several different transport modes. The main differentiators of *combined transport* are listed in Table 5.8.

Combined transport is a way of conducting transport in which goods are carried from the drain to the source in one loading unit without changing the load carrier,

by using several transport modes consecutively within a transport chain. To this end, entire vehicles are loaded onto carrier vehicles, or loading units – if suitable – are loaded from the carrier vehicle of one transport mode onto the carrier vehicle of another transport mode.

Types of combined transport are:

- *Piggy-back transport:* Trailer trucks and semi-trailers are loaded onto special railway carriages which perform the main carriage to the destination area; on-carriage to the point of destination is carried out by truck
- *Loading unit or container transport:* Containers are used as rationalizing transport aids, which can be transported in any transport mode
- *Roll-on-Roll-off transport:* trucks or semi-trailers are driven onto RoRo ships using ramps
- *Trajectory transport:* rail freight wagons are rolled onto rail-equipped ferries

5.4.2 Means of Transport

In order to provide transport services, *means of transport* need to be utilized. We distinguish between stationary and mobile means of transport. Stationary means of transport are means of conveyance (see Chap. 6) which are only used in hubs within transport chains, such as warehouses or transshipment sites. Mobile means of transport are vehicles which are used for transport between hubs.[10] A variety of vehicles is employed in *road freight transport*. They can be categorized according to net load class and volume capacity and include utility vans, trucks (motor vehicle and trailer), and semitrucks (tractor unit and trailer). The most common transport means in road freight transport are shown in Fig. 5.14.

The broad spectrum of usage possibilities is complemented by *loading aids*, which can be fixed or interchangeable. The former type comprises superstructures and roadbeds providing more transport safety than, for example, covers or roof arches. They are also a technical prerequisite for refrigerated cargo transport or hazardous goods transport. Interchangeable loading aids are swap bodies in the form of standardized containers which are equipped with foldable supports. Trucks are able to drive below these swap bodies to pick up cargo, which renders the loading and unloading process independent of the transport vehicle.

Rail wagons are the means of transport in *rail freight transport*. Apart from the engines, there is a variety of goods wagons in standard and special design (depending on the transported goods) and are categorized into various types (see Table 5.9 and Fig. 5.15). The goods wagons are owned by the railway

[10] Cf. Isermann (1994), p. 1095.

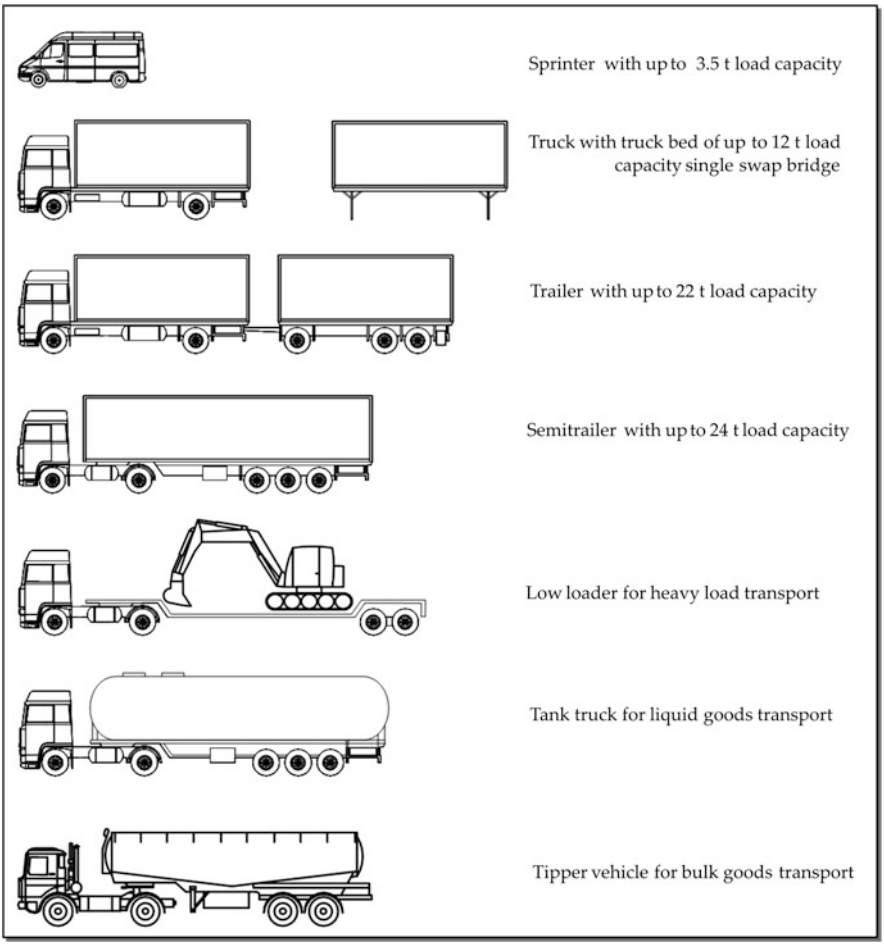

Fig. 5.14 Transport means in road freight transport

companies as well as by the dispatching companies. Furthermore, there are rental companies offering wagons, especially tank wagons, for hire.

The loading gauge determines up to what height an open wagon may be loaded. This, in turn, is dependent on the so-called minimum clearance outline along railway routes. The minimum clearance outline is the same in most European countries. Exceptions are France, Italy, and Switzerland, where a smaller loading gauge applies accordingly.

Container ships are the prevalent means of transport in *ocean shipping*. Depending on the goods to be transported, other types of ocean vessels include crude oil tankers, gas tankers, and bulk ships. Bulk ships are equivalent to traditional freight ships which can be loaded with individual bulk cargo. However, bulk

Table 5.9 Wagon types of DB Schenker Rail Deutschland AG (Cf. DB Schenker Rail Deutschland AG 2011)

Type E: Open wagons
Type F: Open hopper wagons
Type G: Covered wagons
Type H: Covered, spacious sliding wall wagons
Type K: Flat wagons with double wheel sets
Type R: Bogie flat wagons with four wheel sets
Type S: Bogie flat wagons for coil transports
Type S: Bogie flat wagons for metal plates
Type S: Bogie flat wagons for stakes
Type S: Bogie flat wagons with six wheel sets
Type T: Covered hopper wagons
Type T: Wagons with openable roof
Type U: Low-floored wagons with/without special equipment
Autoracks
Wagons for combined transport
Tank wagons for fuel, chemicals, or other types of liquid

ships are becoming less important since container transport is gaining more and more popularity due to its efficiency.

There are different types of containers, such as:

- Open-Top-Container (with detachable roof),
- Open-Side-Container (without sidewalls),
- Platform Container (without walls),
- Special containers (tank, bulk, refrigerated).

The most important types of containers are 20- and 40-ft containers, whose sizes allow transport of 14 or 29 pallets, respectively. The measurements of a 20-ft container are 6.06 × 2.44 × 2.59 (L × W × H in m; external); 40-ft containers measure 12.19 × 2.44 × 2.59 (L × W × H in m; external).

Container ships have become significantly more efficient in the past few years with regard to size and loading capacity. We can differentiate between the following types or generations of all-container ships[11] (see Fig. 5.16):

- Fourth, outdated generation with about 4,500 TEU loading capacity (so-called post-Panamax class – since 1988),
- Fifth, current generation with up to 10,000 TEU loading capacity (so-called super-post-Panamax class – since 1997),
- Sixth, future generation with up to 13,000 TEU loading capacity (so-called Suezmax class – since 2006).

[11] Cf. Brinkmann (2005), p. 66 et seq.

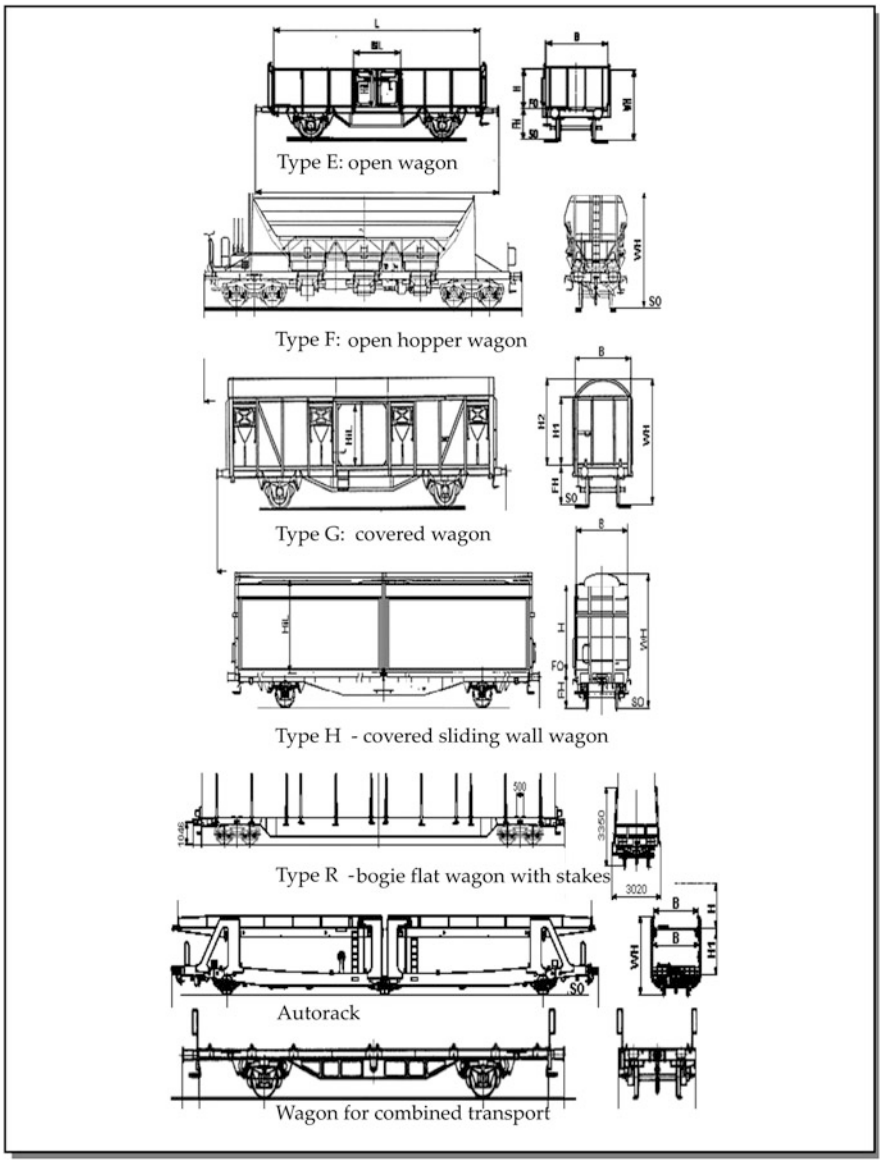

Fig. 5.15 Railway wagons (Cf. DB Schenker Rail Deutschland AG 2011)

TEU stands for Twenty-Foot Equivalent Unit and is the measurement most commonly used in container transport based on the measurements of a 20-ft container. This means, for example, that a 10,000 TEU container ship can transport the equivalent of five thousand 40-ft containers. The terms Panamax and Suezmax

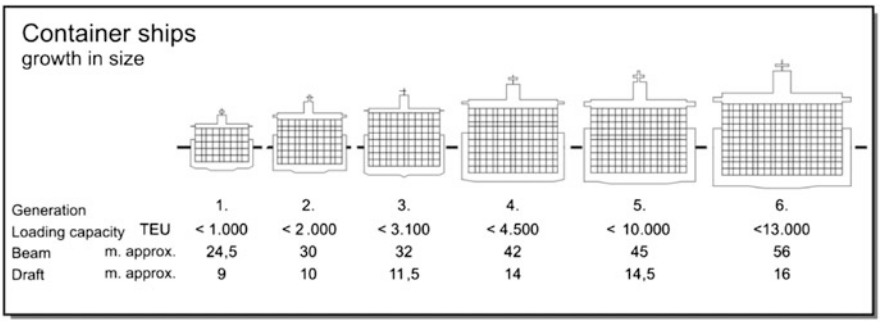

Fig. 5.16 Ship generations in container transport (Cf. Nuhn 2005, p. 113)

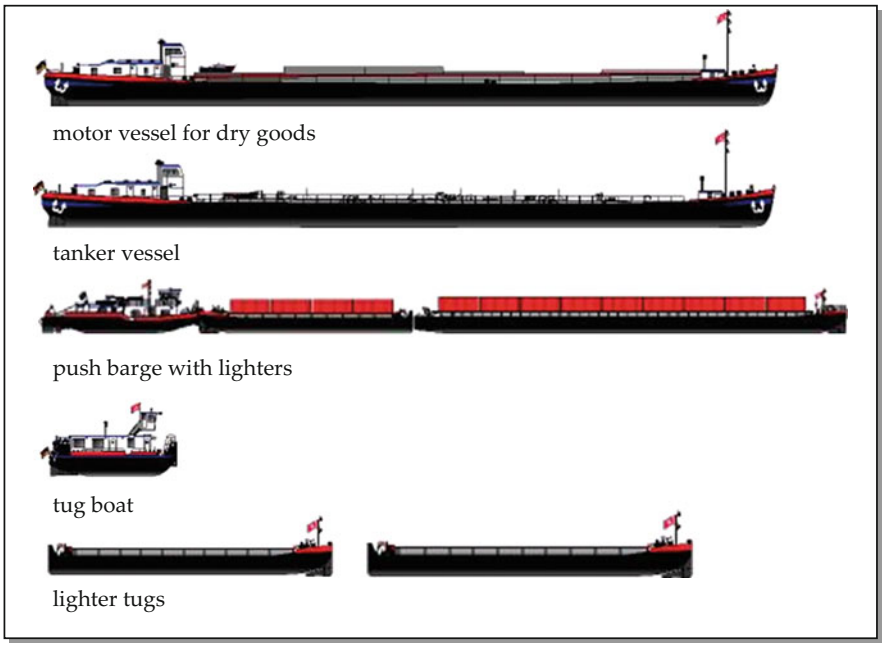

Fig. 5.17 Transport means of inland waterway transport (Deutsche Binnenreederei 2007)

relate to the maximum ship size for navigating the respective canal. The largest container ship that can barely navigate the most important shipping routes is the *Emma Maersk* of the Maersk shipping company in Copenhagen.

Ship types used in *inland waterway transport* include motor vessels, push barges, lighters, tug boats, lighter tugs, and towed barges. Other types of vessels include sea-going inland waterway vessels, ferries, and RoRo schips. Figure 5.17 shows the individual transport means typically used in inland waterway transport.

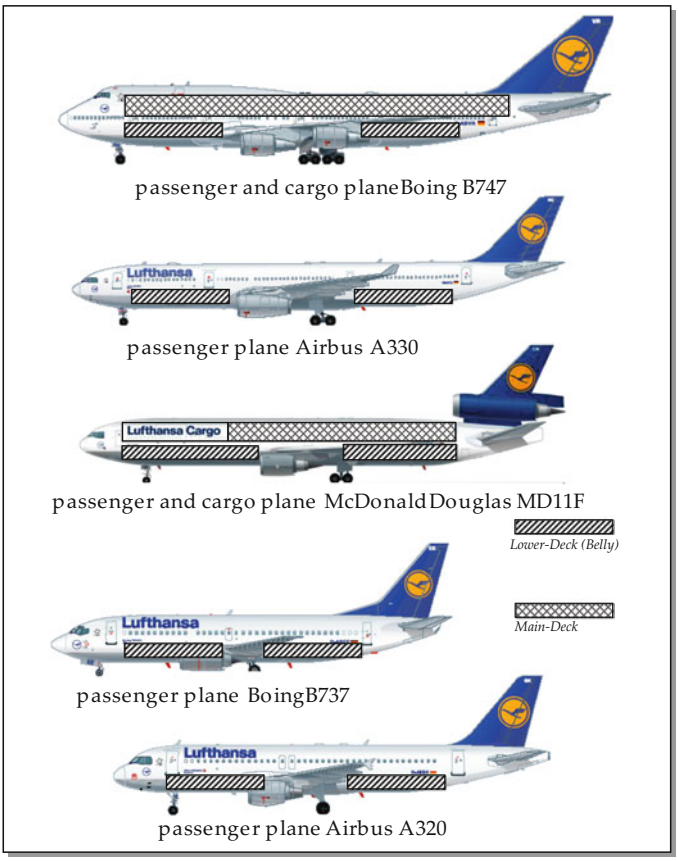

Fig. 5.18 Airplane types (Deutsche Lufthansa AG 2007)

With *air freight* transport services, the airplane as a means of transport is differentiated into passenger plane, quick-change plane and all-cargo plane. To a limited extent the lower deck loading capacity (belly capacity) of passenger planes can be utilized for goods transport.[12] More lower deck capacity is available on combined passenger/cargo planes. All-cargo planes are solely used for freight transport. Figure 5.18 shows the different airplane types and their basic freight capacities.

The distinct shape of airplanes requires the use of special loading aids for air transport. A selection of commonly-used air freight containers which are fitted to airplane shapes is depicted in Fig. 5.19.

[12] Cf. Mensen (2007), p. 52 et seq.

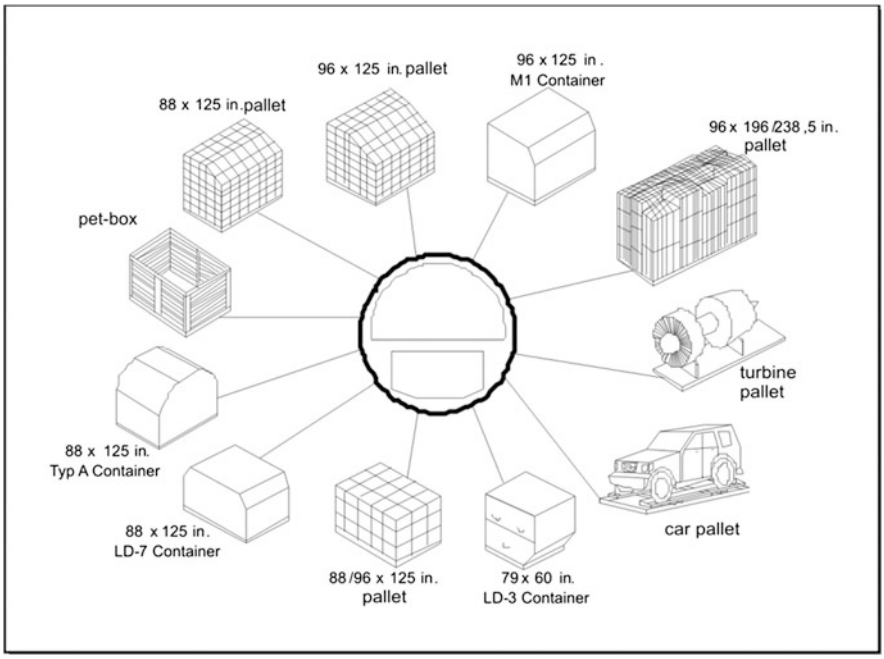

Fig. 5.19 Air freight containers (Deutsche Lufthansa 2005, o. S.)

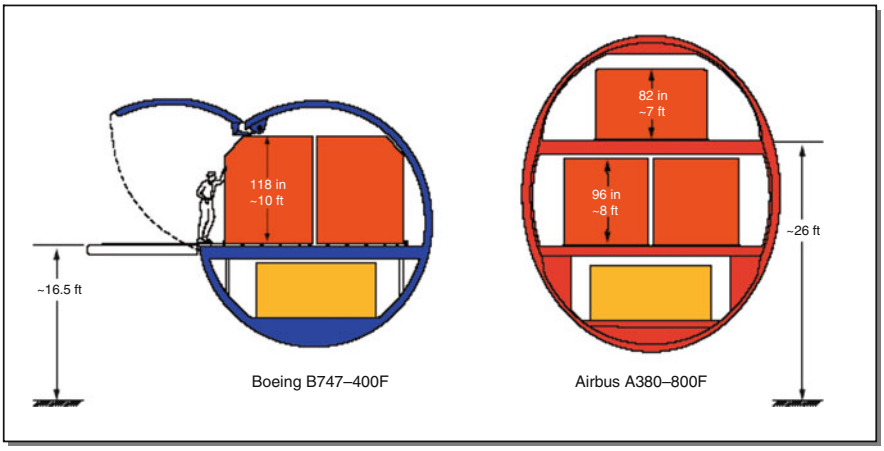

Fig. 5.20 Loading profiles of all-cargo planes (Boeing 2006)

Figure 5.20 shows the different loading profiles of cargo planes on two and three levels. The planes are loaded either from the side, in front, or from the rear.

Case Study 5.5: Loading of Air Cargo

In accordance with the loading and booking list for a flight, the consignment is first checked against prohibitions on co-loading certain goods. This is especially relevant for shipments of living animals and hazardous goods. Furthermore, package volumes are checked to ensure efficient space utilization on air pallets or in air containers.

Depending on airplane type, there are different restrictions in place as to the loading height on air pallets or the use of certain kinds of containers. A so-called counter frame is used to indicate the exact height and inclination of the external walls on the cargo plane's main deck.

Type MD 11 all-cargo planes provide a loading height of 1.6 m on the lower deck. Passenger planes transporting cargo on the lower deck offer loading heights of 1.16 m (type A320/321), 1.09 m (type A319), and 0.86 m (type B737).

If the goods contain prefabricated elements which are firmly attached to the pallets, additional straps are used to secure heavy and wide load parts. Finally, a cover sheet for weather protection (rain) and a net to secure the whole pallet are wrapped around the goods.

Subsequently, the pallet is weighed. The data is then transmitted to the operations department at *Weight & Balance*, where a trim calculation is carried out. This way, pallets with different weights can be loaded and spread evenly across the airplane's loading space.

5.5 Logistics Service Providers

5.5.1 Carriers and Forwarders

Apart from transport means and transport chains which represent the technological and organizational aspect of transport systems, we can draw institutional distinctions according to the stakeholder involved in the transport system. More specifically, we can distinguish between carriers, haulage contractors, forwarders, couriers, express service providers, parcel service providers, and logistics service providers.

Transport system operators, in turn, can be differentiated according to the technologies they use. For every transport mode there is a corresponding *carrier*. These are companies that carry out transport autonomously, such as airlines, shipping companies, independent ship owners, and railroad companies. In ocean shipping, carriers are also referred to as consignors. In § 7 par. 1 of the German Code of Commercial Law, a haulage contractor is defined as somebody who is bound by the haulage contract to transport a good to the point of destination.

According to the German Code of Commercial Law HGB § 453 par. 1, *forwarders* are companies that are contractually obliged to organize transportation of goods. This, however, usually implies disposition services, as opposed to actual transport services. Forwarders act as mediators between the party demanding the transport service (sender) and the party providing the transport service (commercial

goods traffic). Thus, a forwarder organizes mode-neutral transportation of goods. For this reason, forwarders are sometimes called the *architects or organizers of transport chains*. Through own-name transactions (Code of Commercial Law HGB § 458), transport services and other services may also be rendered by the forwarders themselves. Forwarders focus on certain transport modes or service areas, such as truck, railroad, air freight, or sea freight. Table 5.10 provides an overview of the different service areas and the corresponding focus areas.

Consolidated transport or groupage transport on the road assumes a prominent function. The table shows that 41.3 % of all forwarders surveyed carry out this kind of transport. Such operations were the main focus area for 21.6 % of the companies

Table 5.10 Service areas and service focus of forwarders (Benchmark: 2,900 surveyed companies, multiple answers possible) (Cf. DSLV (2010), p. 2)

Service area of forwarders	service area	service focus
Consolidated road freight transport	41.3 %	21.6 %
Consolidated rail freight transport	4.4 %	1.4 %
Parcel and express services	11.1 %	4.6 %
Freighting of external trucks	63.3 %	21.9 %
Long-distance truck transports (own-name)	47.4 %	29.4 %
Short-distance transport / cartage	51.8 %	21.4 %
DB general cargo private haulage	7.8 %	3.9 %
International forwarder	55.1 %	24.1 %
Air freight transport company	23.9 %	11.9 %
Sea port forwarder	17.1 %	7.8 %
Customs clearance	45.2 %	12.2 %
Inland waterway forwarder	6.6 %	2.1 %
Inland waterway transshipment	5.6 %	2.6 %
Moving company	9.5 %	4.6 %
Distribution warehousing	39.5 %	4.6 %
Bulk commodity warehousing	8.3 %	3.3 %
Cereal and feedingstuff warehousing	3.7 %	2,0 %
Hazardous goods handling	31.2 %	5.9 %
Distribution logistics	24.0 %	11.0 %
Procurement logistics	19.3 %	7.8 %

surveyed. With these operations, the forwarder organizes dispatch of goods shipments from different senders as consolidated cargo (consolidated shipment or groupage consignment). Apart from consolidated cargo traffic there is combined transport. Combined transport is used for goods that either do not take up the full capacity of a means of transport (part-load shipping) or that take up a transport means' full capacity (full-load shipping). The term consignment comprises all goods which have been handed over to a forwarder by a sender together with a shipping order and which are meant to be shipped to a receiver. A consignment may consist of several individual shipping orders. Conversely, one shipping order may be carried out through several consignments. In groupage traffic, a transport chain involves:

- The collection of single consignments within a local/regional area (pre-carriage)
- The spatial and temporal consolidation of grouped consignments of as many senders as possible and for receivers in the same destination areas
- The joint transport of those consignments in one means of transport over as long a distance as possible
- Discharge at the points of destination
- Delivery of the consignments to the receivers (onward carriage)

One of the benefits of groupage traffic is economies of scale, which are brought about through increased capacity utilization of the means of transport, thus reducing transport costs per shipment.

Groupage transport is very common for the transportation of *general cargo* shipments. *General cargo* consists of individual goods in solid form, which can be separately handled and informationally registered. These include unpacked goods, packages, and loading units. They can weigh from 25 up to 3,000 kg. *General cargo* shipments are usually very heterogeneous and consist of several shipping units. Groupage transport is an important submarket of *small goods transport,* which also includes courier services, express services, parcel services, and mail services.

5.5.2 Courier, Express, Parcel and Mail Service Providers

In contrast to forwarders of groupage cargo, courier messenger, express and parcel (CEP) service providers focus on specific transport objects, such as documents or parcels with weight restrictions, whose shipment usually only comprises one shipment unit. These services require speedy transactions and high reliability. Express services provide transport of consignments with or without weight and size restrictions. Speediness and reliability are again paramount for these kind of services. Parcel services offer transport of one-piece parcels with weight and size restrictions (e.g. maximum weight 31.5 kg; maximum girth measurement 3 m).

In many cases, *CEP service providers* are integrators (Integrated Service Carrier) which are providing the entire transport chain. They produce and sell

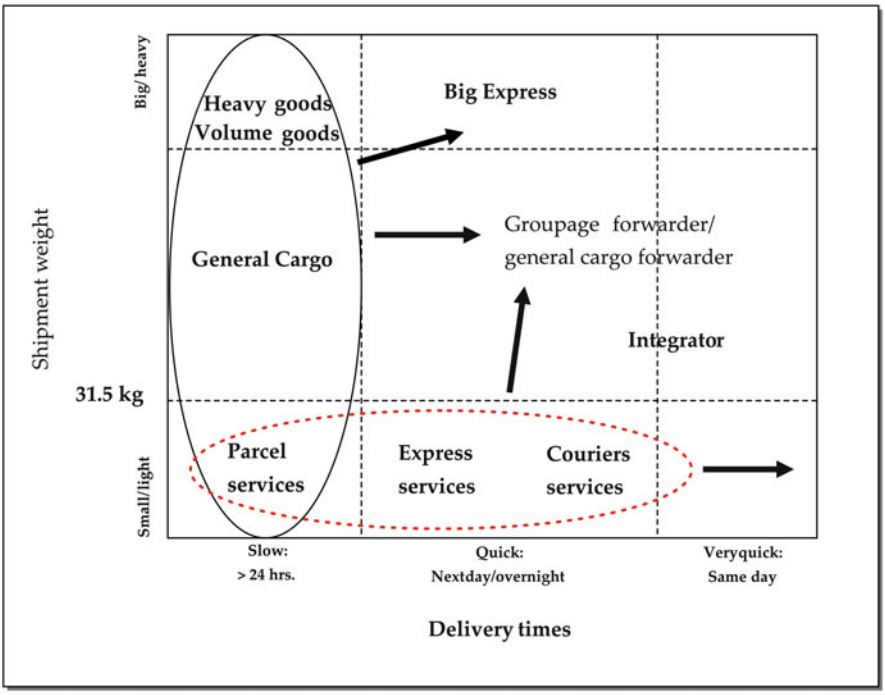

Fig. 5.21 Competition matrix: forwarder/integrator (Vgl. Bjelicic 2005, o. S.)

their services autonomously by means of using their own airplanes, transshipment facilities, and vehicles. Integrators continuously expand their world-wide networks. Thus, they are also expanding their business field by offering additional logistics services. Extended or suspended weight restrictions are leading to an increased overlap between the business fields of integrators, groupage cargo forwarders, and CEP service providers and to growing (substitution) competition among these stakeholders, as can be seen in Fig. 5.21.

Mail services include the transport of letters, small goods, and mail items. In Europe, mail service providers often used to be state-owned. Meanwhile, however, many of the formerly state-owned logistics companies have been privatized or are undergoing privatization processes, as is the case in Germany, for example. Mail service providers also frequently offer monetary transactions, as well as fax, email, and other kinds of services. In principle, mail services are a highly specialized form of goods transport dispositioned by the state. The fact that mailboxes are emptied on a regular basis – regardless of how many mailings are in it – serves as an example to differentiate mail services from other logistics and forwarding services. Apart from the formerly state-owned mail companies, there are privately-run mail service providers. These are going to broaden the range of services on the mail markets, especially due to the abolishment of the letter monopoly.

Case Study 5.6: Express Service Provider as Integrator

The term *integrator* comes from the English verb *(to) integrate*. More specifically, this refers to the logistical service structure of a transport service provider. This means that an integrator unifies or integrates procurement, production and sales of a service in their portfolio on an international level. To this end they make use of their own networks, hubs, vehicles, and airplanes. For example, with 672 airplanes the American express service provider FedEx runs the world's largest air fleet. In parallel to air freight companies, integrators also participate in the international freight market by offering loading space to other airlines or by requesting additional loading space in the case of a bottleneck situation. The product portfolio of these companies not only comprises CEP services but by now also includes aspects of contract logistics (especially storage, order-picking, billing), consulting services, mail services, and financial services. This underlines a strong tendency towards the formation of integrated logistics groups. Additionally, the logistics service provider's extended range of services becomes apparent by offering a number of value added services.

World-wide there are four integrators which generated an aggregate turnover of about € 120 bn in 2010 (see Table 5.11). With a turnover of roughly € 11 bn, TNT is the smallest company out of the four. TNT operates their own air freight and road network in Europe to provide their services (see Fig. 5.22).

These networks are based on the hub-and-spoke principle, which connects superordinate locations with subordinate ones in a radial way. TNT's European air network is a single-tier system with one central airport in Lüttich (Belgium) and 58 associated destinations in 23 countries. The European road network comprises 414 depots in 33 countries and has a multi-level structure since several smaller hub-and-spoke systems are integrated into an overarching hub-and-spoke system. Thus, TNT's Express division operates the most extensive air and road network in the whole of Europe.

5.5.3 Systems Service Providers and Contract Logistics Providers

Over the past few years, there has been a significant trend towards *outsourcing* logistics services to external service providers (see Sect. 8.5). Several forms of outsourcing have developed on the market. These developments include carriers and forwarders outsourcing freight services as well as allocating entire logistics

Table 5.11 The most important integrators and their turnover in 2010 (Cf. Annual reports of TNT, UPS, FedEX, DPWN 2010 ($ exchange rate as of 31.12.2010))

	TNT	UPS	FedEX	DPWN
Turnover (across the group in 2010)	€11.3 bn	€37.3 bn	€26.1 bn	€51.5 bn
Market share	8.9 %	29.6 %	20.7 %	40.8 %

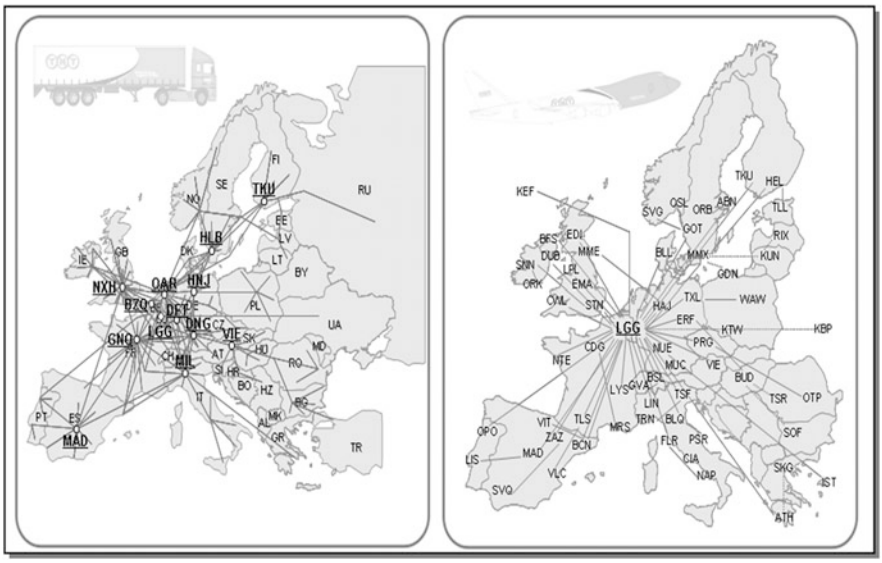

Fig. 5.22 Air and road network of TNT Express (TNT Express GmbH 2007)

locations to logistics service providers. Comprehensive services like these are also termed *contract logistics*.[13] In such cases, logistics service providers become *contractual partners* for systems services and are responsible for the organization of complete supply chains (see Sect. 12.4).

In particular, contract-logistical services may include:

- Central warehousing management for procurement and distribution logistics
- Internal and external production-logistical functions or job order production
- Comprehensive pickup and delivery systems

One of the main characteristics of contractual performance – together with the scope of services provided – is the sustainability of co-operation between the outsourcing company and the service provider. For this reason, contract periods of 3 years or longer are not unusual, especially if the outsourcing process requires investments on the part of the service provider.

Contract logistics opens up a market with high profit margins and rapid growth for the logistics service sector. Thus, double-digit growth rates are forecast for the next few years. In this context, the German logistics market can be counted among the largest ones in Europe with a turnover of 205 billion Euros in 2007. The logistical expenses comprise all transport, warehousing, transshipment, and value-added services as well as all activities associated with logistical co-ordination. Transport services account for a share of over 40 % of the overall

[13] Cf. Weber et al. (2007), p. 37 et seq.

logistics volume, while storage and transshipment services make up about one quarter. The remainder includes services related to order processing, inventory management, and supply chain management.[14]

There are, however, numerous requirements to be met by providers of contract-logistical services. These include a minimum enterprise size, corresponding availability of capital and, most importantly, know-how in logistics and market cultivation. In addition, certain company functions, such as marketing, production, quality management, controlling, and IT, are confronted with increased challenges.

[14] Cf. Klaus and Kille (2008), p. 45; BVL e. V. (2011), p. 1.

Review Questions

1. Differentiate between transport services and logistics services.
2. What is meant by volume-of-goods effect and goods-structure effect?
3. What is containerization?
4. What are the advantages of inland waterway transport as a mode of transport?
5. What are the differences between wagonload transport, part-load transport, and combined transport?
6. What do the acronyms ICAO and IATA stand for?
7. Explain the structure of an air transport chain.
8. What is the significance of road traffic?
9. What is the difference between a transport chain and a means of transport?
10. What is contract logistics?

Additional Literature

Aberle, G. (2009). *Transportwirtschaft: Einzelwirtschaftliche und gesamtwirtschaftliche Grundlagen* (5th ed.). München/Wien: Oldenbourg.

Biebig, P., Althof, W., & Wagener, N. (2004). *Seeverkehrswirtschaft: Kompendium* (3rd ed.). München: Oldenbourg.

Klaus, P., & Kille, C. (2008). *Die Top 100 der Logistik*. Hamburg: Dt. Verkehrs-Verl.

Korf, W. (Ed.) (2005). *Lorenz-Leitfaden für Spediteure und Logistiker in Ausbildung und Beruf, Vol. 1*, (20th ed.). Hamburg: DVZ.

Kummer, S. (2010). *Einführung in die Verkehrswirtschaft*. Wien: Facultas.

Liberatore, M. J., & Miller, T. (1995). A decision support approach for transport carrier and mode selection. *Journal of Business Logistics, 16*(2), 85–116.

Merkel, H., & Bjelicic, B. (Ed.) (2003). Logistik und Verkehrswirtschaft im Wandel: Unternehmensübergreifende Versorgungsnetzwerke verändern die Wirtschaft, Festschrift für Gösta B. Ihde. München: Vahlen.

Schubert, W. (Ed.) (2000). Verkehrslogistik: Technik und Wirtschaft. München: Vahlen.

Sterzenbach, R. (2009). Luftverkehr: Betriebswirtschaftliches Lehr-und Handbuch, 4. Edition, München: Oldenbourg Verlag.