1. Introduction

Transport is at the foundation of any economy as it constitutes the heart of the supply chain. Without good transport networks the proper functioning of markets is impossible – particularly the European Market. Transport infrastructure investments boost economic growth, create wealth, and enhance trade, accessibility and the mobility of people. Transport is also a key ingredient for a high quality of life, ensuring accessibility and bringing people together. The transport industry is also an important component of the EU economy: when considering the whole logistic chain it directly employs around 10 million people and accounts for about 4.6% of GDP. Furthermore, many European companies are world leaders in infrastructure, logistics, traffic management systems and manufacturing of transport equipment [1].

Transport and distribution are key considerations when planning for international trade. Choosing the right mode of transport is essential to ensure your import or export operation is efficient and cost-effective. There are four ways of importing and exporting - road, rail, air and sea - although the using more than one type of transport.

2. Modes and means of transport

There are several transport modes and means of transport (see Fig. 1). A transport mode provides the necessary infrastructure for using a certain means of transport. Without this infrastructure, no transport would be possible. The transport modes are situated on land, on the water and in the air, land transport comprises road, rail and pipeline transport, waterborne modes are inland waterway, deep sea and short sea shipping, the air mode comprises air traffic.

Means of transport are technical facilities and equipment for the transport of people or goods. Transport means in freight transport are, for example, the inland vessel, the truck or the plane. Due to the fact that transport cannot usually be handled using a single mode or means of transport, varying forms of transport have been developed, which are described as transport processes.

3. Transport processes

Transport can be processed in several forms (e.g. either directly or by making use of several modes of transport) and it...
is therefore necessary to specify these processes more clearly. Transport processes can be initially classified into direct and non-direct transport. In the case of a non-direct transport process, the transhipment of goods takes place, whereas in direct transport no such transhipment is needed.

In direct transport, goods are transported directly from a point of departure to the destination. For this reason, it is also called door-to-door transport. In this case, the means of transport (e.g. truck, vessel or railway) is not changed and there is also no change of transport mode (e.g. rail or inland waterway). Direct transport can always be classified as unimodal, goods are transferred from the starting point to the end point by one means of transport.

Multimodal transport is characterized by the transport of goods using two or more different transport modes. In order to change the means of transport, transhipment of goods is required. In doing this, the strengths of the several individual transport modes can be used and cheapest and most environmentally friendly combination can be chosen. Main characteristics of multimodal transportation are transhipment terminals that allow efficient cargo handling between short-distance and long-distance traffic as well as application of standardized and reusable loading units. However, combined freight transport can be organized in different ways. In general, trucks cover short distances between the loading area and the transhipment point or between the place of arrival and the recipient. Long-distance haulage is conducted by other means of transport such as train, ship or even plane. Multimodal transport is a very interesting approach that solves a big part of cargo mobility problems [2].

Combining private and state transport in a multimodal transport system offers the opportunity to capitalize the best rates and transit time possible.

As many understand, multimodal transport refers to a transport system usually operated by one carrier with more than one mode of transport under control or ownership of one operator. It involves the use of more than one means of transport such as a combination of truck, railcar, railways, aeroplane or ship in succession to each e.g. container line which operates both a Bratislava’s company to the Port of Bratislava by truck. This is followed by transport to Romania, which is handled via inland vessel and finally, a truck carries the container to the consignee’s location.

4. Types of transhipment

Transhipment can be divided into processes in which intermodal loading units are lifted and processes in which units are not lifted:
4.1 Intermodal transport units

To reduce time and costs during the transhipment process, standardized loading units are used in intermodal transport (see Fig. 5). Because of the standardization of the loading unit’s size and the necessary equipment (spreader), easier handling, better scheduling and higher exploitation of space (stackability of containers) can be achieved. Intermodal loading units – also intermodal transport units (ITUs) are transhipped between road, rail and waterway using specialized facilities.

Swap bodies and containers are dominating in continental European Combined Transport (road/rail). Semi-trailers are important in some markets e.g. RoRo process (see Fig. 6).

Containers are standardized receptacles made of metal and available in different sizes and forms. Their many advantages are their extreme robustness and high stackability, resulting in optimum utilization of space minimizing risk of damage, reduction of packing expense, etc. Containers are available in various shapes and sizes for special purpose. Basic dimensions and permissible gross weights of intermodal containers are largely determined by two ISO standards: ISO 668:2013 and ISO 1496-1:2013 [2]. The most common sizes of container available are 20 feet, 40 feet and 45 feet in length.

Swap bodies are trailers for trucks without a chassis and fully compatible with euro-pallets. The sizes of swap bodies are principally standardized [2]. The main advantage of a swap body is its ability to stand freely using four foldable legs that enable easy loading and unloading. The economic benefit for carriers is
At the start of the transport chain, the commodities are carried to Rotterdam by maritime vessels. In Rotterdam, the freight is transhipped to inland vessels by means of mobile cranes or luffing and slewing cranes. After this, the goods are transported from Rotterdam to the Port of Linz via the Rhine, the Main and the Main-Danube-Canal. Motor cargo vessels or pushed convoys are usually used for this, loaded with an average of 1,000 tons of cargo per vessel unit. After the arrival at the Port of Linz, the products are then transhipped to trucks or railway, depending on the customer, and transported to their final destination [11].

5.2 Steel products

Source and destination: From Linz via Moerdijk (the Netherlands) to overseas countries
Means of transport: Inland vessel, maritime vessel, truck and railway
Type of transport process: Split multimodal transport
Cargo: Steel products (general cargo)

The company Industrie-Logistik-Linz (ILL) provides logistics services throughout the entire supply chain. The company has offices in Austria (Linz and Steyr) and in the Netherlands (Moerdijk). 500,000 tons of steel are transported annually between Linz and Moerdijk on inland vessels. While ILL organizes transhipment in Linz and monitors the transport to the Netherlands, an inland navigation service provider or a partner company is responsible for the physical carriage by ship [11].

The steel products are collected by railway wagons from several warehouses on the production site. Following this, they are transported to the covered transhipment hall which is located at the factory port of the voestalpine in Linz (see Fig. 8). From there, the goods are directly transhipped from the wagons onto inland vessels. For this covered transhipment, a gantry crane with a maximum capacity of up to 35 tons is used. Subsequently, the goods are transported to Moerdijk by pushed convoy. There, the steel products are transhipped onto a maritime vessel and then transported to seaports located near the final customers. The latter are located in countries such as Brazil, the USA, Singapore, India, Malaysia or South Africa. In most cases, end-haulage is done by railway, though sometimes by trucks, as the best matching means of transport also depends on the size of the steel products [11].
6. Conclusion

The importance of freight transport for our society is beyond dispute, but transport volumes are ever growing and the problems to accommodate freight flows in an efficient and sustainable way become increasingly alarming. Traffic congestion is rapidly growing and the quality of freight transport is not able to keep pace with the rising ambitions: customers want higher reliability, lower prices, faster deliveries, more flexibility and higher service levels. This paper is primarily concerned with multimodal and intermodal transport.

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